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All India Coordinated Wheat and Barley Improvement Project

PROGRESS REPORT
2013-14

Vol.III

CROP PROTECTION

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Every effort has been made to avoid errors or misprints, etc. However, any printer's devils or omissions that might have crept in inadvertently may please be excused.

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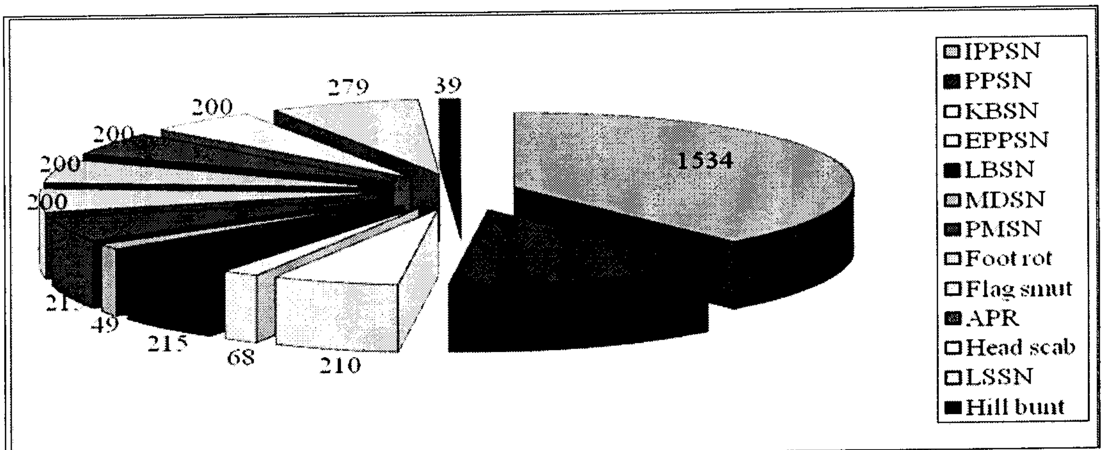
SUMMARY

The major thrust areas of Crop Protection are: crop health monitoring (pre and post harvest), distribution of rust pathotypes, host resistance, rust resistance genes postulation and pest management (host resistance, tillage options, chemical control and IPM modules). The highlights of the programme are given hereunder:

HOST RESISTANCE

For providing support to the wheat breeding programme, evaluation of disease/pest screening nurseries was undertaken at various hot spot locations under natural and artificially inoculated conditions. The major nurseries were: IPPSN, PPSN, EPPSN, MDSN, MPSN, and disease/pest specific nurseries.

The Initial Plant Pathological Nursery (IPPSN), with 1534 entries and Plant Pathological Screening Nursery (PPSN) with 511 genotypes including checks, are the main nurseries which are the major components of the Decision Support System in promotion of entries from one stage to the other, and finally the identification of genotypes for release. The other nurseries that are evaluated at hot spot multilocations are, LBSN, KBSN, LSSN, PMSN, nurseries for diseases of limited importance (FHB, Foot rot, hill bunt, flag smut), EPPSN, MDSN, MPSN and the evaluation against nematodes and insect pests. AVT entries were also evaluated at specific locations for Race Specific Adult Plant Resistance (APR) to three rusts (brown, black and yellow). Slow rusting lines for different rusts were identified by calculating the Area Under Disease Progress Curve (AUDPC) at Karnal (stripe rust) and Mahabaleshwar (leaf & stem rusts) centres. Constitution of plant pathological nurseries during 2013-14 has been shown below:



Constitution of different plant pathological nurseries during 2013-14

Rust resistance materials in AVT IInd and Ist Year (2013-14) with ACI upto 10.0 are given below:

Stem, leaf and stripe rusts: HI 8737 (D), PBW 681, DBW 129, DBW 95, DDW 30 (D), HD 4728 (D), HD 4730, HI 8750 (D), HI 8751 (D), HPW 373, HPW 411, HS 593, HUW 661, K 1204, PBW 677, PBW 697, PBW 703, PBW 723, TL 2995, TL 2996, TL 2998, TL 2999, TL 3000, UAS 451 (D), VL 1003 and VL 3004.

Stem and leaf rusts: BRW 3723, DBW 107, DBW 110, DDK 1042, HD 3118, HUW 666, NIAW 1994, PBW 689, VL 967, DBW 128, DBW 154, DDK 1044, DDK 1046, GW 451, GW 455, HD 2932 + *Lr19/Sr25*, HD 3128, HD 3132, HD 3133, HD 3146, HPW 400, HPW 401, HPW 410, HS 547, HS 577, HS 595, HUW 675, HUW 677, HUW 679, MACS 5031, NIAW 2030, PBW 701, PBW 704, PBW 706, UP 2864, UP 2891, VL 1004, VL 3005, VL 976 and VL 977.
Leaf and stripe rusts: UAS 446 (D), WH 1129, HD 2932+*Lr19/Sr25*, HI 8755 (D), HS 590, HS 592, HS 594, PBW 695, PBW 698, PBW 722 and TL 2997.
Stem and stripe rusts: K 1217, MACS 3916 (D), PBW 692 and VL 3002.

Seedling resistance in wheat genotypes

AVT's lines of wheat were evaluated against different pathotypes at DWR Regional Station, Flowerdale, Shimla. A wide spectrum of pathotypes of black rust (*Puccinia graminis tritici*), brown rust (*Puccinia triticina*) and stripe rust (*Puccinia striiformis*) of wheat, having different avirulence/virulence structure were used. Resistance to all the rusts was observed on PBW 703. All the wheat lines possessing *Sr*31 resistant to black rust, whereas those possessing *Lr*24 and some with *Lr*26 were resistant to brown rust. Some of the lines with *Yr9* were resistant to stripe rust pathotypes.
Resistant to brown and black rusts: HI 1544, HI 1563, UP 2891 and HUW 677.
Resistant to brown and stripe rusts: PBW 681, PBW 697, PBW 698, PBW 722 and PBW 723.
Resistant to stripe rust: PBW 660, HD 3128, HD 4728, HPW 411, HS 592, HS 593, HS 594, HUW 675, HUW 693, HW 1099, K1204, MACS 3927(D), PBW 692, PBW 701, PBW 702, VL 1003,VL 1004 and VL 3002.
Resistant to brown rust: HD 2864 HD 3133, CG 1010, GW 451 and GW 455.
Resistant to black rust: All the lines possessing *Sr31*, HPW 401, HPW 410, HS 547, TL 2942, TL 2969, TL 2998, TL 2999 and TL 3000 were resistant to black rust.

Based on rigorous screening of multiple diseases screening nursery at multilocations, following genotypes have been identified for multiple disease resistance:

Resistant to all three rusts + Karnal bunt + Flag smut: PDW 329 (d)
Resistant to all three rusts + Leaf blight + Flag smut + Powdery mildew: TL 2978(T)
Resistant to all three rusts: GW 1276 (d), HD 3098, PBW 670, Raj 4270, and VL 971
Resistant to stem and leaf rusts: GW 433, GW 1280 (d), HD 3076, HI 1584, HW 5216, KLP 402, KRL 327, MP1259, MP 3353, Raj 4238, Raj 4240, Raj 4245, UAS 336, UP 2824, UP 2825, UP 2828, UP 2852 and VL 971.
Resistant to leaf and stripe rusts: AKDW 4749, HD 3065, HD 3075, HD 3077, HD 3081Q, HD 4725, HI 1579, HI 8626(d), HPW 368, HS 557, MACS 3828, PBW 658, RW 3705, VL 972 and WH 1105
Resistant to stem and leaf rusts + Leaf blight + Flag smut + Powdery mildew + Karnal bunt: HW 1098
Resistant to leaf and stripe rusts + Leaf blight: HS 526, NIAW 1846

Utilization of resistance sources through NGSN

A total of 41 entries known for confirmed sources of multiple disease and insect pests resistance were contributed in the NGSN, 2013-14. They were planted at 22 breeding centres across different agro climatic zones of country for their utilization in breeding programme against various biotic stresses. All entries were utilized in the range of 4.1-37.5 % by most of the breeding centres. The most utilized entries at many centres were DBW 58, HD 3058, HI 1572, HPW 360, HS 534, HS 545, HUW 640, KRL 304, MACS 3828, MP 3288, MP 3304, NW 5013, PBW 648, PBW 658, RSP 561, UAS 320, VL 941 and WH 1095. The Sagar centre, utilized 24 entries in their breeding programme followed by Kanpur and Vijapur.

Preparedness to combat Ug99

Indian wheat advance lines (221) were evaluated at Kenya and Ethiopia for resistance against Ug99, as a part of our strategy to meet the threat in case this pt. is able to enter India. Following genotypes evaluated at Ethiopia and Kenya during 2013 were categorized resistant (Coefficient of infection upto 10.00).

Wheat lines resistant to Ug 99 in Ethiopia: CoW (W), HD 2864, HI 1563, HW 2044, HW 5216, MACS 6222, MP 4010, NIAW 1415, RAj 4229, Raj 4238, GW 432, HD 3090, HD 3093, HD 3096, HI 1584, HUW 652, HW 5224, NIAW 1689, Raj 4240, Raj 4270, TL 2978 and UP 2825.

Wheat lines resistant to Ug99 in Kenya: DDK 1009, HI 1500, HI 8498, HI 8627, HI 8713, HPW 360, HW 1098, HW 2044, K 8027, MACS 2971, MACS 3828, MACS 3828, MP 3336, MPO 1215, NIDW 292 (d), PDW 291, PDW 314, UAS 428, WHD 948, HI 8728, VL 971, HI 8728 (d), HI 8726 (d), GW 1277 (d), HI 8725 (d), GW 1276 (d), HI 8724 (d), UPD 93 (d), MPO 1255 (d), HI 8725 (d), PDW 329 (d), HI 8724 (d), AKDW 2997-16 (d), MACS 5008, DDK 1042, GW 1280 (d), HI 8730 (d), TL 2978, MACS 3817 (d), HI 8731 (d), HI 8728 (d), K 1016, UAS 439 (d), HS 557, AKDW 4749, MPO 1262 (d), MACS 5012, MACS 5022, HI 8727 (d), PDW 327 (d), DBW 88, RKD 219, PBW 675, VL 975, WHD 950 and GW 1280 (d).

Rust resistance genes in AVT material

Rust resistance genes (*Lr, Sr, Yr*) were characterized using gene matching technique.
***Yr* genes**: In AVT II material, 5 *Yr* genes/patterns were characterized in 71 lines. *Yr*2 was found to confer resistance in 46 lines. However, this gene is susceptible to many of the virulent pathotypes. *Yr*9 which is linked to *Lr*26 and *Sr*31 was postulated in 21 lines. Other resistance genes like *Yr*A, *Yr*18, *Yr*27, were postulated in few lines only. In AVT I lines, four *Yr* genes were postulated in 76 lines. *Yr*2 was inferred in 47 lines while *Yr*9 which is linked to *Lr*26 and *Sr*31 was identified in 17 lines. *Yr*A was characterized in 15 lines whereas *Yr*27 was identified in 2 lines only.

***Sr* genes:** In AVT II year lines, 11 *Sr* genes (*Sr*2, 5, 7b, 8a, 9b, 9e, 11, 12, 13, 24, 31) were characterized in 83 lines. *Sr*11 was postulated in 33 lines followed by *Sr*2 and *Sr*31 in 27 and 21 lines, respectively. Postulation of *Sr*2 is based on characteristic micro-flecking. Postulation of *Sr*31 is based on its linkage to *Lr*26 and *Yr*9. *Sr*9b was identified in 12 lines, *Sr*7b in 9, *Sr*5 in 7, *Sr*8a and *Sr*9e in 6 lines each. *Sr* 24 was inferred in 5 lines whereas *Sr*12 and *Sr*13 in one line each. Most of the durum wheat varieties had resistance based on *Sr*7b, *Sr9e*, *Sr*11, *Sr* 12 and *Sr*13. In AVT I material, 12 *Sr* genes (*Sr*2, 5, 7b, 8a, 9b, 9e, 11, 13, 25, 26, 30, 31) were characterized in 99 lines. *Sr*11 was postulated in 50 lines followed by *Sr*2 and *Sr*9b in 42, 19 lines, respectively. *Sr*31 was postulated in 17 lines whereas *Sr*7b in 17 lines. *Sr*13, *Sr*8a were postulated in 13 and 3 lines, respectively. Other resistance genes *Sr*9e, *Sr*25, *Sr*26 and *Sr*30 were postulated in one line each. Most of the durum wheat lines had resistance based on *Sr*7b and *Sr*11.

***Lr* genes:** In AVT II material, nine *Lr* genes (*Lr*1, 3, 10, 13, 18, 23, 24, 26, 34) were characterized in 77 lines. Most of the lines possessed more than two resistance genes. *Lr*23 was the most common resistance gene and was characterized in 37% of the lines followed by *Lr*13 (28 lines). The proportion of lines with *Lr*26 has reduced and was identified in 21 lines only. Likewise *Lr*10 was inferred in 17 lines,*Lr*3 in 3 lines, whereas *Lr*24 and *Lr*34 were postulated in 5 lines each. *Lr*18 was inferred in one line only. In AVT I material, 10*Lr* genes (*Lr*1, 2a, 10, 13, 14a, 18, 19, 20, 23, 26) were characterized in 87 lines. *Lr*13 was the most common resistance gene and was characterized in about 39% of the lines followed by *Lr*23 (28 lines), *Lr*10 was postulated in 20 lines, whereas *Lr*26 was characterized in 17 lines. *Lr*1, *Lr*18 were postulated in 12 and 4 lines, respectively. *Lr*2a, *Lr*14a, *Lr*19 and *Lr*20 were inferred in one line each.

SURVEY AND SURVEILLANCE

Pre- Harvest Crop Health Monitoring

Crop health was rigorously monitored during the crop season as well during the off season in the high hills of Himachal Pradesh (Lahaul, Spiti, Kullu), Nilgiri hills (Tamil Nadu) and J & K (Ladakh). Advisory for stripe rust management was issued during December-March regularly. Information on wheat crop health was disseminated through the "*Wheat Crop Health Newsletter*", Vol. 19(4 issues). Mehtaensis Vol. 34, No. 1 and 2 was issued in January and July, respectively. This crop year was marked with the sporadic appearance of yellow (stripe) rust in some pockets of Northern India. Though the yellow rust was observed in early January 2014, however, due to the resistance in cultivated varieties as well as pro active steps for the management, it could be managed well. Black (stem) rust of wheat was observed in May, 2014 on indigenous wheat material planted at Bhowali, Hawalbagh and Pantnagar (Uttarakhand) and in wheat fields from Nashik and Dhule districts of Maharashtra during 2nd fortnight of March, 2014. Except for the yellow rust in NHZ and NWPZ, the overall crop health status was satisfactory in the country.

Stripe rust: Stripe rust was observed 1st time on January 1, 2014 in village Ratangarh in Yamunanagar district of Haryana on variety WH 711. Upto February, 2014, stripe rust was observed at 40 farmers fields in 25 villages in Yamunanagar, 15-20 farmers fields in Karnal, five villages (Darba, Paniwala Mota, Bhagsar, Audhan and Bara Gurha) in the periphery of 5-10 km in Sirsa (small foci of yellow rust in the range of 20-30S) and one village in Ambala. The disease was observed on wheat varieties, WH 711, HD 2932, HD 2851, HD 2967, DPW 621-50, Shri Ram 271, DBW 16, DBW 17 and Barbat. In Sirsa, in the stripe rust infected fields, the farmers have planted the varieties HD 2851, WH 147 and PBW 343. By March stripe rust spread was also in other districts but timely application of chemicals controlled its further spread. In Punjab, stripe rust was observed on var. HD 2967 and PBW 550 in villages, Dabkheraupralla (Roop Nagar) and Bare Bajwara (Hoshiarpur) on January 6, 2014. During February-March, the disease spread to Mohali, Gurdaspur, Ludhiana, Amritsar, Fatehgarh Sahib, Patiala and Bhatinda but timely application of chemicals controlled its further spread and there was no significant loss. In Jammu region, stripe rust was observed in village Tahlar, Zone Arnia, RS Pura in var. DPW 621-50 on January 21, 2014. During last week of February, the disease was observed in Udhaywalla, Marh, Chinor, Akhnoor, Jammu, RS Pura, Bishna (Jammu district) and Vijaypur (Samba District) with 5 to 60 per cent intensity. Varieties viz. PBW 343, Sonalika, WH-711, PBW-550, PBW-175, RAJ-3077 and RAJ-3765 were infected with yellow rust (20-80 per cent severity) in affected fields but varieties *viz.*, DPW-621-50 and HD-2967 were affected upto 20% severity. In other areas of Samba and Kathua districts, yellow rust was less (severity and intensity). In western UP, stripe rust, leaf rust, powdery mildew were observed in last week of March and 1st week of April in Western UP on most of the varieties grown.

On 17.1.2014, stripe rust was noticed in TPN (Kharchia mutant) and SAARC (Agra Local) nurseries including infector rows planted at Dhaulakuan, Himachal Pradesh. The disease spread to other districts, Mandi, Una, Hamirpur, Bilaspur by 1st week of February. The stripe rust was observed in traces in areas such as Chandpur, Majari, Bassi Dabt, Auhar, Bhaani, Reshikesh, Luharwin and Tikkri in Bialspur district in 2nd fortnight of March. The stripe rust in patches was observed in districts *viz.*, Hamirpur, Kullu, Mandi, Sirmour, Shimla, Solan, Una and Kangra. In April, 2014, stripe rust was recorded in severe form on susceptible wheat varieties *viz.*, HPW 251, VL 829, VL 616, HS 277 (early sown vars), HPW 184, HPW 211, HS 240, VL 738, VL 804, DBW 17, Raj 3765, PBW 343, PBW 502, PBW 550, WH 711, Super 369, Sonak, Kanaku, Local (varietal mixture) (timely sown vars), HPW 42, HS 295, HS 420, VL 892, Raj 3777, Sonalika (late sown vars) etc. at farmers' fields and severity ranged from 40-80S. The stripe rust severity remained comparatively low in foot hills due to warmer climate/ rise in temperature in March-April and the wheat varieties *viz.*, HPW 236, HPW 211, HPW 249, VL 829, VL 616 etc. which succumbed to stripe rust in mid hills (Bajaura, Malan, Sunder Nagar) recorded less severity 5-20S in foot hill areas (Akrot, Una, Dhaulakuan). Since, the area under resistant varieties has gone up in the state as well as farmers have become vigilant against stripe rust and spraying their crop with propiconazole at the appearance of yellow rust so, the overall severity of yellow rust remained moderate not causing much loss to the wheat crop. In 2nd week of June, yellow rust was observed in Kullu areas In village Bhalayani, yellow rust severity was more (60-80S). During June 20-22, 2014, no rust was observed in wheat crop in Leh (Ladakh).

Stripe rust (traces) was observed in last week of February in Khatima block of Udham Singh Nagar (Uttarakhand) on varieties PBW 343, PBW 502, HD 2967, PBW 550 and DPW 621-50. On May 19, 2014, heavy infection of all three rusts was observed on most of the collections planted at Bhowali (Uttarakhand). Surprisingly, there was high (60-80S) stem rust infection on about 50 % of the collections.

Leaf and stem rust: In Kullu area, leaf rust was also observed but most of the pustules are converted in to teliopustules. Leaf rust with severity 20-60S was recorded at few locations viz. Una, Nalagarh, Kunihar, Malan, Kangra etc. Flag smut with incidence ranging from 3-11% was recorded at some locations in foot and mid hill areas. Leaf rust in TPN nursery was observed on 22nd January in varieties WL 711(TS), C 306 (5S), and Agra Local (TS) planted at Pune. By 3rd February, it spread on more varieties and ARI germplasm viz. WL 711, HD 2329, Agra Local. Lal Bahadur, C 306, WH 147, HD 2160, BARI 82, BARI 102, Kenphad 25 and *T. sphaerococuum* and level on infection increased and severity varied from TS to 40S. Leaf rust was also observed in ARI germplasm nursery on varieties viz; Bari-82, Bari-102, Gulab, Kenphad 25 and *Tritium sphaerococcum* with severity ranging from 5S to 40S. No Natural incidence of black rust was observed under field condition as well as Trap plot nursery till February 28, 2014. Incidence of foliar blight was observed in many varieties viz; Agra local, Lal Bhahdur, Bijaga yellow, A 206, NI 146, Lok-1, Gold 21, ARI breeding material etc. with severity ranging from 12 to 79. Some traces of stem borer were observed in late sown crop at Hol farm. On Feb. 6-7, natural incidence of leaf rust was observed on varieties DWR 162 and off type mixtures in MACS 6222 with severity ranging from 30S to 60S. On Jan. 13, leaf blight was observed in varieties, Kharchia mutant, Bijaga Yellow, A 206, NI 973 and NI 146 at ARI, Pune. On 30th Jan., leaf blight was observed at farmers fields on varieties, Gold 21 and Gold in villages Sakharwadi and Phadtarwadi (Satara). Laf rust (TS-40S) was observed in off types plants at farmers fields in Western Maharashtra during 2nd fortnight of February. The first natural incidence of leaf rust was observed in Wheat Disease Monitoring Nursery on Lal Bahadur variety on 2/2/2014, which increased upto 80S on Feb. 26, 2014. The incidence of stem rust was not seen in the nursery till Feb., 28, 2014. Out of 20 genotypes in TPN, only HD 2329, HD 2160, HW 2021, HD 2204, C 306, HW 2008, DL 784-3, MACS 2496 and HW 971 were free from leaf rust. Incidence of stem rust has not been observed on the surveyed farmers fields in Nasik district. Survey was undertaken for wheat crop health status in Nasik district on 11/3/2014 and 13/3/2014 by Dr. B.C.Game, ARS, Niphad. Stem rust in farmers field was not noticed. Leaf rust was recorded for the first time in two fields on variety LOK-1 at Jopul village (Dindori Tahsil, Dist.Nasik). In Dindori Tehsil, leaf rust severity was recorded upto 80S on Lok-1 and other susceptible off-types. Incidence of stem rust was found in two fields, first field of Lok-1 and in second field on off-types from Mohadi and Korhate villages. During first fortnight of March, leaf rust upto 60S was reported in farmers fields of western Maharashtra and Marathwada region. Stem rust severity upto 40S was observed in wheat fields from Nashik and Dhule districts of Maharashtra during 2nd fortnight of March, 2014. Leaf rust and stem rust incidence was recorded in trap plot nursery planted at IARI Regional station, Indore on 12.3.2014. Leaf rust was observed in range of 5MR to 80S and stem rust (TR-50MS) on the test varieties in trap plot nursery. In Central Zone, leaf rust in off types in farmers fields of Jabalpur was observed on the way from Kota to Sawai Madhopur. In North Eastern Plain Zone, brown rust was also observed in Kharchia (TPN) at Araul at Dalipnagar on 24th Feb., 2014.

Powdery mildew, flag smut and loose smut: Powdery mildew with high intensity/ severity up to 8 (on 0-9 scale) was recorded on susceptible varieties at some locations, otherwise, its overall intensity/ severity remained low to moderate (3-5) during current *rabi* season. Loose smut was also observed at some places but incidence was very low. Flag smut with incidence ranging from 3-11% was recorded at some locations in foot and mid hill areas in Una, Nalagarh, Kunihar, Malan, Kangra etc..

Insect pests: The termite damage in wheat fields remained moderate throughout the crop season in Rajasthan. Population of brown wheat mite was medium and noticed later on at ear head stage of the crop. The attack of pink stem borer in wheat was also observed. The incidence of *Spodoptera litura* and *Helicoverpa armigera* was very low but widespread. In Maharashtra, heavy aphid population in Nasik district were observed. The severity of damage was recorded up to 5 to 35 per cent. In Punjab, sporadic incidence of termites was observed in District Faridkot. Moderate to severe incidence of wheat aphid was observed in some villages of Mukatsar (Chakdiwala), Ferozepur (Sarenaga & Sekha Kalan) and Moga districts. Minor incidence of pink stem borer was observed in some parts of Nawanshahr district. Low level of root aphid incidence was also observed in few fields in KVK, Bahowal and adjoining areas. In Haryana, moderate to severe incidence of wheat aphid was observed in some villages of Karnal (Bastli), Kaithal, Jind and Hisar. Moderate termite damage was recorded in some parts of Karnal (Basthali) and Kaithal (Batta). In Shillongni, sporadic infestation of cutworm was observed.

Nematodes: In Haryana, cereal cyst nematode (CCN) was reported in 41.4% (24/58) samples. Other soil borne plant parasitic nematodes reported were *Hoplolaimus* (12 %), *Tylenchorhynchus* sp. (52%), *Helicotylenchus* sp (7%) and *Pratylenchus* sp. (24 %). In Punjab, *H. avenae*, species of *Meloidogyne, Tylenchorhynchus, Hirschmanniella, Helicotylenchus and Hoploloaimus. H. avenae* cysts were recorded from Moga (District Moga), Kotkapoora (District Faridkot), Aulakh, Chibranwali (District Muktsar), Abohar and Fazilka (District Fazilka). In Rajasthan, CCN infestation was recorded from 18 districts of Rajasthan. Sangaria, Tibbi, Rawatsar, Nohar and Bhadra Tehsils of Hanumangarh district known as grain bowl of state (adjourning to Haryana) were heavily infested with "Molya Disease". In Bihar, nematological survey of wheat fields was conducted at 15 places in three districts namely Samastipur Muzaffarpur and vaishali. The stunt nematode (*Tylenchorhynchus nudus* + *T. mashoodi*) was the predominant population (41.50%) followed by lesion nematode, *Pratylenchus* spp. (26.5%), lance nematode (*Helicotylenchus indicus* + *H. dihystera*, 6.5%) and root-knot nematode (5.7%).

Wheat Disease Monitoring Nursery (WDMN)

46th Wheat disease monitoring nursery comprising of 20 genotypes (was planted at 66 locations covering all the major wheat growing areas in the country, especially those situated near the bordering areas to the neighboring countries. Yellow rust was mostly confined to NHZ and NWPZ, however it was also observed at Faizabad and Kanpur in NEPZ. Brown rust appeared at all the locations in NEPZ, CZ, PZ, and SHZ. In addition, brown rust was also observed at Shimla, Dhaulakuan, Pantnagar, Almora, Kathua and Udhaywalla in NHZ and Hisar in NWPZ. Black rust was reported from Almora, Indore, Powarkhera, Vizapur, Mangrol (Junaagarh), Wellington. At Almora centre, it was observed only on one entry i.e. Agra Local and that too in traces. All the entries of WDMN at Dharwad were free from black rust. Under NEPZ, leaf blight was observed at all the locations except at Bilaspur. Leaf blight was also recorded at Hisar in NWPZ, Pune and Dharwad in PZ and Wellington in SHZ. Report on powdery mildew was received only from Kathua, Udhaywalla and Shimla locations in NHZ.

SAARC Wheat Disease Monitoring Nursery

The nursery was planted at 27 locations in India, Bangladesh, Afghanistan, Nepal and Bhutan.

Wheat disease situation in India

Powdery mildew and blight: Among the five locations i.e. Pusa, Kathua, Almora, Udhaywalla and Wellington, the earliest report of powdery mildew was from Almora (11.02.14), followed by Udhaywalla (16.02.14), Kathua (18.02.14), Wellington (05.03.14) and Pusa (07.03.14). All the entries were infected with powdery mildew at all the locations except Pusa and Wellington. Leaf Blight of wheat was observed only at seven locations of SAARC nursery. Like previous year, first report of blight was from Faizabad (01.02.14) followed by Pusa (06.02.14), Rajauri (13.02.14), Kathua (01.03.14), Wellington (05.03.14), Almora (15.03.14), and Udhaywalla (30.03.14). All the entries were showing blight infection at Udhaywalla (Jammu), Kathua, Almora, Pusa and Faizabad. Severity of leaf blight was maximum at Pusa, where 19 entries were showing severity of more than 45. At wellington WL1562, PBW 343 and Gaurab were free from blight infection.

Rusts: SAARC nursery was planted at 6 locations of NHZ, 5 locations of NWPZ, Faizabad, Pusa, Durgapura and Wellington. Yellow rust was observed at all the SAARC nursery locations in India except at Wellington and Jaipur. Yellow rust was observed at Udhaywalla {(Jammu) (10.01.14)} followed by Dhaulakuan (12.01.14), Kathua (02.02.14), Pantnagar (05.02.14) and Ludhiana (07.02.14). All the entries of SAARC nursery were infected at 4 locations viz. Gurdaspur, Kathua, Ludhiana and Udhaywalla. At Faizabad only 5 entries viz. Raj3765, PBW373, Faisalabad 85, Gourab and Susceptible check were showing yellow rust infection with 5S severity of the rust in each entry. Entries PBW343 and HD2687 were showing yellow rust infection at all the locations except Faizabad where yellow rust was observed. Similarly, Raj3765 and PBW373 were infected at all the SAARC nursery locations except Delhi. Maximum severity of yellow rust was observed at Dhaulakuan, where 18 of the SAARC entries showed more than 40S severity. Annapurna-1, Raj3765 and Susceptible check were showing 100S severity at Dhaulakuan.

Brown rust was observed at all the locations except at Firozepur, Dera Baba Nanak, Ludhiana, Rajauri and Jaipur. First report of brown rust was from Wellington (17.12.13) followed by Pantnagar (05.02.14), Udhaywalla (16.0.14), Kathua (18.02.14) Faizabad (28.02.14) and Gurdaspur (10.03.14). At Gurdaspur susceptible check with brown rust severity of 60S was the only entry showing brown rust infection. Wellington was the only location where all the SAARC nursery entries were infected with brown rust. The brown rust severity at Pusa ranged between traces to 10S only. Gourab with 20S and HP1633 with 40S severity of brown rust at Wellington were free from brown rust in est of the SAARC nursery locations in India. Stem rust was observed at Wellington and Almora only. Black rust was first observed at Wellington on 23.01.14 and on 20.0414 at Almora. It was observed on HD2204 (Traces) only at Almora. All the entries except WL1562 were black rust infected at Wellington. However, score of black rust on some of the entries doesn't appear to be realistic.

Disease situation in Bangladesh

SAARC wheat disease monitoring nursery was planted at five locations i.e. Dinajpur, Joydebpur, Jamalpur, Jessore and Ishurdi by P.K. Malaker and group. Both brown rust and leaf blight diseases of wheat were observed at all six locations. Earliest report of brown rust was from Dinajpur (23.02.14) followed by Rajshahi (28.02.14). At Dinajpur, all entries except Gourab were infected with brown rust. All other entries were showing brown rust infection at one or more locations. Except at Dinajpur, Raj 3765 was free from brown rust at all other locations. Leaf blight was very severe at all six locations and appeared when plants were at seedling stage.

Incidence of wheat rusts in Nepal

SAARC nursery was planted at three locations in Nepal but the data on the same have been received from two locations (Khumaltar and Bhirahawa) only, while the data from other location is awaited. At Khumaltar only yellow rust was observed on all the SAARC nursery entries. Yellow rust severity of 60S was reported on WL1563, HP1633, Faisalabad 85 and susceptible check (Morocco). Brown rust was observed at Bhirahawa on all the entries except WL1563, Punjab 81 and Gourab.

PATHOTYPE DISTRIBUTION OF WHEAT RUSTS

Stripe rust of wheat & Barley (*Puccinia striiformis*): During this crop year, 312 samples of yellow rust of wheat and barley were analyzed from six North Indian states and Nepal. Owing to the cool and humid weather, the population of pathotype 46S119, which is virulent to *Yr9* and *YrA* has increased in proportion and was observed in more than 74 % of the samples analyzed. Since 2011, there is a drastic shift of pathotypes in favor of pt.46S119. Partly it is due to the cold climate over the years as well as decrease in the area under PBW343. Many of the wheat lines/varieties which were resistant to yellow rust in farmers' field prior to 2011, became susceptible due to this shift in virulence. The proportion of PBW343 virulent pathotype 78S84 which is virulent to *Yr9* and *Yr27* has reduced to 18.5%. Three other pathotype were found in about 4% of the samples only. In eleven samples, a new pathotype has been identified which is not very virulent but is very competitive. During repeated tests, new pathotype has shown virulence to *Yr1*, *Yr* 6 and *Yr* 7 but is avirulent to *Yr9*.

Stem rust of wheat (*Puccinia graminis tritici*): Black rust of wheat was observed in 9 states of India, Nepal and Bangladesh. Virulence on *Sr31* (Ug99 type of pathotypes) were not identified anywhere in India, Bangladesh, Bhutan and Nepal. Among the 224 samples analyzed, pathotype was widely observed in Karnataka, Maharashtra and some areas in Northern India but not in the Nilgiri hills. In Gujarat, pathotype 40A was identified in maximum number of samples whereas three other pathotype were observed in one sample each. Diversity of pathotype was maximum in Madhya Pradesh where seven pathotypes were identified in 15 samples with predominance of pathotype 40A. In Uttar Pradesh, pathotype 11 was identified in two samples whereas in Uttarakhand, Rajasthan and Himachal Pradesh pathotype 21-1 which was identified in 1985 was identified in maximum numbers of samples. In north Indian states other pathotypes of 21 group were identified in few samples whereas pathotype 11 was observed in Uttarakhand. Preliminary studies have shown the occurrence of two new pathotypes in one sample each from Tamil Nadu .These were designated as 40-4 and 40-5. Both the pathotypes seem to be an off-shoot of pathotype 40A. While 40-4 is virulent to *Sr21*, 40-5 has additional virulence to *Sr7a*. These new pathotypes appear to be virulence selection in 40A on diploid and tetraploid wheat.

Leaf rust of wheat (*Puccinia triticina*): Thirty pathotypes were identified in 673 samples of brown rust of wheat analyzed from 15 states of India, Nepal, Bhutan and Bangladesh. Pathotype 77-5, virulent to *Lr23* and *Lr26* was predominant in 14 states and 3 neighboring countries. Pathotype 104-2 , virulent to *Lr23* and *Lr26* succeeded 77-5 and was observed in 12 states and two adjoining countries Nepal and Bangladesh. In Nilgiri hills, the proportion of pathotype 77-9 has increased in comparison to the previous years and was identified in 56% of the samples analyzed from that area. Frequency of predominant pathotype 77-5 for the last more than 18 years has reduced considerably. Likewise, in Karnataka, pathotype 77-9, 12 and 77-11 were the three most frequent pathotypes. In addition pathotype 77-5, 12-2 and 104-2 were also frequent. Fifteen other pathotypes were identified in the remaining samples. In Maharashtra pathotype 12 was most frequent followed by pathotype 77-5 whereas other pathotype were identified in few samples only. Contrarily pathotype 104-2 was predominant in Gujarat, Rajasthan and Madhya Pradesh. Based on the analysis of 17 samples from North eastern states of Bihar and West Bengal, pt 77-5 was the most predominant. In Uttar Pradesh, pts. 77-5 and 104-2 were identified in

31% of the samples each. Eleven other pathotypes were detected in few samples only. In Uttarakhand, pathotype 104-2 was most frequent whereas in Himachal Pradesh pt 77-5 and 104-2 were more predominant with equal frequency. In Punjab, pt. 77-3 was found in maximum number of samples whereas in Jammu &Kashmir, pt. 12-9 occurred in the only two samples analyzed. In Nepal Bhutan and Bangladesh pt. 77-5 and 104-2 were identified in maximum numbers of samples whereas thirteen other pathotype were identified in few samples only. In few samples from the Nilgiri hills, a new pathotype designated as 77-12 was identified. The new pathotype is close to the pathotype 77-9 but is avirulent to *Lr*26. In a sample from the Maharashtra, a new pathotype, designated as 77-13 was identified. This pathotype appears to be the result of a loss of virulence on *Lr*26 in the pathotype 77-10, which has virulence to *Lr*28. Further studies on rust resistance, avirulence/virulence structure are being undertaken.

POST HARVEST ANALYSIS

Karnal Bunt and black point

A total of 8900 grain samples collected from various mandies in different zones, were analyzed for Karnal bunt (KB). The highest KB incidence (83.98%) was recorded from UP. In Haryana followed by Haryana (47.99 %), Punjab (39.13 %), Rajasthan (30.13 %) and Uttarakhand (24.67 %). In MP, out of 294 samples, 6.12 per cent samples were KB infected. Based on the overall KB occurrence, it emerged that the KB incidence this year was less than the previous year. No sample from West Bengal, Gujarat (Vijapur), Maharashtra (Pune) and Karnataka (Dharwad) was found infected with KB. Out of 5717 grain samples analyzed for black point from different zones in the country, 78.95 per cent samples were found black point infected.

Nematodes

In Rajasthan, out of 761 samples collected from five districts *viz.* Ajmer, Alwar, Dausa, Jaipur and Tonk, 118 were found infected with ear cockle nematode (ECN). Highest infestation (30.30 %) was recorded from Kishangarh of Ajmer District followed by Devli (24.00 %) of Tonk District. In Punjab, out of 1919 wheat grain samples, none of the sample showed incidence of ECN. In Bihar, out of 150 samples collected from Samastipur, Muzaffarpur and Vaishali, none was found infected with ECN.

EVALUATION OF WHEAT GENOTYPES FOR INSECT PEST RESISTANCE AND MANAGEMENT

Among AVT's lines, none of entry was resistant to shoot fly, aphids, root aphids and brown wheat mite. Two genotypes [NIAW 1415 (C) and A 9-30-1 (D) (C)] showed moderate resistance (>10%) to shoot fly. Genotypes, NW 3069, MACS 6221, VL 924, PDW 315, PDW 317, DBW 46, HPW 308, HPW 309, HI 8692 and WH 1076 have shown moderate resistance to brown wheat mite. Genotypes, NIAW 1994, NIAW 1885, K 1006 (I) (C), DBW 107, WH 1138, HD 2932+*Lr19/Sr25*, KB 2012-03, PBW 723, UAS 451 (D), PBW 692, HD 3128, VL 1004 and VL 3002 were found moderately resistant to root aphid.

Imidacloprid 600 FS (Gaucho) @ 0.72 g a.i. /kg seed was identified quite effective for the control of termite damage and improving yields. Propargite 57 SC (Omite) @ 1.5 ml/l of water was very effective for brown wheat mite management. The foliar application of Pride (Acetamiprid 20SP) @ 20 g.a.i./ha was found to be quite effective for the management of foliar aphids in wheat. The results of initial studies on stored grain pest indicate that emamectin benzoate (Proclaim @40.0 mg/kg) and spinosad (Tracer 4.4 mg/kg) as seed protectant were quite effective for the management of wheat stored grain pests.

During 2013-14, to verify the results of IPM modules on farmers field, the module was validated at farmers' fields. The IPM module was evaluated with two varieties Trimbak (NIAW - 301) and NIAW-34 in five locations at farmers fields in Nasik district of Maharashtra. The module consisted of seed treatment with Azotobactor, PSB and Cruiser spray for the management of aphids. The yield from farmers practice was in the range of 30.0 to 38.5 q/ha whereas yield of IPM modules in ranged from 37.5 to 47.5q/ha. The population of aphids was observed to be above threshold level during the tillering stage in farmers practice plots, while in IPM plot it was below economic threshold level.

EVALUATION OF WHEAT GENOTYPES FOR NEMATODES RESISTANCE AND MANAGEMENT

None of the entry of AVTs showed resistant or moderately resistant reaction to CCN, *Heterodera avenae* and *H. filipjevi* at Hisar. At Ludhiana, only two genotypes HS 507 (C)and HD 3059 (C) in AVT II and eight in AVT I namely; HPW 400, DBW 98, UP 2855. HI 8755 (D), UP 2864, DDK 1042, HW 1098 (I) (C), and TL 2997 have shown moderately resistant reaction to . At Delhi centre, all the varieties screened under AVT I and AVT II were susceptible to highly susceptible. All AVTs lines were susceptible to highly susceptible to root knot nematode, *Meloidogyne graminicola* at Ludhiana but at Pusa Bihar, all entries were found resistant against *M. graminicala.* The biotypes studies of carried out at Durgapura indicated resistant reaction of ten differentials, AUS-15854, Raj MR-1, AUS-7869, Capa, KVL-191, Dalmitsche, Harta, Martin, L-62 and Morocco to cereal cyst nematode (Jaipur population).

On the basis of three years results of Durgapura, Carbosulfan 2% 25 EC was effective in reducing the cyst population of nematode and increased grain yield over control. All the neem based formulations was also found effective in reducing the population of nematodes and increased grain yield over control. Neem gold 10ml/kg seed showed its overall superiority and better plant growth response may be due to the fact that besides having nematicidal potential and might have increased the tolerance level of plant and develop potential to resist the nematode attack. The three years (2011-14) experiment conducted at Agricultural Research Station, Durgapura, Jaipur in naturally infested soil revealed that cabbage and mustard are effective in reducing cyst of *Heterodera avenae.*

STRIPE RUST MANAGEMENT

Stripe rust awareness among farmers was created by organizing Farmers' Fair in collaboration with State Department of Agriculture, Yamunanagar at Bilaspur (Yamunanagar) on September 25, 2013 and more than 2500 farmers attended the fair. On September 28, 2013, one Kisan Mela was organized at Kaithal and stripe rust management cards were distributed among the farmers. Farmers Innovator and Seed day was organized at DWR, Karnal on October 15, 2013 in which farmers were apprised of the strategies enhancing wheat production including crop production and protection technologies with emphasis on stripe rust management. Preventive steps were taken by DWR (ICAR), DAC and State Departments. Strategy meeting was organized by DAC on Oct 5, 2013 in Panchkula (Haryana) for stripe rust management. Strategy meeting were also organized in Dehradoon and Jammu in October, 2013. A meeting was organized by DAC, Ministry of Agriculture, Govt. of India at Una (HP) on January 8, 2014 for stripe rust management in NWPZ and NHZ. Advisory for stripe rust management was issued by DWR, Karnal on December 17, 2013, January 2, February 3 and March 3, 2014.

Training on wheat health management: A training course on Techniques and Procedures in Crop Health Monitoring and Field Evaluation of Host Resistance in Wheat and Barley was organized by DWR (Karnal and Flowerdale, Shimla) and DRRW project of BGRI for the co-operators of AICW&BIP at DWR, Karnal during January 29-31, 2014. A total 23 scientist working in wheat pathology throughout the country were precipitated in the training. They were familiarized with survey and surveillance techniques including online filling of survey records, disease rating scales, inoculum multiplication, inoculation, epiphytotic creation, and data recording and reporting.

Impact of Strategies to combat stripe rust of wheat: Though, stripe rust was occurring in India since long, it was in the year 2001 when a new virulence was detected on PBW 343. With the increase in area under PBW 343, eventually the stripe rust spread to large areas (approx. 3mha) in 6 states (Himachal Pradesh, Jammu region of Jammu and Kashmir, Punjab, Haryana, Uttar Pradesh, Uttarakhand). Due to its high intensity in some years resulting in losses to farmers, led to the formulation of a strategic plan during 2010-11 to limit its occurrence below threshold levels of economic losses. Major emphasis was on bringing in farmer's awareness in replacing susceptible varieties with resistant ones, early detection of the rust, identifying initial foci of infection by regular monitoring of crop after 40 days of planting and immediately spraying the crop with fungicides to limit its spread. Special cards were devised for the awareness to farmers and circulated in large numbers in all the affected areas. Every year strategic planning meetings were held under the chairmanship of Secretary, Department of Agriculture and Cooperation, Government of India, for enhancing wheat production and stripe rust management. Advisories were issued as and when the disease was detected with major emphasis on advising farmers for frequent visits in their fields and making available the recommended fungicide (Propiconazole). Extensive training programmes were organized for the officers' of Department of Agriculture, scientists and farmers of affected areas. In high disease prone areas TRAP nursery/advanced varieties trials were planted for early detection of stripe rust/identifying resistant varieties. To create genetic diversity at farmers' field, several stripe rust resistant varieties viz., HD 2967, WH 1105, HD 3086, DBW 88, HD 3059, WH 1021, WH 1080, HD 3043, DBW 71, DBW 90, HS 507, HPW 349 and HS 542 were released. A gradual decline in stripe rust occurred in disease prone states since 2011 due to awareness to farmers leading to drastic decline in area under susceptible varieties, and replacement with resistant varieties viz., PBW550, DPW 621-50, HD 2967, HD 3059, HS 490, VL 829, VL 892, VL 907, PBW 590 in large areas, feedback from farmers of its early detection and timely spraying with fungicide. In the year 2013-14 though the disease was first detected in 1st week of January coupled with favourable environmental conditions throughout the season the disease did not spread to large areas and furthermore its intensity also remained low avoiding losses to the tune of about 3 mt.

PROGRAMME OF WORK 2013-2014

The programme for the crop year 2013-2014 was chalked out in the 52nd All India Wheat and Barley Research Workers Meet held at CSAUA&T, Kanpur during Sept., 1-4, 2013. The various activities to be executed at respective centres are given below:

PROGRAMME 1: HOST RESISTANCE: IPPSN AND PPSN

Adult Plant Resistance for rusts & other diseases

i. **Initial Plant Pathological Screening Nursery (IPPSN)**
Objectives
To evaluate breeding materials generated at various centres against rusts and foliar blights for promoting to coordinated multi-location trials. (Under artificial inoculated conditions)

(a) **Rusts:**
North:
Leaf Rust: Delhi, Hisar, Karnal, Durgapura, Ludhiana (5)
Yellow Rust: Gurdaspur, Dhaulakuan, Malan, Karnal, Durgapura, Ludhiana and Jammu (7)
South: No. of Centres, 5
Stem Rust + Leaf Rust: Mahabaleshwar, Wellington, Powarkheda, Niphad and Indore

(b) **Leaf Blight:** No. of centres: 6
Faizabad, Pusa (Bihar), Varanasi, Kalyani, Sabour, Ranchi and Coochbehar

ii. **Plant Pathological Screening Nursery (PPSN)**
Objectives
Promotion of entries from one stage to the other in the coordinated trials and identification of varieties after AVT level on the basis of their level of disease resistance.

Rusts:
North:
Yellow Rust: Dhaulakuan, Gurdaspur, Malan, Bajaura, Karnal, Ludhiana, Pantnagar, Durgapura, Jammu, Kudwani (Kashmir) (10)
AVT material will also be evaluated under natural conditions at Nawan Shahar (Punjab) and Yamunanagar (Haryana) for yellow rust.
Leaf Rust : Delhi, Hisar, Jammu, Kanpur, Karnal, Ludhiana, Pantnagar, Durgapura (8)
South: No. of Centres: 9
Leaf and Stem Rusts: Wellington, Mahabaleshwar, Niphad, Vijapur, Pune, Junagarh, Powarkheda, Dharwad and Indore

Note: The samples of leaves of AVT IInd year entries in PPSN and the varieties (checks) showing resistance in the past but now showing rust severity of 40S or more at any of the centres, should be sent immediately to the Head, DWR Regional Station Flowerdale, Shimla for pathotype analysis, with information to P.I. (Crop Protection).

Monitoring of PPSN

A team of Plant Pathologists was constituted during the work-planning meeting for effective monitoring and data recording in PPSN at various locations in NWPZ. The team consists of Dr. M. S. Saharan, Dhanbir Singh (DhaulaKuan), Dr. R. K. Bansal (Durgapura) and will monitor PPSN at Ludhiana, Karnal, Hisar, Dhaulakuan and Delhi. Dr. S. K. Jain and Dr. Deep Shikha will monitor PPSN at Pantnagar. Dr. S. K. Rana, Dr. R. Devlash and Dr. Selva Kumar will monitor PPSN in Bajoura, Malan, Jammu and Khudwani. Dr. I. K. Kalappanavar, Dr. D. A. Shambharkar, Dr B K Honrao and Parmod Parsad (Shimla) will monitor PPSN in PZ. Dr. A. N. Mishra, Dr. K. K. Mishra and Dr. O. P. Gangwar will monitor PPSN in CZ. Breeders will also join the teams.

iii **AUDPC based identification of slow rusters in AVT material:**
Leaf and yellow rusts - DWR, Karnal; stem and leaf rusts - Mahabaleshwar; stem rust - Indore; Yellow rust - Ludhiana.

PROGRAMME 2: RUSTS (BROWN, YELLOW AND BLACK)

A. APR: Race specific and slow rusting

i. Leaf rust: AVT entries of NWPZ, NHZ and NEPZ, alongwith the check entries of the respective zones.
Centres: New Delhi and Ludhiana under field conditions and Flowerdale (under controlled conditions)

ii. Stem rust: AVT of CZ and PZ, along with the check varieties of the respective zone.
Centres: Indore, Pune, Powarkheda and Mahabaleshwar

iii. Yellow rust: AVT entries of NWPZ and NHZ alongwith the checks of the respective zones.
Centres: Ludhiana and N. Delhi under field conditions and Flowerdale (under controlled condition)

Race inoculum to be supplied by Flowerdale: Races should be the same for all the respective centres.

i) Leaf rust: 77-5 and 104-2
ii) Yellow rust: 46S119 and 78S84
iii) Stem rust: 40A and 117-6

B. Seedling Resistance Tests and postulation of Rust Resistance Genes

i. Leaf, Stem and Stripe rusts (All races): DWR, Regional Station, Flowerdale, Shimla for AVT's (aestivum) entries. Flowerdale centre to generate data on rust resistance genes of all the AVT entries. Besides, this, identification of rust resistance genes to be done in selected entries of MDSN, MPSN and EPPSN.

ii. Stem and Leaf rusts: Mahabaleshwar for SRT on AVT entries of CZ, PZ and NIVT, durum entries.

PROGRAMME 3: LEAF BLIGHT

i. **Leaf Blight Screening Nursery (LBSN):** No. of Centres: 16
This nursery will consist of earlier identified resistant materials as well as the AVT's and special trials.

NWPZ:	Pantnagar, Ludhiana, Karnal, Kaul and Hisar.
NEPZ:	Varanasi, Faizabad, IARI Pusa, Coochbehar, Shillongani, Ranchi and Kalyani.
PZ:	Dharwad
SHZ:	Wellington
CZ	Gwalior

ii **Management of foliar blight of wheat through chemicals**
Centres: Faizabad, Kanpur, Varanasi, Kalyani, Pusa (Bihar), Sabour and under controlled conditions at Karnal

iii. **Biological control of leaf blight :** Formulations will be provided by Dr. Rashmi Aggarwal, IARI, New Delhi
Centres: Karnal, Coochbehar and Faizabad

iv. **Basic studies on foliar blights:** These will be undertaken at Karnal, Faizabad, Varanasi and Delhi.

PROGRAMME 4: KARNAL BUNT

Karnal Bunt Screening Nursery (KBSN): This nursery will consist of the earlier identified resistant materials and the AVT-II year entries of 2013-2014. These evaluations will be done under artificially inoculated conditions.
No. of Centres, 7
Dhaulakuan, Ludhiana, Delhi, Pantnagar, Hisar, Karnal and Jammu.
Karnal will also evaluate AVT-Ist year entries. Ludhiana and DhaulaKuan will evaluate AVT-I and NIVT entries also.

PROGRAMME 5: LOOSE SMUT

Loose smut Screening Nursery: It will contain resistant materials identified in the past and AVT Ist year entries.
Centres: Ludhiana, Almora, Durgapura and Hisar.

PROGRAMME 6: POWDERY MILDEW

Powdery Mildew Screening Nursery: No. of Centres: 9
Almora, Pantnagar, Ranichauri, Shimla, Malan, Bajaura, Dhaulakuan, Wellington and Kaul.

PROGRAMME 7: REGION SPECIFIC DISEASES

Disease Screening Nurseries of the region specific diseases will include resistant materials identified during the past, along with AVT entries at the locations given below:

i. **Head scab:** Karnal, Gurdaspur, Dhaulakuan and Wellington (AVT). At Gurdaspur and Wellington, evaluation for head scab will be done under natural conditions. Evaluation at Gurdaspur will be done by Ludhiana centre.
ii. **Flag smut:** Ludhiana, Hisar, Karnaland Durgapura
iii. **Hill bunt:** Malan, Bajaura and Almora

PROGRAMME 8: CROP HEALTH

Crop Health Monitoring: Pre harvest surveys

- All the centres associated with Crop Protection Programme will supply information fortnightly on crop health from the areas of their jurisdiction to P.I. Crop Protection starting from November 2013 till the harvest of crop.
- 'Wheat Crop Health Newsletter' will be issued on monthly basis from DWR, Karnal, during the crop season. Information on off season crop will also be included.

Monitoring of new virulences of rusts in NWPZ by specially constituted teams: Specially constituted teams will visit the areas as per the schedules given below for effective monitoring of crop health in general and appearance and spread of yellow rust in particular, along the areas near the western border and foothills / sub-mountaneous areas in NWPZ. Entomologists will also accompany the teams.

Team 1: Last week of December 2013	Drs O. P. Gangwar, R Selvakumar and R. Devlash
Team 2: Mid January, 2014	Drs. M. S. Saharan, S. K. Rana and Ritu Bala
Team 3: 1st week of February, 2014	Drs. Madhu Meeta, Sudhir Kasnia and V.K. Singh
Team 4: Last week of Feb., 2014	Drs. S. S. Karwasara, R. K. Jaiman and Parmod Parsad

(Visits in March, 2014 will be arranged as per need).

Teams will cover the yellow rust prone areas in Punjab, Haryana, HP and J & K. Monitoring of yellow rust in hills in HP, J & K and Uttarakhand will be undertaken by a team of Plant Pathologists during off season (May-August, 2014).

Monitoring the pathotype distribution of rust pathogens: It will be undertaken by DWR, Regional Station, Flowerdale, Shimla (all three rusts from all zones) and Rust Research Station, Mahabaleshwar (brown and black rust from CZ and PZ). All the cooperating centres are required to send the rust infected samples (natural infection) for pathotype analysis to the concerned centres.

Wheat Disease Monitoring Nursery (To be co-ordinated by Flowerdale, Shimla): The nursery will be planted at 38 locations including Kudwani (Srinagar), Varanasi and Yamunanagar (Haryana). Samples from this nursery should be sent regularly to R.S. Flowerdale, Shimla for virulence analysis and information. Information on rust appearance to be provided at monthly intervals, starting from end of December to the P.I. (Crop Protection).

Reconstitution of Wheat Disease Monitoring Nursery (WDMN): Keeping into account the changed varietal situation, the zone specific varieties of NWPZ and NEPZ were recasted. The detailed constituents of WDMN from 2013 onwards would be as given below:

Common set of varieties of wheat disease monitoring nursery
WL 711, HD 2329, Agra Local, HD 2160, Lal Bahadur, WL 1562, HW 2021(*Sr26/Sr24*), HD 2204, C 306, WH 147, HW 2008 (*Sr24/Lr24*), Kharchia mutant, HP 1633, DL 784-3 and *Lr24*.

Zone specific varieties
NWPZ: DBW17, WH 542, PBW 343, DPW 621-50 and WH 896
NEPZ: K 8804, HD 2402, HP 1102, HUW 468 and NW 1014
CZ: HI 8381, DL 803-3, Lok -1, GW273 and GW322
PZ and SHZ: MACS 2496, Bijaga Yellow, HW 971, HD 2501 and HW 2022 (*Sr24/Lr24*)
NHZ and High Altitude Zone: HPW 251, VL892, HS 420, Sonalika, VL 738 and Barley Local

Off-season Disease Monitoring Nursery (To be coordinated by DWR Reg. Station, Flowerdale): This nursery will be planted in Dalang Maidan, Kukumseri, Sangla, Sarahan (HP) and Leh (J&K). High altitude varieties and one hulless barley variety will also be included in this nursery.

SAARC- Nursery (To be co ordinated by Flowerdale, Shimla): Nursery will be planted at 15 Indian locations, *viz.*, Ludhiana, Delhi, Dhaulakuan, Gurdaspur, Dera-Baba-Nanak, Abohar, Sri Ganganagar, Chattha, Kathua, Rajouri, Almora, Durgapura, Faizabad, Pantnagar and Wellington.

Monitoring of Karnal bunt and blackpoint in harvested grains
Post harvest monitoring will be undertaken by cooperating centres by analysing samples from grain *mandies* in each district of their respective states. Centres from C.Z. (Indore, Sagar, Powarkheda, Junagarh, Vijapur, Jabalpur) and PZ (Pune, Niphad and Dharwad) may also supply grain samples to DWR Karnal for analysis.

PROGRAMME 9: IPM IN WHEAT

A. GENETICAL (HOST RESISTANCE)

(a) **Elite Plant Pathological Screening Nursery (EPPSN) :**
North: No. of Centres, 8
Delhi, Karnal, Ludhiana, Pantnagar, Durgapura, Hisar and Almora
South: No. of Centres, 4
Wellington, Mahabaleshwar, Dharwad and Indore.

(b) **Multiple Disease Screening Nursery (MDSN):** It will be subjected to artificial epiphytotics as detailed below:-

(i) DISEASES
North: No. of Centres, 14
Yellow rust: Karnal, Ludhiana, Dhaulakuon, Pantnagar
Brown rust: Karnal, Ludhiana, Delhi
Karnal Bunt: Karnal, Ludhiana, Dhaulakuoan
Powdery mildew: Dhaulakuan, Almora, Pantnagar, Kaul, Chattha
Foliar blights: Kaul, Faizabad, Varanasi, Coochbehar
Loose smut: Hisar, Durgapura, Ludhiana
Flag smut: Hisar, Durgapura, Ludhiana
Head scab: Karnal, Dhaulakuoan and Wellington
South: No. of Centres, 3
Leaf and Stem rust: Mahabaleshwar, Indore and Wellington

(ii)Nematodes (CCN) : Durgapura, Hisar, Ludhiana

(c) **Contribution to NGSN:** The resistant entries to major diseases identified after multilocation & over years of testing will be contributed to NGSN for the use of breeders in crossing programme. (Centre: Karnal)

B. MANAGEMENT OF DISEASES

(a) **Chemical control of Yellow Rust* :** Karnal, Ludhiana, Bajoura, Pantnagar, Jammu, DhaulaKuan and Khudwani
(b) **Chemical control of Stem rust* :** Mahabaleshwar, Niphad, Powarkheda and Dharwad
(c) **Chemical control of foliar blight*:** Karnal, Faizabad, Varanasi, Coochbehar and Pusa (Bihar)

*The layout and other details will be provided by P.I, (Crop Protection).

PROGRAMME 10. WHEAT ENTOMOLOGY

The Entomology programme for the crop year 2013-2014 was formulated at the 52nd All India Wheat and Barley Research Workers Meet held at CSAUA&T, Kanpur during September, 1-4, 2013. The various activities to be executed at respective centres after the deliberations with all the entomologists are given below:

(A) HOST PLANT RESISTANCE

EXPT.1. ENTOMOLOGICAL SCREENING NURSERY FOR

(a) Shoot fly (Dharwad, Durgapura, Ludhiana, Kanpur)
(b) Brown wheat mite (Durgapura and Ludhiana)
(c) Wheat Aphids (Niphad, Ludhiana, Karnal, Shillongani and Kanpur)
(d) Root aphid (Entkhedi, Niphad, Karnal and Ludhiana)

EXPT.2. MULTIPLE PEST SCREENING NURSERY

(a) Shoot fly (Dharwad, Durgapura, Ludhiana, Kanpur and Karnal)
(b) Brown mite (Durgapura and Ludhiana)
(c) Foliar aphids (Niphad, Ludhiana, Karnal, Shillongani and Kanpur)
(d) Root aphid (Entkhedi, Niphad, Karnal and Ludhiana)

(B) CHEMICAL CONTROL

EXPT.3. Effect of insecticidal seed treatment on germination, termite damage and yield. (Centres: Durgapura, Kanpur, Ludhiana, Vijapur and Banasthli).

EXPT.4. Management of termite damage through broadcasting of newer insecticides in standing wheat crop. (Centres: Durgapura, Ludhiana, and Vijapur).

EXPT.5. Chemical control of foliage feeding wheat aphids.
(Centres: Karnal, Ludhiana, Niphad and Pantnagar).

EXPT.6. Eco-friendly management of aphids through biorational approaches.
(Centres: Niphad, Karnal, Ludhiana and Pantnagar).

EXPT.7. Management of brown wheat mite with different pesticides/acricides.
(Durgapura and Ludhiana)

(C) INTEGRATED PEST MANAGEMENT

EXPT.8. Survey of pests infesting wheat and barley and their natural enemies (All centres)

EXPT.9. Incidence and population build of major insect pest indifferent dates of sowing. (Niphad, Ludhiana and Karnal) **(New trial)**

EXPT.10. Basic studies for development of IPM strategies

(a) Pest modeling for Foliage aphids
(Niphad, Ludhiana, Karnal & Pantnagar)
(b) Brown mite ETL (Durgapura)
(c) Root aphid (Entkhedi)
(d) Thrips (Pantnagar)
(e) *Helicoverpa armigera* (Pantnagar)

(D) STORED GRAIN PESTS

EXPT.11. Management of stored grain insect pest.
(Durgapura, Kanpur and Ludhiana)

PROGRAMME 11. WHEAT NEMATOLOGY

The Nematology programme for the crop year 2013-2014 was formulated at the 52nd All India Wheat and Barley Research Workers Meet held at CSAUA&T, Kanpur during September, 1-4, 2013. The various activities to be executed at respective centres after the deliberations with all the Nematologists are given below:

1. **Monitoring of Nematodes:**
   i) ***Anguina tritici***: Pusa (Bihar), Jammu, Durgapura, Ludhiana, Varanasi, Delhi and Palampur
   ii) ***Heterodera avenae***: Durgapura, Delhi, Hisar, Ludhiana and Malan,
   iii) **Community analyses of Nematodes in wheat:** Durgapura, Delhi, Hisar, Ludhiana, and Malan
   iv) **Mapping of nematode population:** Durgapura, Delhi, Hisar, Ludhiana, and Malan
   v) **Soil borne nematodes:** Survey will be conducted in Bihar (RAU Pusa centre), Varanasi commissionery (BHU Centre), parts of Rajasthan (Durgapura centre), southern Haryana (Hisar centre), Chattha (Jammu centre), Delhi (western UP including Meerut, Aligarh, Gaziabad, Baghpat, Sonipat, etc), Punjab (Ludhiana centre) and HP (Malan)
2. **System based Research:**
   i) **Population monitoring in wheat based systems:**
   Rice-Wheat: Ludhiana, Pusa (Bihar), Chattha (Jammu), Varanasai, Kangra (Palampur) and Delhi.
   Cotton - Wheat: Hisar and Ludhiana.
   Maize - Wheat: Chatha (Jammu).
   Bajra - Wheat: Durgapura.
   Groundnut - Wheat: Durgapura.
   Til - Wheat: Pusa (Bihar)
   Cowpea - Wheat: Durgapura.
   Wheat - Moong: Durgapura
   ii) **Diversification in existing wheat based systems for CCN management-** Durgapura.
   iii) **Biofumigation as management tool for nematodes:** Ludhiana, Durgapura, Hisar and Delhi.
   iv) **Testing of advanced breeding materials generated at Durgapura and Delhi against CCN:** Durgapura, Hisar, Ludhiana and Delhi.
   v) **Molecular characterization of** *Heterodera filipjevi*: Delhi
   vi) Evaluation of **ecofriendly approaches in management of CCN:** Hisar, Ludhiana, Durgapura and Delhi.
3. **Evaluation of resistance against Nematodes parasitizing wheat:**
   i) ***Heterodera avenae***: Hisar, Durgapura and Delhi,
   ii) ***Heterodera filipjevi***: Ludhiana.
   iii) **Screening against *M graminicola***: Pusa (Bihar), Ludhiana.
   iv) **Biochemical/Molecular studies on *M graminicola***: IARI, New Delhi
   v) **Evaluation of international nurseries against CCN:** All centres (subject to availability of materials from the overseas source).

Monitoring of Nematodes: Team (Drs. D. J. Kaur, R. S. Kanwar, S. S. Vaish): 1st week of Feb., 2014

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Malan
Sudhir K. Rana

SKUAST-Kashmir Khudwani, Anantnag
Z.A. Bhat

Dhaulakuan
Dhanbir Singh

Bajoura
Rakesh Devlash

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Laxmi Rawat

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Ch. C.S. H.A.U, Hisar
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SKUAST-J, Chatha , Jammu
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MPKV, Mahabaleshwar
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Niphad
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F. SHZ

IARI, Regional Station, Wellington
J. Kumar, P. Nallathambi, C. Umamaheshwari

G. NEMATOLOGY PROGRAMME

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Pankaj

PAU, Ludhiana
Daman Jeet Kaur

ARS, Durgapura
Indra Rajvanshi

CCS HAU, Hisar
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SKUAS&T., Jammu
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RAU, Pusa
K.N. Pathak

H. ENTOMOLOGY PROGRAMME

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PROGRAMME 1. HOST RESISTANCE: IPPSN AND PPSN

1.1 INITIAL PLANT PATHOLOGICAL SCREENING NURSERY (IPPSN)

OBJECTIVES

Evaluation of breeding materials generated at various centers against rusts and foliar blights for inclusion in the coordinated multilocational yield evaluation trials.

SIZE AND COMPOSITION

No. of entries: 1534
No. of breeding centers: 38

TEST LOCATIONS

North:
Leaf Rust: Delhi, Hisar, Karnal, Durgapura, Ludhiana (5 locations)
Yellow Rust: Gurdaspur, Dhaulakuan, Malan, Karnal, Durgapura, Ludhiana and Jammu (7 locations)

South:
Stem Rust + Leaf Rust: Mahabaleshwar, Wellington, Powarkheda, Niphad and Indore (5 locations)

Leaf Blight: Faizabad, Ranchi, Pusa (Bihar), Varanasi, Kalyani, Sabour and Coochbehar (7 locations)

Data was not considered due to poor/erratic disease development from the following centres:
Leaf rust: Durgapura, Ludhiana and Karnal
Yellow rust: Durgapura

Evaluation under artificial epiphytotics

Uniform procedure was adopted for evaluation of IPPSN at all the test centers. Rust inoculum represented by a wide spectrum of pathotypes, was used in artificial inoculation of IPPSN materials. Rust inocula were supplied by DWR Regional Station Flowerdale and Mahabaleshwar centers. Following pathotypes were supplied for inoculation:

STEM RUST PATHOTYPES

Flowerdale (Shimla)
11(79G31), 40A(62G29), 42 (19G35), 122(7G11), 117-6 (37G19)
Mahabaleshwar
11 (79G31), 40A (62G29), 42 (19G35), 122(7G11), 117-6 (37G19)

LEAF RUST PATHOTYPES

Flowerdale (Shimla)
12-2 (1R5), 77-2(109R31-1), 77-5 (121R63-1) and 104-2(21R55)
Mahabaleshwar
12-2 (1R5), 77-2(109R31-1), 77-5 (121R63-1) and 104-2(21R55)

STRIPE RUST PATHOTYPES

Flowerdale (Shimla)

K(47S102), P(46S103), L(70S69), 13(67S8) , 46S119 and 78S84

An account of entries exhibiting rust response upto ACI 15 to three rusts is given in Table 1.1. and Figs. 1.1-1.5. The disease data was sent to the concerned breeders in the second week of July, 2014 and was also uploaded on DWR website.

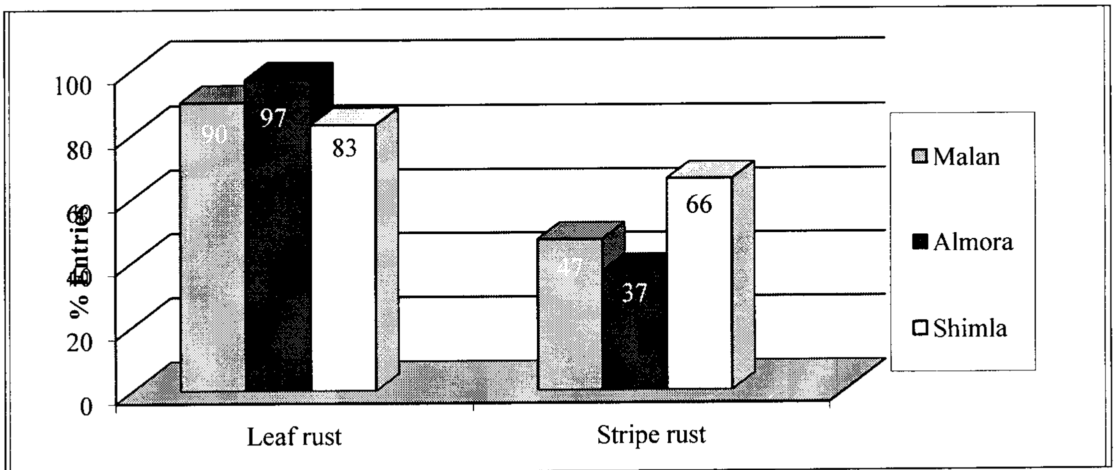

Fig. 1.1 Percent of rust resistant entries in IPPSN slots belonging to cooperating centres of NHZ (Leaf and Stripe rust)

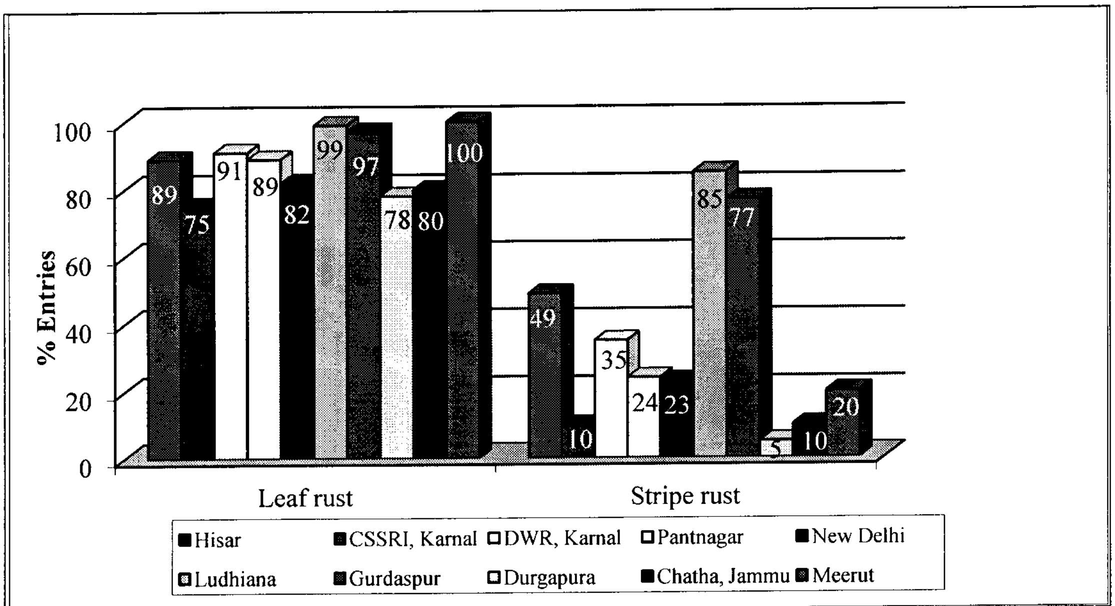

Fig. 1.2 Percent of rust resistant entries in IPPSN slots belonging to cooperating centres of NWPZ (Leaf and Stripe rust)

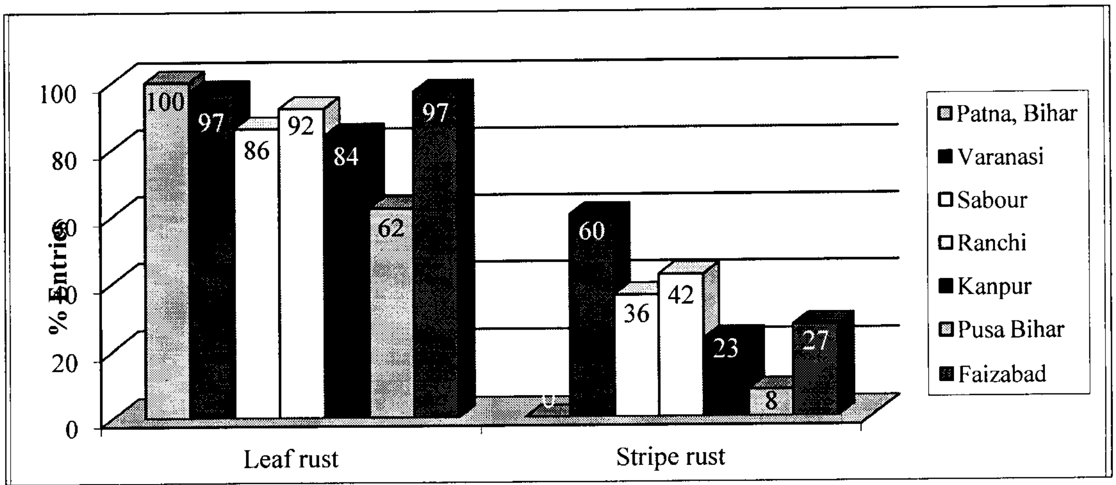

Fig. 1.3 Percent of rust resistant entries in IPPSN slots belonging to cooperating centres of NEPZ (Leaf and Stripe rust)

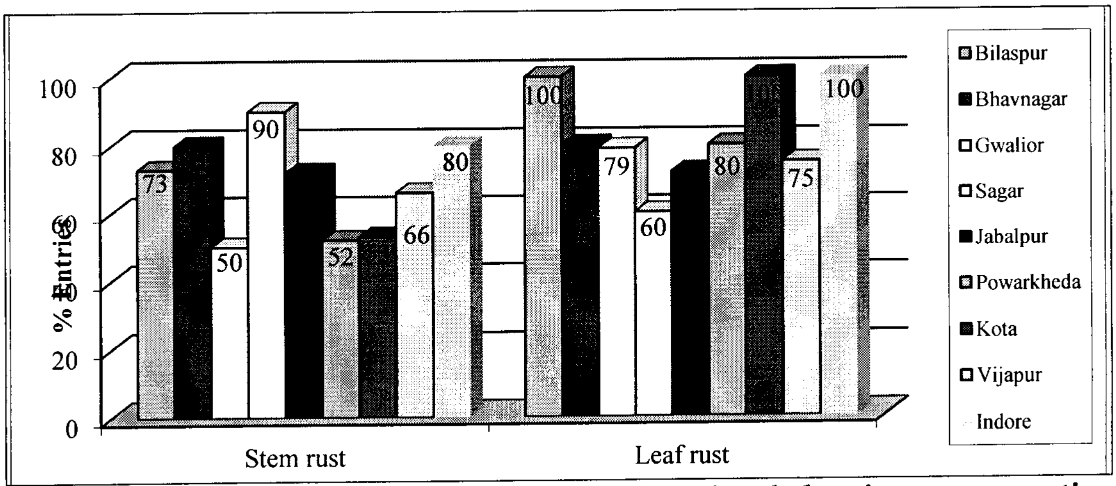

Fig. 1.4 Percent of rust resistant entries in IPPSN slots belonging to cooperating centres of CZ (Stem and Leaf rust)

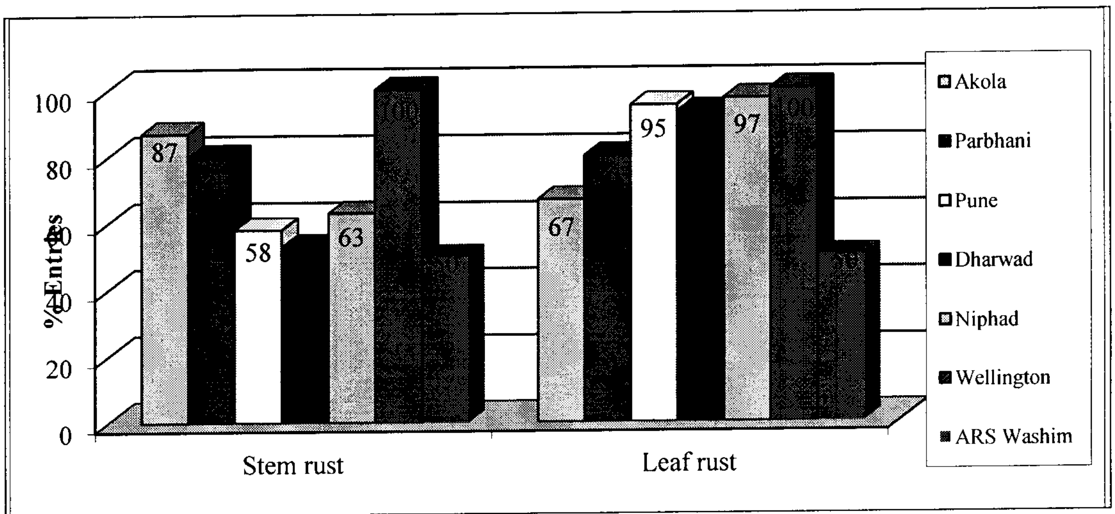

Fig. 1.5 Percent of rust resistant entries in IPPSN slots belonging to cooperating centres of PZ and SHZ (Stem and Leaf rust)

Table 1.1 Percent of rust resistant lines (ACI up to 15) in IPPSN slots of different centres

Sr. No.	Name of Centre	Total	PERCENT ENTRIES RESISTANT TO			
			SOUTH		NORTH	
			STEM	LEAF	LEAF	STRIPE
I. NORTHERN HILL ZONE						
1	VPKAS, Almora	60	80	87	97	37
2	CSK, HPKVV, Malan	30	80	83	90	47
3	Shimla	35	71	89	83	66
II. NORTH WESTERN PLAIN ZONE						
4	CCS HAU, Hisar	110	63	97	89	49
5	CSSRI, Karnal	20	85	75	75	10
6	DWR, Karnal	147	60	85	91	35
7	GBPUA&T, Pantnagar	75	77	84	89	24
8	IARI, New Delhi.	121	47	93	82	23
9	PAU, Ludhiana	175	75	98	99	85
10	PAU, RS, Gurdaspur	30	57	97	97	77
11	RAU, ARS, Durgapura	85	80	88	78	5
12	SKUAS&T, Chatha, Jammu	10	30	60	80	10
13	SVBPUA&T, Meerut	5	80	60	100	20
III. NORTH EASTERN PLAIN ZONE						
14	ARI, Patna, Bihar	3	0	100	100	0
15	B.H.U., Varanasi	30	73	97	97	60
16	BAC, Sabour	14	36	64	86	36
17	BAU, Kanke, Ranchi	12	100	83	92	42
18	CSAUA&T, Kanpur	110	59	87	84	23
19	IARI, Pusa, Samastipur	26	58	81	62	8
20	Kumarganj, Faizabad	30	57	97	97	27
21	SHIAT&S, Allahabad					
IV. CENTRAL ZONE						
22	ARS, Ummedganj, Kota	17	53	100	94	47
23	Bilaspur	15	73	100	80	7
24	College of Agriculture, Gwalior	14	50	79	93	36
25	Indore	70	80	100	84	61
26	JNKVV, Jabalpur	18	72	72	39	11
27	JNKVV, ZARS, Powarkheda	25	52	80	88	52
28	RARS, Sagar	10	90	60	70	10
29	Sanosara, Bhavnagar	10	80	80	50	0
30	SDAU, Vijapur	71	66	75	66	15
V. PENINSULAR ZONE						
31	ARI, Pune	40	58	95	83	18
32	MAU, Parbhani	5	80	80	100	0
33	MPKV, ARS, Niphad	32	63	97	75	50
34	UAS, Dharwad	30	53	93	87	30
35	Wheat Research Unit, Akola	15	87	67	67	40
36	ARS Washim (MS)	6	50	50	83	17
VI. SOUTHERN HILLS ZONE						
37	IARI, RS, Wellington	18	100	100	78	0
VII. INTERNATIONAL						
38	BISA Material	10	70	100	100	40

1.2 PLANT PATHOLOGICAL SCREENING NURSERY (PPSN)

OBJECTIVES

To help in promotion of entries from one stage to the other in the coordinated trials and identification of varieties after AVT level on the basis of their level of disease resistance.

SIZE AND COMPOSITION

PPSN, 2013-2014 included AVT, NIVT and the special trials (511 entries) including checks. The released / identified varieties as per respective trials, were used as checks and a mixture of susceptible varieties like Agra Local, A-9-30-1, WL-711, PBW 343, Sonalika, C-306, Kharchia 65, VL 804, K 8027, HD 2932, NI 5439, Cow(W) -1, GW 322, HD 2864, NIAW 1415, MACS 2496, MP 4010 and B. Yellow were used as infectors.

The PPSN was evaluated nationwide under artificially created epiphytotics at respective hot spot locations against three rusts. AVT entries were also evaluated against Karnal bunt, Foliar blight, Powdery mildew, Loose smut, Flag smut, Hill bunt, Head scab and Foot rot under respective disease screening nurseries (Fig. 1.6).

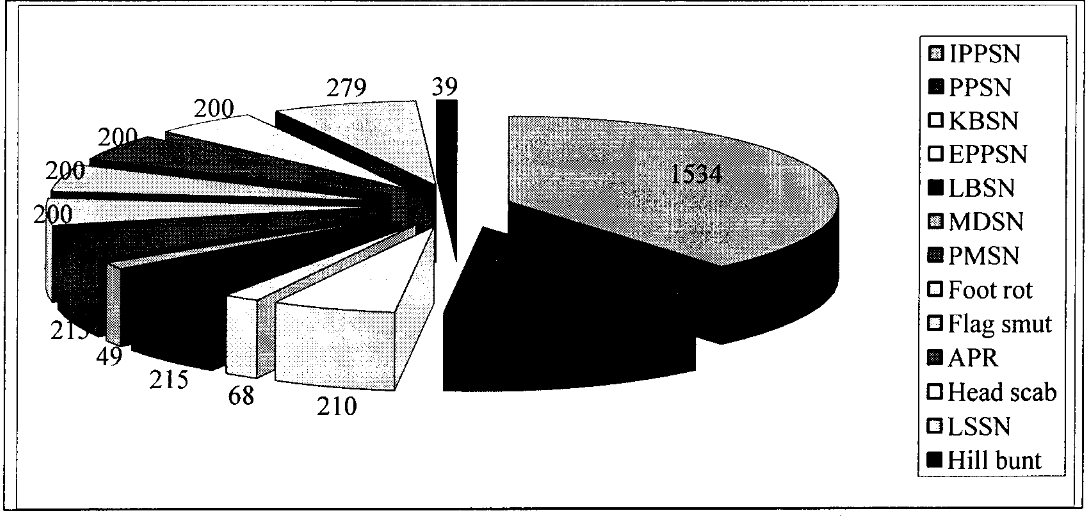

Fig. 1.6 Constitution of different plant pathological nurseries during 2013-14

TEST LOCATIONS

North:

Yellow Rust: Dhaulakuan, Gurdaspur, Malan, Karnal, Ludhiana, Pantnagar, Bajaura, Durgapura, Jammu, Kudwani (Kashmir) (10 locations)

Leaf Rust : Delhi, Hisar, Jammu, Kanpur, Karnal, Ludhiana, Pantnagar, Durgapura (8 locations)

South:

Leaf and Stem Rusts: Wellington, Mahabaleshwar, Niphad, Vijapur, Pune, Junagarh, Powarkheda, Dharwad and Indore (9 locations)

Data was not considered due to poor/erratic disease development from the following centres:

Leaf rust: Ludhiana, Karnal, Durgapura, Vijapur and Dharwad
Yellow rust: Durgapura

Evaluation under artificial epiphytotics
Uniform procedure was adopted for scoring of PPSN at all the test centers. Rust inoculum represented by a wide spectrum of pathotypes, was used in artificial inoculation of PPSN materials. Rust inocula were supplied by DWR Regional Station Flowerdale and Mahabaleshwar center. Inoculum of yellow, brown and black rusts was supplied by DWR Regional Research Station, Flowerdale, Shimla and Mahabaleshwar center supplied the inoculum to Centres in CZ and PZ. The mixture of pathotypes supplied by Flowerdale and Mahabaleshwar centres are given in IPPSN.

Disease data of AVT II year entries recorded at the hot spot locations is given in Table 1.2 that of AVT-I and NIVT (three rusts) is presented in Tables 1.3 and 1.4. Rust resistant genes postulated in AVT IInd year and AVT Ist year by DWR Regional Station Flowerdale have also been given in the respective tables and also in Tables 1.2 and 1.3.

AVT material was also evaluated under natural condition at Yamunanagar (Haryana) and Langroya (Punjab). The data is depicted in Annexures. **Other diseases data (Table 1.5) is presented in Annexure -I.**

Rust Resistance materials in AVT IInd and Ist Year (2013-14) with ACI upto 10.0 are given below:

Stem, Leaf and Stripe Rusts
AVT IInd Year
HI 8737 (D) and PBW 681
AVT Ist Year
DBW 129, DBW 95, DDW 30 (D), HD 4728 (D), HD 4730, HI 8750 (D), HI 8751 (D), HPW 373, HPW 411, HS 593, HUW 661, K 1204, PBW 677, PBW 697, PBW 703, PBW 723, TL 2995, TL 2996, TL 2998, TL 2999, TL 3000, UAS 451 (D), VL 1003 and VL 3004.

Stem and Stripe Rusts
AVT IInd Year
Nil
AVT Ist Year
K 1217, MACS 3916 (D), PBW 692 and VL 3002.

Stem and Leaf Rusts
AVT IInd Year
BRW 3723, DBW 107, DBW 110, DDK 1042, HD 3118, HUW 666, NIAW 1994, PBW 689 and VL 967.
AVT Ist Year
DBW 128, DBW 154, DDK 1044, DDK 1046, GW 451, GW 455, HD 2932-Lr19/Sr25, HD 3128, HD 3132, HD 3133, HD 3146, HPW 400, HPW 401, HPW 410, HS 547, HS 577, HS 595, HUW 675, HUW 677, HUW 679, MACS 5031, NIAW 2030, PBW 701, PBW 704, PBW 706, UP 2864, UP 2891, VL 1004, VL 3005, VL 976 and VL 977.

Leaf and Stripe rusts
AVT IInd Year
UAS 446 (D) and WH 1129.
AVT Ist Year
HD 2932+Lr19/Sr25, HI 8755 (D), HS 590, HS 592, HS 594, PBW 695, PBW 698, PBW 722 and TL 2997.

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M.S. SAHARAN, R. S. TAYA (KVK)	YAMUNANAGAR
DHANBIR SINGH	DHAULAKUAN
MADHU MEETA JINDAL	LUDHIANA, GURDASPUR
J KUMAR, DEEP SHIKHA, KANAK SRIVASTAVA	PANTNAGAR
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K. K. MISHRA	POWARKHEDA
K.V. JIVANI, K.H. DHABHI/ A.G. PANSURIYA	JUNAGARH
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R. S. JAIMAN	VIJAPUR
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B.K. HONRAO	PUNE
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G.T. BHANGALE, B.C. GAME	NIPHAD
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JAVED BAHAR KHAN	KANPUR
S.P. SINGH	FAIZABAD
S.S. VAISH	VARANASI
S K MUKHOPADHYAY, S DUTTA	KALYANI
C S AZAD	SABOUR
SUNITA MAHAPATRA	COOCHBEHAR
H.C. LAL	RANCHI
ASHISH KUMAR	PUSA, BIHAR

Table 1.2. Adult plant response of AVT IInd year material against wheat rusts under field conditions (artificial inoculations) during 2013-14

Sr. No.	Variety	RUST RESPONSE (HIGHEST SCORE AND ACI)								Postulated Gene		
		South				North						
		STEM		LEAF		LEAF		STRIPE				
		HS	ACI	HS	ACI	HS	ACI	HS	ACI	*Sr*	*Lr*	*Yr*
I. NORTHERN HILL ZONE												
1	HPW 376	40S	14.3	20S	6.3	10S	3.1	60S	15.5	*Sr* 5+	*Lr* 10+13+23+	*Yr* 2+
2	VL 967	20S	6.9	40S	8.3	10S	3.4	60S	17.4	*Sr* 8a+9 b+11+	*Lr* 13+	*Yr* 2+
3	HPW 251 (C)	10MR	1.4	20S	6.7	5S	3.0	100S	52.2	*Sr* 2+31+	*Lr* 23+26+	*Yr* 9+
4	HPW 349 (C)	20S	10.1	5S	1.7	5S	1.6	40S	11.0	*Sr*2	*Lr* 13+	*Yr* 2+
5	HS 277 (C)	10S	2.3	20S	4.6	5S	1.6	100S	72.2	*Sr* 31+	*Lr* 26+34+	*Yr* 9+18+
6	HS 375 (C)	10S	1.7	20S	3.6	5S	1.9	100S	48.2	*Sr* 5+31+	*Lr* 26+34+	*Yr* 9+18+
7	HS 490 (C)	20S	7.9	15S	3.4	40S	11.0	60S	13.8	*Sr* 2+9b+	*Lr* 23+	-
8	HS 507 (C)	5S	1.3	10S	1.6	20S	4.0	20S	8.4	*Sr* 31+	*Lr* 1+ 26+	*Yr* 9+
9	HS 542 (I) (C)	5S	1.0	5MR	0.4	5S	2.4	40S	8.0	*Sr* 5+8a+9b+11+	*Lr* 10+13+	*Yr* 2+
10	VL 804 (C)	10S	3.9	20S	7.1	80S	28.8	80S	34.9	*Sr* 5+31+	*Lr* 10+ 26+34+	*Yr* 9+18+
11	VL 829 (C)	5S	0.7	20S	4.6	10MS	2.6	60S	31.7	*Sr* 2+5+31+	*Lr* 26+34+	*Yr* 9+18+
12	VL 892 (C)	5MS	1.6	20S	2.9	10S	2.9	100S	42.2	*Sr* 2+	*Lr* 10+13+23+	*Yr* A+
13	VL 907 (C)	20MS	3.3	20S	3.5	40S	10.4	80S	20.5	*Sr* 31+	*Lr* 1+26+	*Yr* 9+27+
II. NORTH WESTERN PLAIN ZONE												
14	HUW 666	20S	3.6	40S	7.4	10S	2.2	40MS	15.7	*Sr* 9b+11+	*Lr* 10+13+	*Yr* A+
15	PBW 681	30S	8.5	20S	4.3	0	0.0	10S	1.7	*Sr* 2+11+	R	R
16	WH 1129	60S	11.3	10MS	1.9	15S	4.0	20S	7.7	*Sr* 9b+11+	*Lr* 10+13+	*Yr* 2+
17	WH 1138	40S	15.9	20MS	2.8	30S	12.2	40S	12.9	*Sr* 7b+	*Lr* 3+10+13+	*Yr* 2+
18	WH 1142	20S	6.9	40S	15.7	20S	6.6	40S	16.3	*Sr* 2+31+	*Lr* 1+3+26+	*Yr* 9+
19	DBW 88 (I) (C)	20MS	2.8	10MR	0.9	TR	0.0	40S	22.1	*Sr* 11+	*Lr* 10+13+	-
20	DBW 90 (I) (C)	60S	24.1	5S	1.2	40S	18.0	40S	16.3	*Sr* 13+	*Lr* 3+10+13+	*Yr* 2+
20. A	INFECTOR	100S	61.1	100S	90.0	80S	70.0	100S	78.9			
21	DPW 621-50 (C)	20S	4.5	10MS	2.0	15S	4.8	60S	17.3	-	*Lr* 10+13+	-
22	HD 2967 (C)	30S	12.3	15MS	3.6	20S	5.6	60S	32.9	*Sr* 8a+11+	*Lr* 23+	*Yr* 2+
23	HD 3043 (C)	20S	7.7	80S	13.4	20MS	5.0	60S	20.2	-	*Lr* 10+13+	*Yr* 2+
24	HD 3059 (C)	10S	3.7	20MS	3.0	TS	0.2	40S	20.9	-	-	-
25	HD 3086 (I) (C)	60S	26.9	20S	11.0	20S	9.6	40S	13.0	*Sr* 2+7b+	*Lr* 3+10+13+	*Yr* 2+
26	PBW 590 (C)	5MS	1.2	10S	1.4	20S	5.0	100S	58.9	*Sr* 5+31+	*Lr* 1+23+26+	*Yr* 9+

Sr. No.	Variety	RUST RESPONSE (HIGHEST SCORE AND ACI)								Postulated Gene		
		South				North						
		STEM		LEAF		LEAF		STRIPE				
		HS	ACI	HS	ACI	HS	ACI	HS	ACI	*Sr*	*Lr*	*Yr*
27	PBW 644 (C)	10S	5.0	10MS	1.1	20S	4.4	80S	37.3	*Sr* 2+	*Lr* 1+13+	*Yr* 2+
28	PBW 660 (I) (C)	10S	1.4	10S	1.4	20MS	3.3	20MS	3.8	*Sr* 5+31+	*Lr*3+26+	*Yr* 9+, R
29	PDW 233 (C)	40S	7.1	5MS	1.5	10S	3.6	20S	5.5	*Sr* 2+9e+	*Lr* 23+	-
30	PDW 291 (C)	40S	10.0	30S	9.5	10MS	2.5	20MS	4.1	*Sr* 9e+	*Lr* 23+	-
31	PDW 314 (C)	60S	18.4	30S	7.8	10S	2.1	20MS	2.9	*Sr* 9e+	*Lr* 23+	*Yr* 2+
32	WH 1021 (C)	30S	4.4	20S	3.2	20S	11.0	100S	53.3	*Sr* 2+31+	*Lr* 1+26+	*Yr* 9+
33	WH 1080 (C)	40S	11.0	30S	8.1	20S	8.8	40S	20.3	*Sr* 2+9e+	*Lr* 13+	*Yr* 2+
34	WH 1105 (C)	40S	9.8	40S	12.0	20S	5.2	20S	6.6	*Sr* 11+	*Lr* 13+	*Yr* 2+
35	WH 1124 (I) (C)	60S	21.1	20S	3.8	10S	4.0	60S	21.8	*Sr* 2+7b+	*Lr* 10+13+	*Yr* 2+
III. NORTH EASTERN PLAIN ZONE												
36	BRW 3723	40S	8.3	40S*	5.8	20S	6.0	100S	44.0	*Sr* 9b+11+	*Lr* 13+	*Yr* 2+
37	DBW 107	20S	4.8	40S	8.5	5S	3.0	40S	19.2	*Sr* 31+	*Lr* 3+26+	*Yr* 9+
38	HD 3118	40S	8.3	20S	4.3	10S	6.0	40S	14.8	*Sr* 9b+11+	*Lr* 13+	*Yr* 2+
39	K 1114	30S	8.3	40S*	6.9	60S	22.0	100S	57.8	*Sr* 2+11+	*Lr* 13+	*Yr* 2+
40	C 306 (C)	60S	20.9	60S	28.9	40S	28.0	80S	25.4	-	-	-
40. A	INFECTOR	100S	63.3	100S	87.1	80S	70.0	100S	83.3			
41	DBW 14 (C)	60S	9.1	20S	4.0	10S	4.6	100S	43.3	*Sr* 2+	*Lr* 23+	-
42	DBW 39 (C)	5S	2.0	20S	2.9	15S	4.7	60S	30.6	*Sr* 31+	*Lr* 1+23+26+	*Yr* 9+
43	HD 2733 (C)	20MS	5.1	20S	7.0	20S	6.0	100S	67.8	*Sr* 31+	*Lr* 26+34+	*Yr* 9+18+
44	HD 2888 (C)	10S	1.8	5S	0.7	5S	2.0	60S	26.5	*Sr* 24+	*Lr* 24+	*Yr* 2+
45	HD 2985 (C)	80S	15.0	40S	15.0	40S	28.0	100S	55.6	*Sr* 7b+	*Lr* 10+13+	*Yr* 2+
46	HI 1563 (C)	40MS	5.2	5S	0.8	40S	14.8	100S	61.1	*Sr* 2+	R	*Yr* 2+
47	K 0307 (C)	40S	10.7	60S	12.9	20S	10.0	80S	45.0	*Sr* 2+	*Lr* 1+23+	*Yr* 2+
48	K 1006 (I) (C)	30S	8.2	60S	13.3	40S	12.0	80S	36.1	*Sr* 8a+9b+11+	*Lr* 10+23	*Yr* 2+
49	K 8027 (C)	80S	19.8	60S	28.0	70S	26.8	100S	59.4	*Sr* 2+11+	*Lr* 13+	*Yr* 2+
50	NW 2036 (C)	30S	6.6	20S	6.3	60S	17.4	100S	63.3	*Sr* 31+	*Lr* 23+26+	*Yr* 9+
51	NW 5054 (I) (C)	60S	18.9	40S	12.3	30S	8.1	80S	36.4	*Sr* 7b+	*Lr* 23+	*Yr* 2+
IV. CENTRAL ZONE												
52	DBW 110	40S	6.9	20S	2.9	20S	6.4	80S	38.9	R	*Lr* 10+13+	*Yr* 2+
53	HI 8736 (D)	20S	4.2	60S*	10.9	10S	4.4	60S	10.5	*Sr* 11+	*Lr* 23+	*Yr* 2+

Sr. No.	Variety	RUST RESPONSE (HIGHEST SCORE AND ACI)								Postulated Gene		
		South				North						
		STEM		LEAF		LEAF		STRIPE				
		HS	ACI	HS	ACI	HS	ACI	HS	ACI	*Sr*	*Lr*	*Yr*
54	HI 8737 (D)	10S	3.4	5S	1.6	0	0.0	10S	4.4	*Sr* 9e+	*Lr* 23+	*Yr* 2+
55	MP 3382	30S	5.9	20S	9.0	40S	19.0	100S	46.1	*Sr* 9b+11+	*Lr* 3+13+	*Yr* A+
56	NIAW 1885	60MS	20.5	40S	14.6	30S	10.0	100S	54.4	*Sr* 7b+	*Lr* 10+23+	*Yr* 2+
57	PBW 689	40S	8.3	10S	2.6	10MS	1.6	80S	27.9	*Sr* 9b+11+	*Lr* 10+13+	*Yr* 2+
58	A 9-30-1 (D) (C)	80S	42.7	100S	58.6	30S	6.4	100S	83.3	*Sr* 11+	*Lr* 23+	-
59	GW 322 (C)	10S	3.2	20S	4.7	40S	14.8	100S	67.8	*Sr* 2+11+	*Lr* 13+	*Yr* 2+
60	HD 2864 (C)	40S	6.7	20MR	2.4	60S	19.0	100S	67.8	*Sr* 8a+11+	R	*Yr* 2+
60. A	INFECTOR	100S	61.1	100S	88.6	80S	66.0	100S	83.3			
61	HD 2932 (C)	80S	14.2	40S	22.7	60S	20.0	100S	66.7	-	*Lr* 13+	-
62	HI 1500 (C)	20S	3.2	5S	1.3	10S	2.0	80S	47.8	*Sr* 24+	*Lr* 24+	*Yr* 2+
63	HI 1544 (C)	20S	3.7	10MS	1.2	20S	7.8	100S	71.8	*Sr* 2+ R	*Lr* 24+	*Yr* 2+
64	HI 8498 (D) (C)	20S	5.4	10S	3.7	10S	4.4	80S	11.2	*Sr* 2+11+	*Lr* 23+	*Yr* 2+
65	HI 8627 (D) (C)	20S	4.1	20S	3.7	5S	2.0	20S	3.3	-	*Lr* 13+	-
66	MP 3288 (C)	30S	4.7	20MR	2.3	20S	8.8	80S	27.8	*Sr* 24+	*Lr* 24+	*Yr* 2+
67	MP 3336 (C)	20S	3.3	20S	5.8	20S	13.0	100S	55.0	-	-	*Yr* 2+
68	MP 4010 (C)	40S	6.5	15MS	2.3	60S	26.0	100S	58.9	*Sr* 2+24+	*Lr* 24+	*Yr* 2+
69	MPO 1215 (d) (C)	30S	4.8	10S	2.9	10S	3.6	20S	5.8	*Sr* 11+	*Lr* 23+	-
V. PENINSULAR ZONE												
70	NIAW 1994	30MS	8.9	20S	5.8	10S	3.0	100S	71.1	*Sr* 9b+11+	*Lr* 1+23+	*Yr* A+
71	UAS 347	40S	12.4	30MS	7.6	10MR	1.3	80S	38.9	*Sr* 2+7b+11+	*Lr* 23+	*Yr* 2+
72	UAS 446 (D)	40S	11.4	20S	5.7	0	0.0	20MS	2.9	*Sr* 2+11+	*Lr* 23+	*Yr* 2+
73	AKDW 2997-16(d) (C)	30S	6.7	20S	8.3	40S	9.6	60S	12.0	*Sr* 7b+	-	-
74	HD 3090 (I) (C)	10MR	1.1	10MS	1.7	30S	10.0	100S	60.6	*Sr* 2+31+	*Lr* 1+26+	*Yr* 9+
75	MACS 6222 (C)	20MS	3.0	20S	3.4	60S	14.8	60S	36.4	*Sr* 31+	*Lr* 1+26+	*Yr* 9+27+
76	MACS 6478 (C)	20S	7.0	30S	7.8	40S*	8.0	70S	40.0	-	*Lr* 23+	*Yr* 2+
77	NI 5439 (C)	40S	16.5	80S	47.1	60S	20.0	100S	80.9	*Sr* 11+	-	*Yr* 2+
78	NIAW 1415 (C)	5S	1.7	10S	2.0	10MS	2.4	80S	54.7	*Sr* 31+	*Lr* 26+	*Yr* 9+
79	NIDW 295 (d) (C)	20S	4.5	30S	7.1	20S	4.0	10S	2.2	*Sr* 2+9e+12	*Lr* 18+	-
80	Raj 4083 (C)	10S	3.2	40S*	6.3	30S	11.1	100S	43.3	*Sr* 11+	*Lr* 23+	*Yr* 2+
80. A	INFECTOR	100S	65.6	100S	85.7	80S	62.0	100S	84.4			

Sr. No.	Variety	RUST RESPONSE (HIGHEST SCORE AND ACI)								Postulated Gene		
		South				North						
		STEM		LEAF		LEAF		STRIPE				
		HS	ACI	HS	ACI	HS	ACI	HS	ACI	*Sr*	*Lr*	*Yr*
81	UAS 428 (d) (C)	30S	5.2	30MR	4.1	5MS	1.8	20S	4.8	*Sr* 11+	*Lr* 23+	-
VI. SOUTHERN HILLS ZONE												
82	CoW (W) 1 (C)	40S*	5.2	5MS	0.6	30S	8.0	80S	62.9	*Sr* 31+	*Lr* 26+	*Yr* 9+
83	HW 2044 (C)	20MS	2.2	10S	2.9	10MR	1.4	100S	50.6	*Sr* 2+24+	*Lr* 24+	*Yr* 2+
84	HW 5216 (C)	10S	2.3	5S	1.3	20S	12.2	100S	56.1	*Sr* 31+	*Lr* 26+	*Yr* 9+
VII. SPECIAL TRIAL												
85	DDK 1042	20S	2.4	5S	1.3	20S	4.8	60S	28.7	*Sr* 11+	*Lr* 23+	-
86	MACS 5022	30S	4.2	10S	1.7	60S	20.8	60S	37.8	*Sr* 11+	-	*Yr* 2+
87	DDK 1029 (C)	20S	3.5	20MR	1.7	5S	2.0	60S	38.2	*Sr* 11+	-	-
88	HW 1098 (I) (C)	20S	2.7	20MR	1.1	10S	2.2	40S	20.6	*Sr* 11+	-	-
89	Kharchia 65 (C)	60S	27.3	100S	62.6	80S	38.0	100S	83.3	-	-	-
90	KRL 19 (C)	40S	10.9	60S	16.1	90S	40.8	100S	70.0	*Sr* 8b+9b+11+	-	-
91	KRL 210 (C)	60S	19.6	40S	14.1	60S	28.0	40S	17.1	*Sr* 7b+	*Lr* 10+13+	-
92	MACS 2496 (C)	20S	7.2	80S	27.9	20S	6.0	100S	58.9	*Sr* 2+31+	*Lr* 23+26+	*Yr* 9+
93	MACS 2971 (C)	20S	4.7	10S	2.0	60S	13.0	60S	26.9	*Sr* 11+	-	*Yr* 2+
93. A	INFECTOR	100S	61.1	100S	85.7	80S	68.0	100S	83.3			

Table 1.3. Adult plant response of AVT Ist year material against wheat rusts under field conditions (artificial inoculations) during 2013-14

Sr. No.	Variety	RUST RESPONSE (HIGHEST SCORE AND ACI)								Postulated Gene		
		South				North						
		STEM		LEAF		LEAF		STRIPE				
		HS	ACI	HS	ACI	HS	ACI	HS	ACI	*Sr*	*Lr*	*Yr*
I. NORTHERN HILL ZONE												
1	HPW 373	20S	7.8	40MS	7.5	5S	1.0	20S	3.2	*Sr*11+	*Lr*1+10+23+	*Yr*A+
2	HPW 400	20S	5.7	20S	4.9	20S	8.0	40MS	15.7	*Sr*9b+11+	*Lr*13+	*Yr*2+
3	HPW 401	10S	2.3	20S	4.7	10S	2.1	60S	16.0	R	*Lr*13+	*Yr*2+
4	HPW 410	20S	7.3	40S	9.4	10S	2.4	30S	11.7	R	*Lr*13+	*Yr*2+
5	HPW 411	10S	4.6	60S*	9.4	10S	3.0	20S	5.0	*Sr*2+13++	*Lr*1+13+	R
6	HPW 412	20S	2.9	60S	20.0	10S	4.4	60MS	20.1	*Sr*31+	*Lr*1+26+	*Yr*9+A+
7	HS 547	20S	2.8	20S	3.3	10S	2.0	80S	21.9	R	*Lr*1+10+13	*Yr*2+
8	HS 558	40S	12.1	30S	12.8	20S	10.2	80S	30.5	*Sr*9b+11+	*Lr*13+	*Yr*2+
9	HS 562	40S	22.0	60S	15.6	5S	1.8	10S	3.6	*Sr*5+8a+9b+11+	*Lr*23+	*Yr*A+
10	HS 577	30S	5.3	20S	5.8	10MS	1.7	80S	32.9	*Sr*2+7b+11+	*Lr*3+23+	*Yr*2+
11	HS 590	40S	16.9	20S	8.9	10S	4.0	5S	1.1	*Sr*7b+	*Lr*13+	*Yr*A+
12	HS 591	40S	14.0	30S	7.5	5MR	0.4	60S	12.2	*Sr*2+7b+11+	*Lr*10+13+	-
13	HS 592	40S	14.6	15MS	3.0	20S	4.8	10S	1.2	*Sr*9b+11+	*Lr*1+10+13+	R
14	HS 593	20S	6.7	40S*	7.2	10S	3.0	20S	6.6	*Sr*7b+	*Lr*13+	R
15	HS 594	40S	16.6	20S	5.6	0	0.0	20S	2.8	*Sr*2+7b+	*Lr*13+	R
16	HS 595	30S	8.4	5MR	0.3	10S	2.8	40S	13.0	*Sr*2 +9b+11+	*Lr*1+10+13+	*Yr*2+
17	UP 2890	40S	8.0	60S	18.6	10S	5.0	100S	63.8	*Sr*7b+	*Lr*13+	*Yr*2+
18	UP 2891	20S	5.0	20MR	3.3	5S	3.0	100S	65.6	*Sr*2+	R	*Yr*A+
19	VL 976	5S	1.4	20S	5.2	TR	0.0	40MS	10.5	*Sr*2 +31+	*Lr*1+23+26+	*Yr*9+
20	VL 977	10S	2.8	20S	3.0	5S	1.2	80S	27.1	*Sr*31+	*Lr*23+26+	*Yr*9+R
20. A	INFECTOR	100S	54.4	100S	87.1	100S	66.0	100S	83.3			
21	VL 1003	5S	0.8	20S	4.1	0	0.0	20S	5.4	*Sr*31+	*Lr*23+26+	*Yr*9+R
22	VL 1004	40S	7.1	20S	4.5	5S	1.0	60S	16.2	*Sr*2+9b+11+	*Lr*10+23+	R

Sr. No.	Variety	RUST RESPONSE (HIGHEST SCORE AND ACI)								Postulated Gene		
		South				North						
		STEM		LEAF		LEAF		STRIPE				
		HS	ACI	HS	ACI	HS	ACI	HS	ACI	*Sr*	*Lr*	*Yr*
23	VL 3002	20S	7.7	60S	11.5	20S	6.8	20MS	5.6	*Sr*2+13+	*Lr*13+	R
24	VL 3004	20S	4.4	5S	1.5	5S	1.0	30S	7.6	*Sr*31+	*Lr*1+26+	*Yr*9+A+
25	VL 3005	20S	4.9	40S*	6.5	5S	1.2	100S	33.5	*Sr*2+9b+11+	*Lr*23+	*YrA* +
26	VL 3006	20S	5.7	60S	10.3	20S	6.2	100S	45.6	*Sr*2+7b+	*Lr*10+13+	*Yr*2+
II. NORTH WESTERN PLAIN ZONE												
27	DBW 95	40MS	9.9	20S	7.3	10S	2.0	20S	5.8	*Sr*2+9b+11+	*Lr*13+	*Yr*2+
28	DBW 128	20S	8.3	20S	4.1	20MS	3.7	40S	18.9	*Sr*9b+11+	*Lr*13+	*Yr*2+
29	DBW 129	30S	8.0	10MS	2.7	5S	1.0	10S	2.8	*Sr*2+7b	*Lr*10+23+	*Yr* A+
30	HD 3128	30S	7.4	20S	5.8	10S	2.0	80S	28.2	*Sr*2+31+	*Lr*26+	*Yr*9+ R
31	HD 3132	10MS	2.7	10MR	0.9	5S	1.0	40S	15.8	*Sr*7b+	*Lr*10+13+	*Yr* A+
32	HD 3133	20S	3.1	10MS	1.4	0.4	0.2	100S	52.8	*Sr*2+31	*Lr*26+ R	*Yr*9+
33	HD 3139	40S	13.8	20S	4.7	10S	4.8	40S	19.8	*Sr*2+7b	*Lr*23+	*Yr*2+
34	HD 4730	40S	6.9	20MR	2.4	10S	3.6	40S	6.0	*Sr*2+11+	*Lr*23+	*Yr*2+
35	HUW 675	20S	5.1	10MS	1.7	5S	1.4	60MS	11.6	*S*11+13+	*Lr*10+23+	R
36	K 1204	20S	4.4	20S	5.7	20S	4.0	20S	3.6	*Sr*2+11+	*Lr*1+23+	R
37	MP 1277	60S	17.4	20MS	5.2	10MR	0.8	40S	11.8	*Sr*7b+11+	*Lr*10+23+	Yr2+
38	PBW 677	20S	7.5	20S	4.3	10S	2.0	10S	3.1	*Sr*9b+11+	*Lr*23+	*Yr*2+
39	PBW 692	30S	8.7	40S	14.0	30S	6.0	40MS	7.4	*Sr*2+9b+11	*Lr*13+	R
40	PBW 695	30S	11.9	40S	7.4	0	0.0	20S	3.1	*Sr*2+9b+11+	*Lr*23+	*Yr*2+
40. A	INFECTOR	100S	61.1	100S	90.0	100S	72.5	100S	81.1			
41	PBW 697	30S	9.1	20S	5.0	0	0.0	30S	4.9	*Sr*2+9b+11+	R	R
42	PBW 698	40S	13.1	20MS	5.6	5MS	0.8	10S	2.0	*Sr*2+9b+11+	R	R
43	PBW 702	60S	20.9	80S	33.1	40MS	9.4	40MS	6.3	*Sr*9b+11+	*Lr*10+23+	R
44	PBW 703	40S	6.3	20S	4.9	TR	0.0	20S	4.0	R	R	R
45	PBW 706	20S	2.7	10MS	1.1	10S	4.0	30S	11.6	*Sr*9b+11+	*Lr*13+	-

Sr. No.	Variety	RUST RESPONSE (HIGHEST SCORE AND ACI)								Postulated Gene		
		South				North						
		STEM		LEAF		LEAF		STRIPE				
		HS	ACI	HS	ACI	HS	ACI	HS	ACI	*Sr*	*Lr*	*Yr*
46	TL 2995	20S	4.6	5MS	0.6	0	0.0	5S	1.0	-	*Lr* 9+	*Yr* A+
47	UAS 356	80S	16.5	80S	15.4	10S	4.6	60S	22.9	*Sr* 9b+11+	*Lr* 23+	*Yr* 2+
48	WH 1154	80S	24.7	20S	11.3	10S	4.4	40S	18.1	*Sr* 2+11+13+	*Lr* 13+	*Yr* 2+
49	WH 1156	60S	24.3	40S	16.1	10S	2.8	20S	7.5	*Sr* 9b+11+	*Lr* 13+	*Yr* A+
50	WH 1157	60S	12.6	40S	10.6	20S	4.0	10S	1.6	*Sr* 2+9b+11+	*Lr* 10+13+	*Yr* 2+
51	WH 1164	40S	11.1	80S	16.0	10MS	2.0	40S	7.7	*Sr* 2+8a+13	*Lr* 13+	*Yr* 2+
III. NORTH EASTERN PLAIN ZONE												
52	DBW 126	20S	3.8	80S*	13.3	5S	3.0	60S	22.0	*Sr* 7b+5	*Lr* 13+	*Yr* A+
53	DBW 98	40S	19.7	20S	7.4	10S	4.6	30S	12.9	*Sr* 7b+	*Lr* 10+13+	*Yr* A+
54	HD 3127	30S	12.6	20S	5.0	20S	10.1	60MS	23.5	*Sr* 7b+	*Lr* 13+	*Yr* 2+
55	HUW 661	30S	7.0	20S	3.9	20S	7.8	20MS	6.3	*Sr* 30+	*Lr* 1+2a+10+23+	*Yr* 2+
56	HUW 677	40S	5.9	20S	3.9	10S	4.0	80S	34.2	*Sr* 2+	R	*Yr* 2+
57	HUW 679	40S	6.8	10S	3.4	TR	0.0	80S	26.7	*Sr* 31+	*Lr* 1+10+26+	*Yr* 9+
58	PBW 693	40S	7.8	20S	6.3	40S	11.0	80S	33.3	*Sr* 31+	*Lr* 10+26+	*Yr* 9+R
59	PBW 701	60S	8.4	20S	5.2	30S	6.2	80S	33.1	*Sr* 31+	*Lr* 23+26+	*Yr* 9+R
60	PBW 704	20S	4.5	10S	3.9	5S	2.0	100S	45.0	-	-	*Yr* 2+27+
60. A	INFECTOR	100S	61.1	100S	87.1	80S	66.0	100S	84.4			
61	UP 2855	20S	5.2	20S	10.4	20S	8.2	100S	55.0	*Sr* 31+	*Lr* 1+23+26+	*Yr* 9+
62	WH 1132	60S	25.8	20S	9.2	5S	1.4	40S	11.6	*Sr* 7b+	*Lr* 10+13+	*Yr* 2+
IV. CENTRAL ZONE												
63	CG 1010	40S	8.6	60S	14.2	30S	8.2	100S	76.7	*Sr* 2+	R	*Yr* 2+
64	DDW 30 (D)	20S	6.4	10S	3.6	10S	2.0	30S	4.2	*Sr* 2+11+	*Lr* 23+	*Yr* 2+
65	GW 451	20S	4.0	20S	3.6	20S	4.0	100S	70.0	*Sr* 2+7b	R	*Yr* 2+
66	GW 455	20S	3.1	5MR	0.3	40S*	8.0	100S	63.4	*Sr* 7b+	R	*Yr* 2+
67	HD 3146	5MS	1.7	10MS	2.3	30S	8.0	100S	44.6	*Sr* 31+	*Lr* 23+26+	*Yr* 9+
68	HD 4728 (D)	10MS	3.1	30S	6.0	TR	0.0	10S	2.2	*Sr* 11+	*Lr* 23+	R

Sr. No.	Variety	RUST RESPONSE (HIGHEST SCORE AND ACI)								Postulated Gene		
		South				North						
		STEM		LEAF		LEAF		STRIPE				
		HS	ACI	HS	ACI	HS	ACI	HS	ACI	*Sr*	*Lr*	*Yr*
69	HI 8750 (D)	40S	6.2	20MS	4.1	5MR	0.4	20S	4.9	*Sr*11+	*Lr*18+	-
70	HI 8755 (D)	60S	14.3	20S	4.9	10MR	0.8	10MR	0.4	*Sr*2+13+	*Lr*18+	*Yr*2+
71	K 1215	60S	15.7	60S	16.6	20S	5.0	20S	7.4	*Sr*13+	*Lr*23+	*Yr*2+
72	K 1217	20S	6.7	40S	11.9	5MS	1.0	20S	6.6	*Sr*5+31+	*Lr*23+26+	*Yr*9+
73	MACS 3916 (D)	20S	5.4	30S	10.6	20S	5.4	10S	2.7	*Sr*11+	*Lr*23+	*Yr*2+
74	MACS 3927 (D)	40S	13.8	80S*	18.4	40S	14.0	30S	7.3	*Sr*11+	*Lr*18+	R
75	MACS 6604	20S	6.6	40S	10.4	10S	2.0	100S	63.4	*Sr*5+8a+13+	*Lr*23+	*Yr*2+
76	MP 1279	60S	13.3	20S	3.1	30S	6.0	100S	61.1	*Sr*11+13+	*Lr*23+	*Yr*2+
77	NIAW 2030	20S	4.7	10S	1.4	10MR	1.2	80S	61.8	*Sr*11+	*Lr*23+	*Yr*2+
78	UAS 451 (D)	60S	9.2	10S	3.6	0	0.0	40S	5.8	*Sr*11+	-	*Yr*A+
V. PENINSULAR ZONE												
79	DDW 27 (D)	60S	13.0	40S	11.6	10S	2.0	15MR	1.4	*Sr*2+11+	*Lr*18+23+	*Yr*2+
80	HI 8751 (D)	20S	4.1	20MR	2.3	10MR	1.6	20S	5.3	*Sr*2+11+	*Lr*23+	-
80. A	INFECTOR	100S	63.3	100S	87.1	100S	72.0	100S	85.6			
81	HI 8754 (D)	80S	12.6	20S	5.2	20S	5.2	40S	13.9	*Sr*2+11+	Lr23+	*Yr*2+
82	K 1213	40S	9.0	40S	15.1	10S	4.2	100S	61.3	*Sr*8a+11+13+	-	*Yr*2+
83	UP 2864	10MR	0.6	20S	4.6	20S	4.4	100S	46.8	*Sr*2+5+8a+31+	*Lr*23+26+	*Yr*9+
VI. SOUTHERN HILLS ZONE												
84	MACS 6507	30S	9.2	40S	12.3	40S	21.0	80S	47.8	*Sr*8a+11+	*Lr*13+	*Yr*2+
85	UAS 358	20S	8.2	60S	15.6	20S	5.6	60S	35.7	*Sr*31+	*Lr*10+26+	*Yr*9+A+
VII. SPECIAL TRIAL (Dicoccum and Sailinity and Alkalinity)												
86	DBW 154	20S	3.2	20S	6.4	20S	7.2	100S	46.7	*Sr*31+	*Lr*26+	*Yr*9+
87	DBW 155	80S	21.9	10S	2.1	20S	5.8	80S	28.5	*Sr*11+	*Lr*23+	*Yr*2+
88	MACS 5040	60S	9.2	20S	3.4	40S	12.0	80S	44.7	*Sr*11+	*Lr*20+	*Yr*2+
89	MACS 5031	40S	5.8	5MR	0.4	20S	4.4	40S	22.8	*Sr*11+	-	-
90	DDK 1046	30S	3.6	20S	3.4	10S	3.8	60S	33.7	*Sr*11+	*Lr*20+	*Yr*2+

Sr. No.	Variety	RUST RESPONSE (HIGHEST SCORE AND ACI)								Postulated Gene		
		South				North						
		STEM		LEAF		LEAF		STRIPE				
		HS	ACI	HS	ACI	HS	ACI	HS	ACI	*Sr*	*Lr*	*Yr*
91	DDK 1044	20S	3.2	5S	1.0	20S	4.0	60S	30.0	*Sr*9e+	-	-
92	HW 1099	20S	3.2	20MR	1.1	80S	17.6	40S	22.4	*Sr*11+	*Lr*13+10+	R
III. SPECIAL TRIAL (TRITICALE)												
93	TL 2996	5MR	0.5	5MS	0.7	0	0.0	20MS	3.1	*Sr*11+	-	-
94	TL 2997	80S	14.0	40S	9.9	15S	3.0	20MR	1.9	-	*Lr*13+	-
95	TL 2998	20S	3.7	10MS	1.9	TR	0.0	10MR	0.7	R	*Lr*13+	-
96	TL 2999	5S	1.0	5MS	0.6	10MR	0.8	10MR	0.9	*Sr*2+R	-	-
97	TL 3000	20S	3.4	10S	2.0	0	0.0	40S*	5.3	*Sr*2+R	-	-
98	TL 2942 (C)	5S	0.7	5MS	0.6	0	0.0	5MR	0.4	*Sr*2+R	-	-
99	TL 2969 (C)	20S	2.8	10MS	2.1	0	0.0	10MS	1.4	*Sr*2+R	*Lr*23+	-
IV. SPECIAL TRIAL (MABB/NIL ENTRIES)												
100	PBW 722	60S	12.2	10S	2.9	5MS	0.8	20MS	2.9	*Sr*2+11+13+	R	R
100. A	INFECTOR	100S	58.9	100S	85.7	80S	60.0	100S	86.7			
101	PBW 723	20MS	2.9	10MR	0.6	0	0.0	10S	3.3	*Sr*2+R	R	R
102	KB 2012-13	80S	19.0	80S	31.1	60S	20.2	100S	55.0	*Sr*11+13+	*Lr*23+	*Yr*2+
103	HD 2932+*Sr*26	30MR	2.2	60S	29.4	80S*	22.8	100S	54.0	*Sr*26+	*Lr*3+	*Yr*2+
104	HD 2932+*Lr*19/*Sr*25	5MS	1.7	5MS	1.0	0	0.0	100S	57.8	*Sr*2+25+	*Lr*19+	*Yr*2+
105	MMBL 283	60S	12.1	40S	11.1	5S	3.4	100S	39.6	*Sr*11+	*Lr*13+	*Yr*2+
106	HUW 234 (C)	80S	16.8	60S	27.4	40S	12.0	100S	54.4	*Sr*11+	*Lr*14a+	*Yr*2+
107	PBW 343 (C)	40S	7.6	40S	17.7	30S	8.1	100S	58.9	*Sr*2+31+	*Lr*26+	*Yr*9+27+

Table 1.4. Adult plant response of NIVT material against wheat rusts under field conditions (artificial inoculations) during 2013-14

Sr. No.	Variety	RUST RESPONSE (HIGHEST SCORE AND ACI)							
		South				North			
		STEM		LEAF		LEAF		STRIPE	
		HS	ACI	HS	ACI	HS	ACI	HS	ACI
NIVT 1A									
1	PBW 708	20S	7.2	5MR	0.3	10S	2.0	50S	16.9
2	HD 3153	10MS	2.4	5MS	1.1	10S	4.0	20S	10.4
3	DBW 137	30MS	5.0	TMS	0.1	5S	1.4	80S	24.0
4	DBW 140	20S	7.4	10MS	2.8	5S	3.8	80S	22.1
5	NW 6029	20MS	4.4	10MS	2.3	5S	1.0	30S	7.7
6	RAJ 4373	10S	2.2	10S	3.8	TR	0.0	80S	32.3
7	K 1302	5MR	0.6	10MS	1.4	10S	5.4	40S	13.9
8	NW 6036	20MR	1.6	30S	11.1	20S	7.2	40S	12.7
9	JKW 203	20S	7.6	40S	12.1	10S	4.0	20S	2.2
10	HUW 680	10S	5.1	20MS	4.0	5S	2.0	40S	8.7
11	DBW 139	20MR	2.5	40S	13.4	20S	5.8	100S	63.3
12	HUW 681	10S	3.6	10MS	3.1	10MS	4.0	20S	8.9
13	WH 1172	10MS	2.7	20S	4.7	10S	2.0	0	0.0
14	UP 2873	TR	0.1	20S	3.5	10S	2.0	40S	9.9
15	BRW 3750	10S	2.2	20S	3.0	5MR	0.4	40S	10.6
16	BRW 3742	5S	2.2	20S	5.8	20S	8.0	10S	2.1
17	HD 3158	10S	2.3	20S	4.6	20S	4.0	60S	19.1
18	HD 3151	15S	6.6	60S	12.9	10S	2.0	20MS	4.6
19	UP 2874	15MS	3.0	40S	17.0	10S	6.0	100S	53.3
20	JKW 193	10MS	2.5	40S*	6.1	20S	4.0	80S	13.3
20. A	INFECTOR	100S	47.3	100S	85.7	80S	72.0	100S	78.9
21	HD 3156	20MS	4.0	20S	4.9	5S	1.0	40S	13.9
22	PBW 709	20MS	4.0	20S	4.9	5MR	0.4	60S	14.1
23	DBW 134	20S	4.1	20S	3.4	5MR	0.4	60S	14.3
24	RAJ 4376	20S	7.0	60S*	9.4	20S	4.0	10S	3.4
25	RAJ 4377	20S	4.4	20S	8.4	10S	4.4	80S	45.6
26	DBW 138	10S	2.5	40S*	5.9	40S	8.4	40S	14.3
27	WH 1169	10S	2.5	80S*	11.6	10MS	3.2	0	0.0
28	HD 3157	20S	6.7	80S	16.3	40S	10.4	30S	9.6
29	WH 1168	20MS	7.4	40S	14.5	40S	11.8	80S	33.8
30	HD 3155	20S	8.8	60S	14.1	20S	7.0	40S	8.0
31	RAJ 4375	30MS	8.8	10S	3.4	10S	3.0	20S	5.6
32	RAJ 4374	10S	2.9	5MR	0.3	5S	1.2	80S	45.1
33	DBW 135	40S	7.5	10MS	1.1	5S	1.0	10S	2.8
34	PBW 710	10MS	4.8	60S	12.9	5MR	0.4	40S	8.7
35	WH 1170	5S	1.6	10MS	1.1	5MR	0.4	40S	7.8
36	HD 3152	10S	3.5	40S	7.4	20S	4.4	80S	41.1
37	PBW 707	40S	8.9	60S	16.1	5S	1.8	30S	5.7
38	PBW 711	20S	8.0	60S	12.3	20S	5.6	20S	5.3
39	HD 3154	10S	3.3	60S	10.3	5S	1.8	60S	28.3
40	K 1301	10S	1.8	20S	4.3	10MR	1.2	40S	14.4
40. A	INFECTOR	100S	55.6	100S	90.0	80S	68.0	100S	78.9
41	UP 2875	10S	2.2	TR	0.0	10S	3.0	40S	14.2
42	WH 1171	70MS	12.8	60S	10.2	30S	10.4	40S	11.6
43	UP 2877	20S	2.6	60S*	8.8	30S	7.8	80S	28.4
44	DBW 136	5MR	0.5	40S*	5.8	20S	4.0	40S	13.9

Sr. No.	Variety	RUST RESPONSE (HIGHEST SCORE AND ACI)							
		South				North			
		STEM		LEAF		LEAF		STRIPE	
		HS	ACI	HS	ACI	HS	ACI	HS	ACI
45	UP 2876	20S	2.7	40S*	5.7	30S	7.0	80S	19.2
NIVT 1B									
46	BRW 3748	10S	4.7	60S*	9.1	20S	5.2	30S	8.0
47	DBW 143	40S	14.6	10MS	2.0	20S	4.0	40S	20.6
48	HUW 686	20S	6.3	20S	7.7	40S	9.4	40S	13.9
49	DBW 145	5S	0.8	60S*	9.2	10MR	0.8	60MS	17.4
50	HUW 685	40MS	7.6	60S	12.8	10S	4.0	20MS	4.3
51	WH 1173	40S	13.1	40S	9.0	60S	18.4	60S	20.6
52	HD 3159	20S	5.7	60S	10.7	20S	5.4	40S	17.2
53	HD 3162	20S	11.7	40S	11.5	10S	2.0	80S	38.9
54	NW 6025	10S	1.8	60S	10.1	5S	1.0	80S	35.6
55	NW 6023	10S	1.8	80S	13.0	10S	2.1	40S	18.0
56	K 1306	20S	4.9	80S	13.4	20S	4.4	60S	36.9
57	PBW 714	5S	1.0	80S*	11.9	10S	2.4	20S	3.1
58	HD 3160	30S	8.7	20S	6.7	20S	4.0	10MS	1.3
59	PBW 712	20S	7.3	60S	25.6	10S	6.0	0	0.0
60	UP 2878	15MS	2.8	60S	10.1	10S	2.0	100S	36.7
60. A	INFECTOR	100S	54.4	100S	84.3	80S	64.0	80S	73.3
61	WH 1175	20S	8.7	5S	0.8	40S*	9.4	20S	4.0
62	UP 2879	5MS	0.7	10S	2.0	TR	0.0	100S	47.8
63	NW 6033	5S	1.1	40S	6.9	10MS	2.6	80S	22.2
64	BRW 3743	20S	5.1	60S	11.0	5MR	0.8	30MS	5.7
65	DBW 144	40S	7.3	80S	14.9	10S	3.0	80S	29.5
66	DBW 141	20MR	2.6	15MS	3.1	10S	3.0	60MS	10.8
67	DBW 142	40S	14.5	60S	34.4	40S	16.0	100S	55.6
68	NW 6031	20S	7.9	20S	3.9	0	0.0	60S	26.9
69	WH 1174	60S	19.7	40S	12.6	10S	3.2	20S	6.9
70	KDW 2010	20S	4.2	10S	4.3	TR	0.1	100S	45.4
71	Ankur BW 249	60MS	17.6	20S	12.3	5S	1.4	100S	44.7
72	BRW 3747	10S	4.3	20S	3.6	40S*	8.0	40S	11.6
73	K 1305	20MS	4.7	20S	3.7	10MS	2.0	60S	24.0
74	K 1304	5S	0.8	10S	1.4	5MR	0.4	20MS	4.0
75	PBW 713	40S	10.1	5S	1.4	10S	3.1	80S	25.1
76	HUW 682	5S	2.5	5S	0.8	30S	8.1	60S	38.9
77	HD 3161	10MR	0.6	20S	3.8	10S	3.4	80S	34.7
78	UP 2880	10S	3.7	20S	11.4	20S	4.2	80S	44.4
79	K 1307	20S	5.7	20S	6.6	60S	14.0	60S	19.6
80	HP 1956	10MS	2.4	60S	16.9	30S	14.0	100S	51.1
80. A	INFECTOR	100S	56.7	100S	85.7	100S	72.0	100S	81.1
81	RAJ 4379	30MS	3.3	40S	14.7	60S	13.4	60S	19.0
82	NW 6028	10S	2.6	20S	3.0	10S	2.2	40S	6.8
83	RAJ 4378	10S	2.5	20S	3.9	10S	4.0	60S	32.2
84	HUW 684	20S	5.6	20S	8.3	0	0.0	40S	14.0
85	K 1308	80MS	30.7	60S	13.4	10MS	2.6	80S	39.6
86	HI 1606	10S	2.2	40S	6.6	20S	8.8	80S	44.4
87	HI 1599	40MS	7.6	20S	6.0	TR	0.0	90S	61.2
88	HP 1957	20S	2.6	20S	3.7	5MR	0.9	90S	56.1
89	HUW 683	20S	2.5	20S	4.0	20S	4.2	90S	41.1
90	RAJ 4380	10S	2.9	20S	3.0	20S	4.0	60S	11.7

Sr. No.	Variety	RUST RESPONSE (HIGHEST SCORE AND ACI)							
		South				North			
		STEM		LEAF		LEAF		STRIPE	
		HS	ACI	HS	ACI	HS	ACI	HS	ACI
NIVT 2									
91	HD 3164	20S	4.5	20S	4.9	60S	32.0	80S	30.0
92	UAS 363	40S	11.8	60S	12.7	60S	12.4	80S	36.0
93	GW 463	10S	2.4	40S*	5.8	10MR	0.8	100S	57.2
94	RVW 4205	20MS	4.3	20S	4.0	5MR	0.4	80S	53.3
95	JWS 530	20S	6.7	40S	21.3	40MS	17.4	100S	66.7
96	GW 461	10S	2.2	20S	4.2	10S	4.0	80S	52.0
97	GW 459	5S	2.7	20MS	5.1	40S	8.8	100S	55.0
98	UAS 361	20S	5.9	60S	16.4	10S	2.4	70S	36.0
99	GW 460	20MS	3.2	10S	2.0	30S	6.8	100S	62.2
100	RAJ 4381	20S	2.8	20S	3.2	10S	4.0	80S	42.2
100. A	INFECTOR	100S	54.4	100S	80.0	100S	76.0	100S	78.9
101	RAJ 4382	20S	3.0	40S	5.7	5S	1.4	80S	28.7
102	UAS 362	10S	3.4	60S	16.7	10S	4.1	100S	54.4
103	DBW 146	10S	3.4	20S	3.0	30S	7.6	100S	52.2
104	HI 1600	10S	2.6	20MS	4.0	40S	12.8	100S	65.6
105	UAS 360	20S	4.6	20S	7.5	30MS	9.6	60S	26.9
106	MP 1296	10S	4.1	80S	27.0	20S	11.0	80S	45.8
107	MP 1297	10S	3.0	5S	1.1	30S	10.0	100S	65.0
108	HI 1602	10S	3.5	20S	3.9	10MR	2.0	80S	45.0
109	MACS 6640	10S	2.4	60S*	10.0	10S	2.5	100S	65.0
110	UP 2881	10S	1.5	20S	3.0	10MR	1.1	100S	46.3
111	HI 1601	10S	2.8	10S	2.4	10S	2.5	100S	66.3
112	MP 3421	10MS	2.3	40S	8.7	10S	2.8	100S	58.3
113	HI 1603	10S	5.4	20S	4.4	10S	3.2	60S	17.7
114	GW 458	20MS	3.6	10S	2.1	20S	4.0	100S	62.9
115	PBW 715	5MS	1.4	20S	4.1	5S	1.0	60S	18.9
116	LOK 72	15MS	3.6	10S	2.3	10S	2.0	40S	15.0
117	MP 1298	10S	3.5	20S	3.6	10MR	0.8	60S	21.7
118	MACS 6632	5S	1.1	10S	1.7	5MR	0.4	40S	28.2
119	AKAW 4730	20S	5.4	80S	28.0	40S	23.2	100S	41.8
120	NIAW 2345	30S	14.2	40S	14.1	10S	4.4	100S	33.3
120. A	INFECTOR	100S	50.0	100S	82.9	80S	75.0	100S	85.0
121	K 1310	5S	1.9	40S	7.0	5MR	0.4	40S	16.1
122	CG 1014	5S	1.9	20S	3.6	10S	2.8	100S	56.7
123	WH 1176	30MS	7.5	20S	3.6	5S	1.0	30S	7.7
124	NIAW 2313	20S	6.3	10S	1.8	10MS	2.4	80S	29.6
NIVT - 3	NIVT 3								
125	HD 3170	10S	4.3	40S*	7.0	10S	3.0	80S	40.0
126	GW 465	TR	0.0	TMS	0.1	10S	4.0	80S	50.7
127	RVW 4204	5S	2.0	20S	6.1	10MR	1.2	100S	51.2
128	HD 3167	10S	2.5	5S	1.7	20MR	1.6	70S	27.9
129	HD 3169	20MS	3.6	40S*	7.2	10MR	1.2	80S	42.9
130	UAS 364	20MS	5.8	60S	11.3	20S	6.0	40S	21.6
131	PBW 718	10S	3.0	40S*	6.4	0	0.0	20S	5.2
132	PBW 716	40S	9.5	20S	3.0	10S	2.0	50S	18.9
133	WH 1178	30MS	8.2	20S	5.9	20S	6.0	60S	34.4
134	WH 1179	40S	21.8	60S	15.6	20S	7.0	30S	4.3
135	HI 1604	30MS	5.8	10S	3.1	10S	4.6	10MR	0.5

Sr. No.	Variety	RUST RESPONSE (HIGHEST SCORE AND ACI)							
		South				North			
		STEM		LEAF		LEAF		STRIPE	
		HS	ACI	HS	ACI	HS	ACI	HS	ACI
136	GW 467	20S	3.6	40S	11.0	5MR	0.5	100S	44.5
137	RAJ 4385	20S	4.0	40S	9.6	5S	1.0	80S	40.6
138	K 1313	10S	3.7	60S*	8.8	20S	6.2	60S	17.2
139	DBW 148	20S	4.1	40S*	5.7	20MS	5.2	60S	11.2
140	UP 2884	5S	0.9	20S	4.0	5S	1.3	80S	32.2
140. A	INFECTOR	100S	54.4	100S	84.3	100S	72.0	100S	77.8
141	DBW 151	30S	12.9	60S	10.3	20S	7.6	60S	23.3
142	MP 1299	20MR	2.0	10S	4.1	30S	7.6	100S	65.6
143	UP 2885	20S	3.1	40S*	6.3	10S	4.0	100S	55.6
144	HUW 688	20S	4.3	40S	8.1	30S	6.0	40S	15.0
145	HI 8756 (d)	20S	5.9	40S	7.1	TR	0.0	60S	23.3
146	WH 1177	10S	5.3	20S	8.0	10S	2.0	80S	37.8
147	NW 6024	20S	5.4	60S*	9.6	5S	1.0	30S	6.9
148	UP 2882	10S	1.9	40S	7.0	20S	6.0	100S	53.4
149	RAJ 4384	10S	2.9	40S	7.5	10S	3.0	100S	47.8
150	MP 3420	10MS	2.4	20S	4.8	10S	2.4	100S	51.1
151	UP 2883	20S	2.8	80S*	11.9	10S	3.0	40S	18.1
152	DBW 147	40MS	7.7	10S	3.6	5MR	0.5	40S	14.7
153	MP 1300	5S	2.4	20S	2.9	10S	2.4	60S	26.4
154	PBW 717	20S	5.4	5S	1.1	30S	10.2	60S	29.4
155	AKAW 4843	10S	3.4	10MS	3.1	5S	1.0	100S	76.7
156	K 1312	10S	3.4	20S	4.1	10S	4.0	20MS	2.3
157	CG 1015	30S	8.0	30S	11.3	10S	4.6	100S	50.0
158	BRW 967	60S	19.9	40S	17.0	30S	6.8	80S	28.4
159	K 1314	20S	8.7	20S	8.2	40S	10.8	20S	7.1
160	HUW 687	20S	2.6	40S	6.9	40S	9.0	100S	32.3
160. A	INFECTOR	100S	54.4	100S	82.9	80S	72.0	100S	81.1
161	HD 3166	20S	4.5	40S	7.8	10S	2.0	100S	64.0
162	HD 3168	5S	1.0	10S	2.3	5S	1.2	60S	22.1
163	HD 3165	40S	12.8	60S	12.0	10S	2.0	40S	12.0
164	RAJ 4383	10S	4.2	40S	7.5	20S	5.4	60S	24.7
165	NIAW 2304	20MS	5.2	10MS	2.6	30S	6.4	100S	73.3
166	GW 466	10S	2.2	10S	2.1	10MR	1.4	100S	56.2
167	DBW 150	30S	4.5	15S	4.3	0	0.0	40S	18.9
168	DBW 149	30S	10.6	80S	27.0	80S	27.6	30S	4.3
169	PBW 719	10S	1.9	30S	6.7	20S	4.4	40S	7.9
NIVT - 4	**NIVT 4**								
170	PDW 341	20S	6.1	30S	9.6	10S	3.0	5S	1.0
171	WHD 955	40S	7.2	30S	8.7	10S	2.0	10S	1.1
172	PDW 339	20MR	1.7	20S	6.8	20S	5.0	10MS	0.9
173	GW 1310	10S	2.9	10S	3.1	5MR	0.4	20S	2.7
174	HI 8759	20MS	3.2	20S	4.1	5S	1.2	20MS	3.6
175	PDW 340	30S	9.6	30S	11.3	20S	4.2	10S	2.7
176	HI 8761	10S	3.3	10S	2.6	5MR	0.4	10S	2.7
177	UAS 452	20MS	5.0	20S	4.3	0	0.0	10S	2.7
178	RKD 280	30MS	3.2	30MS	7.6	10S	3.0	40S	17.1
179	HI 8757	40MS	11.2	20S	8.1	5S	2.0	20S	6.2
180	MPO 1302	40S	11.2	80S	16.5	40S	14.8	30S	12.7
180. A	INFECTOR	100S	54.4	100S	81.4	100S	66.0	100S	81.1

Sr. No.	Variety	RUST RESPONSE (HIGHEST SCORE AND ACI)							
		South				North			
		STEM		LEAF		LEAF		STRIPE	
		HS	ACI	HS	ACI	HS	ACI	HS	ACI
181	UAS 453	30MS	6.1	10MS	2.1	20S	4.4	20S	3.1
182	HI 8758	10MS	2.0	10S	2.7	20S	4.8	20MS	4.6
183	RKD 279	10MS	3.9	20MS	5.0	15S	4.0	60S	20.0
184	PBND 5128	20S	3.6	20S	6.1	10S	2.4	40S	7.5
185	NIDW 841	40MR	3.0	20S	5.6	5S	1.0	10S	2.5
186	NIDW 842	60S	14.7	30S	8.7	0	0.0	30S	4.9
187	HI 8760	30MR	3.4	30MS	5.2	5MR	0.8	20MS	6.1
188	HD 4732	30MS	5.3	10MS	2.9	5MR	0.6	20S	5.9
189	UPD 96	30S	11.4	30S	7.3	0	0.0	10S	3.2
190	PDW 342	30S	4.4	10S	4.3	5MR	0.4	20S	4.4
191	HD 4731	20MR	3.0	20S	5.9	5S	1.0	20S	8.3
192	GW 1311	30MR	3.9	10MS	1.6	10S	3.0	20MS	6.0
193	MACS 4024	10S	2.4	10MS	1.4	10S	2.4	20MS	3.7
194	DDW 31	20S	3.8	20S	5.7	20S	4.8	20S	4.1
195	GW 1308	20S	5.4	40S	9.6	10MS	3.4	20S	8.1
196	MACS 3949	10S	3.0	20S	6.4	10S	2.0	10S	2.9
197	WHD 956	20S	5.7	20S	7.9	5S	1.0	5MS	0.5
198	DDW 32	60S	12.9	40S	8.1	20S	5.4	10S	1.3
199	GW 1309	20MS	2.5	30MR	3.6	10S	2.4	40MS	6.0
200	MPO 1301	30MR	3.6	10S	2.8	0	0.0	100S	49.0
200. A	INFECTOR	100S	55.6	100S	87.1	100S	72.0	100S	77.8
201	MACS 4023	30MS	4.5	10S	2.8	10MS	2.5	80S	23.6
NIVT - 5A	**NIVT 5A**								
202	HD 3171	20S	6.1	20S	8.1	15S	4.0	20S	7.8
203	UP 2887	20S	7.5	40S	11.6	30MS	10.8	100S	52.3
204	HD 3174	40S	14.0	20S	3.8	50S	12.0	30S	9.4
205	MP 1290	15S	4.8	20S	5.0	TR	0.0	80S	25.5
206	MP 1293	10MS	3.6	40S	12.9	10S	4.0	80S	68.9
207	HUW 689	10S	5.5	5S	0.8	10S	3.0	20S	5.2
208	WH 1166	40MS	11.8	20S	7.9	10S	2.0	40S	18.8
209	UP 2886	20S	5.3	10MS	2.6	10S	4.0	80S	50.0
210	MACS 6648	20S	5.3	40S	17.1	60S	22.0	100S	61.7
211	K 1316	20S	11.1	20S	7.0	40S	16.8	100S	40.0
212	CG 1012	20S	2.9	10S	2.6	10S	2.0	100S	50.7
213	UAS 365	20MS	4.0	20S	3.8	10S	2.0	80S	42.2
214	K 1315	20S	5.3	20S	6.0	5MR	0.6	60S	20.4
215	HI 1605	30S	7.4	30S	9.0	5S	1.0	40S	15.8
216	RAJ 4386	10S	2.6	20S	5.1	20S	7.8	100S	42.8
217	PBW 720	10S	2.9	10MS	1.1	10S	2.0	20S	4.0
218	PBW 721	20S	8.1	5S	2.5	0	0.0	20S	8.2
219	WH 1167	70MS	16.9	20S	7.0	10S	2.8	20S	2.8
220	MP 3424	40S	13.6	80S	44.6	20S	5.0	100S	56.5
220. A	INFECTOR	100S	52.2	100S	85.7	80S	72.0	100S	83.3
221	NIAW 2325	20S	4.7	10S	1.4	40S	8.8	100S	68.9
222	BRW 3753	30S	13.0	40S	10.7	TR	0.0	20S	6.2
223	MP 1291	40S	15.6	80S	57.1	30MS	9.8	80S	35.8
224	HD 3173	40S	12.8	40S	11.8	10S	2.4	60S	21.7
225	JWS 712	20S	5.8	20MR	2.7	10S	2.0	60S	23.3
226	DBW 153	5S	1.0	10S	1.4	10MR	0.8	30S	10.0

Sr. No.	Variety	RUST RESPONSE (HIGHEST SCORE AND ACI)							
		South				North			
		STEM		LEAF		LEAF		STRIPE	
		HS	ACI	HS	ACI	HS	ACI	HS	ACI
227	K 1317	20S	3.5	10S	1.4	10S	4.1	30S	7.6
228	MACS 6607	20S	6.9	20S	6.3	40S*	8.4	100S	61.1
229	NW 6035	20S	4.9	20S	3.6	10S	2.9	40S	13.2
230	DBW 152	30MS	6.0	10S	4.0	10MS	1.6	40S	13.2
231	HD 3172	10S	2.7	20S	4.7	10MR	1.2	40S	14.3
232	MP 1292	30S	8.3	60S	23.4	0	0.0	100S	73.3
233	JAUW 621	20S	6.9	40S	7.3	40S	13.0	100S	33.3
NIVT - 5B	**NIVT 5B**								
234	UAS 455	20MS	6.1	20MS	4.9	10S	2.8	0	0.0
235	GW 1313	30MS	5.2	20MR	1.9	60S*	12.0	100S	55.2
236	RKD 268	10MS	2.9	10S	3.4	10MR	0.8	20MS	1.8
237	HI 8764	20MR	1.3	20S	3.4	10S	2.1	15MR	0.7
238	RKD 270	30S	5.0	20S	4.8	10MR	0.8	80S	26.6
239	MACS 3972	40MR	2.9	40S	10.7	10S	3.2	20S	3.3
240	HI 8762	10MS	2.7	10S	2.9	TR	0.0	20MS	3.6
240. A	INFECTOR	100S	56.7	100S	87.1	100S	72.0	100S	81.1
241	MACS 3970	40MS	7.6	40S	11.8	5S	1.0	10MS	0.9
242	HI 8765	10MS	2.9	10S	4.9	10S	2.2	10MS	2.0
243	MPO 1294	30S	7.9	60S	17.1	30S	7.8	20S	6.4
244	DDW 34	40S	13.4	20S	5.3	20S	4.0	5MS	0.9
245	GW 1316	30S	12.8	20S	9.3	10MR	1.2	100S	69.1
246	NIDW 765	10MS	2.7	10S	4.3	30S	8.0	20MS	2.3
247	GW 1315	5S	2.7	20S	4.3	5MR	0.4	100S	72.2
248	MACS 4020	10S	3.0	40S	9.8	5S	1.8	60S	14.1
249	MPO 1295	40MS	7.4	20S	6.0	5S	1.8	60S	13.6
250	KD 1318	40MS	9.5	20S	5.5	20S	6.4	40S	8.0
251	UAS 454	5S	1.4	5S	1.7	40S	10.6	10S	1.1
252	GW 1314	10S	3.6	20S	6.5	10S	4.8	40S	6.9
253	HI 8766	10MR	0.8	10S	3.9	5S	2.7	20MS	3.0
254	HI 8763	20S	3.7	20S	4.3	20S	5.1	40MS	15.0
255	GW 1317	20S	4.9	30S	10.1	10MR	0.9	40S	14.4
256	DDW 33	30MS	7.5	10MS	3.4	10S	2.0	TS	0.1
IVT									
I. NORTHERN HILL ZONE									
257	VL 2010	10S	4.6	5MS	1.1	10S	6.0	40S	8.9
258	VL 2007	20S	3.9	20S	10.3	10S	4.0	10S	1.9
259	HS 587	10S	4.0	5S	1.0	20S	4.1	10S	4.9
260	HPW 406	20S	7.6	10S	2.7	10S	4.0	60S	17.3
260. A	INFECTOR	100S	52.2	100S	82.9	80S	66.0	100S	81.1
261	HS 583	40S	15.1	5S	1.6	20S	4.1	40MS	14.2
262	VL 2008	10S	3.2	15MS	3.7	5S	1.0	20S	6.4
263	HPW 405	10S	4.7	20S	6.4	10S	4.0	20S	5.9
264	HS 584	30S	13.4	5S	2.1	20S	4.0	10MS	1.0
265	HS 585	20S	6.8	0.5	0.1	5MR	0.4	20MS	5.9
266	HS 586	10S	4.5	TMS	0.1	5MS	0.8	20S	8.2
267	VL 2012	30MS	8.4	20S	4.3	20S	4.0	80S	10.4
268	UP 2888	10S	1.6	20S	3.7	TR	0.1	80S	38.3
269	HPW 403	5MR	0.4	20S	3.0	10S	2.8	0	0.0
270	VL 2011	20S	4.1	5MR	0.4	20S	11.0	40MS	8.2

Sr. No.	Variety	RUST RESPONSE (HIGHEST SCORE AND ACI)							
		South				North			
		STEM		LEAF		LEAF		STRIPE	
		HS	ACI	HS	ACI	HS	ACI	HS	ACI
271	UP 2889	50MS	12.0	20S	5.1	40S	14.0	30S	11.5
272	HPW 409	5S	0.8	40S*	5.9	10S	3.8	40S	12.9
273	HPW 408	10MR	0.8	20S	5.7	10S	2.0	60MS	11.0
274	HS 581	70MR	7.4	5MS	0.7	5S	1.0	20S	6.4
275	HPW 407	10S	1.9	5S	0.9	10MR	0.9	60S	15.3
276	VL 2009	20S	2.8	40S*	6.5	10S	3.6	20S	9.9
277	HS 582	20MS	6.0	10S	2.7	10S	2.8	15MR	3.2
278	HPW 404	10S	4.6	40S	8.1	10S	4.4	20S	9.0
II. SOUTHERN HILLS ZONE									
279	HW 3620	10MS	2.1	15MS	3.1	10MR	0.8	80S	31.8
280	HW 5801	15MS	2.4	10MS	1.9	10S	3.0	80S	34.0
280. A	INFECTOR	100S	54.4	100S	88.6	80S	66.0	100S	81.1
281	HS 589	5MR	0.5	0	0.0	20S	5.6	100S	45.6
282	HW 5049	20MR	1.2	5S	1.5	30S	7.0	80S	66.7
283	UAS 368	5S	0.8	5S	1.8	10S	2.0	80S	40.0
284	HW 3608	5S	0.8	TMR	0.1	20S	5.0	80S	58.9
285	HW 3627	10MS	1.7	0	0.0	10S	3.0	90S	38.9
286	HW 5802	10MR	0.9	TR	0.0	20MS	3.2	60S	28.9
287	HW 3607	10MS	3.6	15MS	1.7	30S	7.0	20S	7.1
288	HW 3906	10S	2.6	5MS	0.6	10S	4.0	100S	58.4
289	UAS 367	20S	4.2	20S	3.0	10MR	0.8	100S	54.4
290	HW 4215-1	10S	1.8	40S*	7.0	10MR	1.2	80S	38.9
291	HW 5047	5S	1.2	TS	0.1	10S	2.0	60S	32.2
292	HW 5048	5MR	0.4	5MS	0.6	20S	5.0	100S	38.3
III. SPECIAL TRIAL (Wheat Biofortification)									
293	SPL-WB-HD 3175	10S	4.4	15S	4.1	10S	4.8	60S	23.7
294	SPL-WB-HD 3176	10MR	0.9	40S	9.9	10S	3.0	100S	58.7
295	SPL-WB-HD 3177	10MS	2.5	20S	4.3	20S	4.4	100S	65.6
296	SPL-WB-HD 3178	10S	6.2	20S	5.7	40S	11.2	80S	55.6
297	SPL-WB-HD 3179	40S	12.2	20S	4.3	5S	1.0	80S	59.1
298	SPL-WB-HPBW 01	30S	10.2	15S	3.9	10S	3.6	5S	1.1
299	SPL-WB-HPBW 02	20S	10.0	20S	3.8	10S	6.8	5S	1.0
300	SPL-WB-HPBW 03	20S	5.2	30S	10.6	10S	2.0	30S	10.2
300. A	INFECTOR	100S	52.2	100S	88.6	80S	60.0	100S	84.4
301	SPL-WB-HPBW 04	15MS	2.5	TS	0.1	10S	3.0	10MS	2.0
302	SPL-WB-HPBW 05	40X	8.1	20S	5.8	10S	2.6	20MS	6.5
303	SPL-WB-HPBW 06	40X	9.7	60S	14.3	10MR	1.0	30S	10.4
304	SPL-WB-HUW-694	20S	6.0	10S	1.4	5S	1.3	30S	4.0
305	SPL-WB-HUW-695	20S	6.2	15S	2.3	10MR	1.0	30S	4.9
306	SPL-WB-HUW-696	10MS	3.8	10S	2.1	10S	5.1	20MS	4.7
307	SPL-WB-WB-01	10S	5.0	15MS	3.1	0	0.0	10S	2.8
308	SPL-WB-WB-02	20S	7.9	20S	4.3	5S	1.3	20MS	6.1
309	SPL-WB-WB-03	30S	12.9	20S	7.3	10S	2.8	40MS	12.9
310	SPL-WB-WB-04	60S	15.1	20S	6.7	10MR	1.0	30S	6.8
311	SPL-WB-WB-05	30MR	5.2	10S	2.1	10S	3.5	20S	5.6
311. A	INFECTOR	100S	56.7	100S	85.7	100S	70.0	100S	85.6

PROGRAMME 2. RUSTS: BROWN, YELLOW AND BLACK

RACE SPECIFIC APR

AVT entries were evaluated at specific locations for Race Specific Adult Plant Resistance (APR) to three rusts (brown, black and yellow).

Locations:

Brown rust - New Delhi, Ludhiana and Flowerdale (under controlled conditions)

Black rust- Indore, Pune, Powarkheda and Mahabaleshwar (under controlled conditions) and Flowerdale (under controlled conditions)

Yellow rust – Ludhiana, New Delhi and Flowerdale (under controlled conditions)

Stripe rust development was erratic at Delhi so data was not considered. Stem rust data of Powarkheda against leaf rust pathotype (40A) was not considered due to poor development of disease. Leaf rust data of Ludhiana was not considered due to poor disease development.

Mahabaleshwar centre evaluated AVT-II entries of CZ and PZ against black rust pathotypes under controlled conditions (Table 2.4).
The following pathotypes were used for these studies at the respective locations.

1. *P. recondita tritici* : 77-5, 104-2
2. *P. graminis tritici* : 40 A, 117-6
3. *P. striiformis* : 46 S 119, 78 S 84

Table 2.1: APR response of AVT IInd and Ist year entries to individual races of *Puccinia striiformis tritici*

		46 S 119	78 S 84
Sr. No.	Variety	Ludhiana	Ludhiana
AVT IInd Year			
I. NORTHERN HILL ZONE			
1	HPW 376	20MS	40MS
2	VL 967	10MS	20MS
3	HPW 251 (C)	80S	100S
4	HPW 349 (C)	10MS	10S
5	HS 277 (C)	80S	80S
6	HS 375 (C)	60S	80S
7	HS 490 (C)	10S	20MS
8	HS 507 (C)	5MS	5MR
9	HS 542 (I) (C)	5S	40S
10	VL 804 (C)	60S	60S
11	VL 829 (C)	60S	60S
12	VL 892 (C)	60S	100S
13	VL 907 (C)	20S	40MS
II. NORTH WESTERN PLAIN ZONE			
14	HUW 666	40MS	10S
15	PBW 681	0	TS
16	WH 1129	5S	10S
17	WH 1138	10S	5S
18	WH 1142	10S	10MS
19	DBW 88 (I) (C)	20MS	5MS
20	DBW 90 (I) (C)	10S	5MS
20. A	INFECTOR	80S	100S
21	DPW 621-50 (C)	20MS	20MS
22	HD 2967 (C)	5S	40S
23	HD 3043 (C)	40S	60MS
24	HD 3059 (C)	20MS	20MS
25	HD 3086 (I) (C)	10MS	20MS
26	PBW 590 (C)	80S	100S
27	PBW 644 (C)	40S	60S
28	PBW 660 (I) (C)	5S	5S
29	PDW 233 (C)	10MS	10MS
30	PDW 291 (C)	20MS	10S
31	PDW 314 (C)	10MS	5MS
32	WH 1021 (C)	80S	100S
33	WH 1080 (C)	20MS	20MS
34	WH 1105 (C)	5MS	5MS
35	WH 1124 (I) (C)	40S	10MS
III. NORTH EASTERN PLAIN ZONE			
36	BRW 3723	60MS	100S
37	DBW 107	40MS	60S
38	HD 3118	40MS	10MS

Sr. No.	Variety	46 S 119 Ludhiana	78 S 84 Ludhiana
39	K 1114	80S	100S
40	C 306 (C)	40S	80S
40. A	INFECTOR	80S	100S
41	DBW 14 (C)	60S	60S
42	DBW 39 (C)	20MS	60MS
43	HD 2733 (C)	80S	80S
44	HD 2888 (C)	40S	60S
45	HD 2985 (C)	80S	80S
46	HI 1563 (C)	80S	100S
47	K 0307 (C)	60S	60S
48	K 1006 (I) (C)	60S	60S
49	K 8027 (C)	80S	100S
50	NW 2036 (C)	80S	80S
51	NW 5054 (I) (C)	60MS	60S
IV. CENTRAL ZONE			
52	DBW 110	40S	60S
53	HI 8736 (D)	10MS	5MS
54	HI 8737 (D)	10MS	10MS
55	MP 3382	60S	100S
56	NIAW 1885	80S	100S
57	PBW 689	40S	60S
58	A 9-30-1 (D) (C)	80S	100S
59	GW 322 (C)	80S	80S
60	HD 2864 (C)	80S	80S
60. A	INFECTOR	100S	100S
61	HD 2932 (C)	80S	80S
62	HI 1500 (C)	60S	80S
63	HI 1544 (C)	80S	100S
64	HI 8498 (D) (C)	10S	5MS
65	HI 8627 (D) (C)	20MS	10MS
66	MP 3288 (C)	60S	80S
67	MP 3336 (C)	80S	100S
68	MP 4010 (C)	80S	80S
69	MPO 1215 (d) (C)	20S	0
V. PENINSULAR ZONE			
70	NIAW 1994	80S	80S
71	UAS 347	40S	20MS
72	UAS 446 (D)	10MS	5MS
73	AKDW 2997-16(d) (C)	10MS	10MS
74	HD 3090 (I) (C)	80S	100S
75	MACS 6222 (C)	80S	10S
76	MACS 6478 (C)	60S	60S
77	NI 5439 (C)	80S	100S
78	NIAW 1415 (C)	80S	60MS
79	NIDW 295 (d) (C)	0	5MS
80	Raj 4083 (C)	60S	80S
80. A	INFECTOR	100S	80S

Sr. No.	Variety	46 S 119 Ludhiana	78 S 84 Ludhiana
81	UAS 428 (d) (C)	5S	10MS
VI. SOUTHERN HILLS ZONE			
82	CoW(W) 1 (C)	80S	60S
83	HW 2044 (C)	80S	80S
84	HW 5216 (C)	60S	80S
VII. SPECIAL TRIAL			
85	DDK 1042	-	
86	MACS 5022	60S	60MS
87	DDK 1029 (C)	40MS	40MS
88	HW 1098 (I) (C)	-	-
89	Kharchia 65 (C)	80S	100S
90	KRL 19 (C)	80S	80S
91	KRL 210 (C)	10MS	20MS
92	MACS 2496 (C)	80S	80S
93	MACS 2971 (C)	20MS	60MS
93. A	INFECTOR	80S	80S
AVT Ist Year			
I. NORTHERN HILL ZONE			
1	HPW 373	0	0
2	HPW 400	40S	5MS
3	HPW 401	60S	40MS
4	HPW 410	10S	10MS
5	HPW 411	10MS	10MS
6	HPW 412	20MS	40S
7	HS 547	60S	60S
8	HS 558	40S	60S
9	HS 562	10MS	0
10	HS 577	60S	80S
11	HS 590	0	0
12	HS 591	0	0
13	HS 592	0	0
14	HS 593	10MS	10MS
15	HS 594	5MS	0
16	HS 595	10MS	10MS
17	UP 2890	80S	80S
18	UP 2891	60MS	60MS
19	VL 976	40MS	20MS
20	VL 977	60MS	60S
20. A	INFECTOR	80S	100S
21	VL 1003	40MS	20MS
22	VL 1004	40MS	60S
23	VL 3002	20S	40S
24	VL 3004	10S	0
25	VL 3005	60S	60S
26	VL 3006	80S	100S
II. NORTH WESTERN PLAIN ZONE			
27	DBW 95	5S	10MS
28	DBW 128	40MS	20MS
29	DBW 129	0	5MS

Sr. No.	Variety	46 S 119 Ludhiana	78 S 84 Ludhiana
30	HD 3128	80MS	80S
31	HD 3132	10MS	10S
32	HD 3133	80S	100S
33	HD 3139	60MS	60MS
34	HD 4730	5S	10MS
35	HUW 675	10MS	20MS
36	K 1204	0	10MS
37	MP 1277	20MS	20MS
38	PBW 677	0	0
39	PBW 692	10S	40S
40	PBW 695	0	5MS
40. A	INFECTOR	80S	100S
41	PBW 697	40MS	40MS
42	PBW 698	0	0
43	PBW 702	0	40S
44	PBW 703	0	0
45	PBW 706	10S	40MS
46	TL 2995	0	0
47	UAS 356	10S	40MS
48	WH 1154	10S	40S
49	WH 1156	5S	10S
50	WH 1157	0	5MS
51	WH 1164	10MS	10MS
III. NORTH EASTERN PLAIN ZONE			
52	DBW 126	10S	40MS
53	DBW 98	10MS	20MS
54	HD 3127	60MS	60S
55	HUW 661	10MS	10S
56	HUW 677	5MS	5MS
57	HUW 679	40MS	80S
58	PBW 693	60MS	80S
59	PBW 701	60MS	80S
60	PBW 704	80S	80S
60. A	INFECTOR	80S	100S
61	UP 2855	60S	100S
62	WH 1132	20S	40MS
IV. CENTRAL ZONE			
63	CG 1010	80S	100S
64	DDW 30 (D)	5MS	5MR
65	GW 451	100S	100S
66	GW 455	100S	100S
67	HD 3146	80S	100S
68	HD 4728 (D)	5MS	0
69	HI 8750 (D)	20MS	10MS
70	HI 8755 (D)	10MS	0
71	K 1215	40MS	10MS
72	K 1217	10S	5MS
73	MACS 3916 (D)	0	5MS
74	MACS 3927 (D)	0	0
75	MACS 6604	100S	100S

Sr. No.	Variety	46 S 119 Ludhiana	78 S 84 Ludhiana
76	MP 1279	100S	100S
77	NIAW 2030	100S	80S
78	UAS 451 (D)	5S	5MS
V. PENINSULAR ZONE			
79	DDW 27 (D)	5S	10MS
80	HI 8751 (D)	10MS	40MS
80. A	INFECTOR	100S	100S
81	HI 8754 (D)	20MS	40MS
82	K 1213	80S	100S
83	UP 2864	80S	100S
VI. SOUTHERN HILLS ZONE			
84	MACS 6507	80S	80S
85	UAS 358	60S	60S
VII. SPECIAL TRIAL (Dicoccum and Sailinity and Alkalinity)			
86	DBW 154	60S	80S
87	DBW 155	20MS	20MS
88	MACS 5040	60MS	40MS
89	MACS 5031	40S	40MS
90	DDK 1046	40MS	40MS
91	DDK 1044	60MS	60MS
92	HW 1099	20MS	40MS
III. SPECIAL TRIAL (TRITICALE)			
93	TL 2996	0	0
94	TL 2997	5MR	5MR
95	TL 2998	10MR	5MR
96	TL 2999	0	0
97	TL 3000	10MR	10MR
98	TL 2942 (C)	5MR	5MS
99	TL 2969 (C)	5MR	5MR
IV. SPECIAL TRIAL (MABB/NIL ENTRIES)			
100	PBW 722	0	5MS
100. A	INFECTOR	100S	100S
101	PBW 723	5S	10S
102	KB 2012-03	80S	80S
103	HD 2932+Sr26	80S	100S
104	HD 2932+Lr19/Sr25	80S	100S
105	MMBL 283	80S	100S
106	HUW 234 (C)	80S	100S
107	PBW 343 (C)	100S	100S
107. A	INFECTOR	100S	100S

Table 2.2: APR response of AVT IInd and Ist year entries to individual races of *Puccinia graminis tritici*					
		40A		117-6	
Sr. No.	Variety	Indore	Pune	Indore	Pune
AVT IInd Year					
I. NORTHERN HILL ZONE					
1	HPW 376	50MSS	30S	50MSS	30S
2	VL 967	20X	10MR	40X	30MR
3	HPW 251 (C)	40MR	10MR	40MR	10MR
4	HPW 349 (C)	20MSS	60S	50MSS	60S
5	HS 277 (C)	5R	20MR	5R	30MR
6	HS 375 (C)	5MR	10MR	10MR	20MR
7	HS 490 (C)	20MR	0	TR	0
8	HS 507 (C)	10R	5MR	5MR	5MR
9	HS 542 (I) (C)	5MS	0	TR	10MR
10	VL 804 (C)	5MR	0	TMR	10MR
11	VL 829 (C)	10R	0	TMR	0
12	VL 892 (C)	TMS	0	20MSS	10MR
13	VL 907 (C)	5R	10MR	TMR	0
II. NORTH WESTERN PLAIN ZONE					
14	HUW 666	TMR	0	10X	TR
15	PBW 681	5MR	10MR	30MSS	40MR
16	WH 1129	10X	10MR	30X	10MR
17	WH 1138	50S	30S	40MSS	30S
18	WH 1142	40MR	40S	40X	40S
19	DBW 88 (I) (C)	TMR	30MR	10X	20MR
20	DBW 90 (I) (C)	50S	30MR	40X	20MR
20. A	INFECTOR	100S	80S	100S	80S
21	DPW 621-50 (C)	TR	40MS	5S	40S
22	HD 2967 (C)	30S	30MS	20MSS	30MR
23	HD 3043 (C)	20MS	40MR	10MSS	60S
24	HD 3059 (C)	TMR	30MS	5MSS	10MR
25	HD 3086 (I) (C)	60S	60S	60MSS	10MR
26	PBW 590 (C)	5MR	20MR	5X	TR
27	PBW 644 (C)	5S	5MR	15MSS	20S
28	PBW 660 (I) (C)	40MSS	5MR	5MR	20S
29	PDW 233 (C)	40MSS	30MS	20MSS	60S
30	PDW 291 (C)	30MSS	40MR	30MSS	5MR
31	PDW 314 (C)	80S	40MS	80MSS	30MR
32	WH 1021 (C)	5MR	20MR	30MR	30MR
33	WH 1080 (C)	50MR	30MS	50X	20MS
34	WH 1105 (C)	30MSS	30S	30S	40MS
35	WH 1124 (I) (C)	60S	60S	50X	10MR
III. NORTH EASTERN PLAIN ZONE					
36	BRW 3723	30MSS	40MS	40S	5MR
37	DBW 107	30MSS	30MR	40MR	10MR
38	HD 3118	20MR	30MR	40S	40MS
39	K 1114	5MS	30MS	40S	10MR
40	C 306 (C)	60S	60S	50S	40S
40. A	INFECTOR	100S	90S	100S	80S
41	DBW 14 (C)	20MS	40MS	30X	20MR
42	DBW 39 (C)	TR	30MR	40MSS	10MR
43	HD 2733 (C)	20X	40MR	30MR-TS	5MR

Sr. No.	Variety	40A		117-6	
		Indore	Pune	Indore	Pune
44	HD 2888 (C)	5MR	10MR	0	5MR
45	HD 2985 (C)	40MSS	40MS	40MSS	20MR
46	HI 1563 (C)	5R	0	5MR	TR
47	K 0307 (C)	30MSS	30MR	30MSS	10MR
48	K 1006 (I) (C)	20MSS	20MR	10MS	20MR
49	K 8027 (C)	30S	30MSS	40S	30S
50	NW 2036 (C)	10X	20MR	40MR	5MR
51	NW 5054 (I) (C)	50MSS	30MS	60MSS	10MR
IV. CENTRAL ZONE					
52	DBW 110	10MR	0	TR	TR
53	HI 8736 (D)	20MS	40MR	15MS	20MSS
54	HI 8737 (D)	10MS	30MR	40MSS	10MR
55	MP 3382	40S	20S	60MSS	0
56	NIAW 1885	80S	30S	60S	30MS
57	PBW 689	20X	40MR	0	10MR
58	A 9-30-1 (D) (C)	60MSS	60S	80MSS	80S
59	GW 322 (C)	TR	20MR	30MSS	5MR
60	HD 2864 (C)	50MR	30MR	40X	10MR
60. A	INFECTOR	100S	80S	100S	80S
61	HD 2932 (C)	50X	40MS	60MSS	40MR
62	HI 1500 (C)	TMR	10MR	TMR	5MR
63	HI 1544 (C)	TR	5MR	5R	5MR
64	HI 8498 (D) (C)	10X	20MR	10MSS	10MRMS
65	HI 8627 (D) (C)	10MS	10MR	20MSS	10MR
66	MP 3288 (C)	40MR	20MR	20X	TR
67	MP 3336 (C)	5R	10MR	20MSS	0
68	MP 4010 (C)	10MR	20MR	10MS	10MR
69	MPO 1215 (d) (C)	30MS	20MR	30MSS	20S
V. PENINSULAR ZONE					
70	NIAW 1994	40MS	40MS	30S	10MR
71	UAS 347	30X	40MS	40MSS	10MR
72	UAS 446 (D)	40S	20MR	40MSS	30S
73	AKDW 2997-16(d) (C)	40S	10MR	30MSS	30S
74	HD 3090 (I) (C)	10MR	20MR	10MR	10MR
75	MACS 6222 (C)	10MR	10MR	TMR	5MR
76	MACS 6478 (C)	15MSS	40MRMS	15MSS	20MR
77	NI 5439 (C)	30MSS	30MS	40MSS	60S
78	NIAW 1415 (C)	10MR	20MR	30S	5MR
79	NIDW 295 (d) (C)	30MR	20MR	30MSS	40S
80	Raj 4083 (C)	10MR	20MR	20MSS	20MR
80. A	INFECTOR	100S	80S	100S	80S
81	UAS 428 (d) (C)	10MSS	30MS	30S	60S
VI. SOUTHERN HILLS ZONE					
82	CoW(W) 1 (C)	20MR	20MR	TMR	5MR
83	HW 2044 (C)	20R	5MR	TMR	10MR
84	HW 5216 (C)	10MR	20MR	5MR	5MR
VII. SPECIAL TRIAL					
85	DDK 1042	0	10MR	TS	20MR
86	MACS 5022	5S	10MR	30S	10MR
87	DDK 1029 (C)	0	10MR	5MSS	10MR

Sr. No.	Variety	40A Indore	40A Pune	117-6 Indore	117-6 Pune
88	HW 1098 (I) (C)	0	20MR	0	5MR
89	Kharchia 65 (C)	80MSS	80S	40S	80S
90	KRL 19 (C)	40X	40MR	30MSS	30MR
91	KRL 210 (C)	80S	40MS	50MSS	40S
92	MACS 2496 (C)	20MR	20MR	30MR	20MR
93	MACS 2971 (C)	10MR	20MR	5MR	10MR
93. A	INFECTOR	100S	80S	100S	80S
AVT Ist Year					
I. NORTHERN HILL ZONE					
1	HPW 373	10MSS	40MS	20MSS	10MR
2	HPW 400	30X	40MR	50S	20MR
3	HPW 401	TR	5MR	TR	TR
4	HPW 410	40MSS	TR	5MR	5MR
5	HPW 411	30X	30MR	15X	5MR
6	HPW 412	20MR	20MR	20MR	10MR
7	HS 547	20R	20MR	TMR	5MR
8	HS 558	40X	40MR	40X	20MR
9	HS 562	80S	60S	50S	20MS
10	HS 577	0	TR	TR	10MR
11	HS 590	50MSS	40S	40S	30MS
12	HS 591	40S	40MS	30S	20MS
13	HS 592	30MSS	40MS	40S	10MR
14	HS 593	20X	20MR	30X	10MR
15	HS 594	50MSS	40S	20S	30S
16	HS 595	10X	40MS	10X	40MS
17	UP 2890	10X	5MR	10MR	5MR
18	UP 2891	40MR	10MR	30MR	20MR
19	VL 976	0	5MR	5MR	5MR
20	VL 977	TR	5MR	5MS	30S
20. A	INFECTOR	100S	80S	100S	80S
21	VL 1003	0	0	TMR	TR
22	VL 1004	30MSS	5MR	5MS	40MR
23	VL 3002	5S	0	TMR	5MR
24	VL 3004	TR	5MR	TMR	TR
25	VL 3005	5X	10MR	5MR	TR
26	VL 3006	30MSS	20MR	TS	20MS
II. NORTH WESTERN PLAIN ZONE					
27	DBW 95	5MSS	30MS	40S	40MS
28	DBW 128	40MSS	40S	30S	30S
29	DBW 129	40MSS	30S	10S	40MR
30	HD 3128	20X	40MR	40MSS	40MMS
31	HD 3132	40MS	10MR	20X	20MS
32	HD 3133	10X	5MR	10MR	10MR
33	HD 3139	10S	30MS	20S	30MS
34	HD 4730	30S	40MR	30MSS	30MS
35	HUW 675	20MR	20MR	5MR	30MS
36	K 1204	10MS	10MR	10MR	30S
37	MP 1277	30MSS	40MS	60MSS	60S
38	PBW 677	40MSS	40S	15S	30MRMS
39	PBW 692	10X	30MR	30X	30MR
40	PBW 695	15S	40S	40S	40MS

Sr. No.	Variety	40A		117-6	
		Indore	Pune	Indore	Pune
40. A	INFECTOR	100S	90S	100S	80S
41	PBW 697	20MS	40MRMS	10MS	20MR
42	PBW 698	30MS	30MR	40MSS	30MR
43	PBW 702	40MR	40MR	40MSS	30MR
44	PBW 703	40MR	20MR	30MR	20MR
45	PBW 706	0	20MR	20X	20MR
46	TL 2995	5S	20MRMS	10S	10MR
47	UAS 356	40MSS	40MR	50MSS	20MR
48	WH 1154	80S	40S	50MSS	30MS
49	WH 1156	50S	60S	60S	40S
50	WH 1157	50S	40S	50MSS	40S
51	WH 1164	TR	5MR	0	5MR
III. NORTH EASTERN PLAIN ZONE					
52	DBW 126	TS	20MR	5MR	10MR
53	DBW 98	60S	40S	50MSS	30S
54	HD 3127	40MSS	40S	50S	30S
55	HUW 661	5MR	30MR	5MR	10MR
56	HUW 677	20MR	10MR	15MR	5MR
57	HUW 679	30X	20MR	TR	10MR
58	PBW 693	30MSS	20MR	40MR	20MR
59	PBW 701	20MSS	20MR	20MR	5MR
60	PBW 704	TMR	20MR	30S	20MR
60. A	INFECTOR	100S	80S	100S	80S
61	UP 2855	0	20MR	10MR	10MR
62	WH 1132	60S	40MRMS	40MSS	30MR
IV. CENTRAL ZONE					
63	CG 1010	10MR	40MR	TMR	5MR
64	DDW 30 (D)	30MSS	40MR	15S	20S
65	GW 451	0	20MR	10MR	TR
66	GW 455	5MR	5MR	30MSS	5MR
67	HD 3146	TMR	30MR	30MSS	10MR
68	HD 4728 (D)	20X	40S	40X	30S
69	HI 8750 (D)	10MR	5MR	30S	5MR
70	HI 8755 (D)	40MSS	30MRMS	60MSS	30S
71	K 1215	40S	40S	50S	40S
72	K 1217	5MR	20MR	40MR	10MR
73	MACS 3916 (D)	40MSS	30MR	80S	30S
74	MACS 3927 (D)	40MSS	20MRMS	80S	20S
75	MACS 6604	30X	20MR	40MSS	5MR
76	MP 1279	10S	30MS	60MSS	30S
77	NIAW 2030	10MR	10MR	10MR	10MR
78	UAS 451 (D)	50MSS	20MR	60S	30S
V. PENINSULAR ZONE					
79	DDW 27 (D)	40X	30MR	60S	40S
80	HI 8751 (D)	5MR	10MR	10S	10MR
80. A	INFECTOR	100S	80S	100S	80S
81	HI 8754 (D)	40S	30S	40MSS	30S
82	K 1213	5X	30MRMS	20X	10MR
83	UP 2864	5R	20MR	20MR	10MR
VI. SOUTHERN HILLS ZONE					
84	MACS 6507	30MSS	20MR	20MR	5MR

Sr. No.	Variety	40A		117-6	
		Indore	Pune	Indore	Pune
85	UAS 358	5MS	20MR	20MR	10MR
VII. SPECIAL TRIAL (Dicoccum and Sailinity and Alkalinity)					
86	DBW 154	30MS	10MR	40MR	5MR
87	DBW 155	50MSS	60S	60MSS	40S
88	MACS 5040	TS	30MS	0	20MR
89	MACS 5031	0	10MR	0	20MR
90	DDK 1046	0	20MS	10X	5MR
91	DDK 1044	0	20MR	10X	10MR
92	HW 1099	0	20MR	TMR	5MR
III. SPECIAL TRIAL (TRITICALE)					
93	TL 2996	5MR	20MR	20MSS	30MS
94	TL 2997	30MSS	40MS	60S	30MS
95	TL 2998	5MR	40MR	30MSS	30MS
96	TL 2999	5X	30MR	50S	10MS
97	TL 3000	20MSS	40MS	40MSS	20MS
98	TL 2942 (C)	TMR	10MR	10S	20MS
99	TL 2969 (C)	5MR	30MR	15S	10MR
IV. SPECIAL TRIAL (MABB/NIL ENTRIES)					
100	PBW 722	20X	40MS	40MSS	40MR
100. A	INFECTOR	100S	90S	100S	80S
101	PBW 723	40MR	5MR	20MR	5MR
102	KB 2012-03	40MS	40MR	60MSS	20MR
103	HD 2932+Sr26	40X	40MR	50MR	30MR
104	HD 2932+Lr19/Sr25	40X	20MR	30MR	5MR
105	MMBL 283	30MSS	20MR	40S	20MR
106	HUW 234 (C)	20MSS	20MR	60MSS	30MS
107	PBW 343 (C)	60MR	40MR	60MR	10MR
107. A	INFECTOR	100S	80S	100S	80S

Table 2.3: APR response of AVT IInd and Ist year entries to individual races of *Puccinia triticina*

		77-5		104-2
Sr. No.	**Variety**	**Delhi**	**Powerkheda**	**Delhi**
AVT IInd Year				
I. NORTHERN HILL ZONE				
1	HPW 376	5R	TR	TR
2	VL 967	TR	0	TR
3	HPW 251 (C)	TR	10S	10MS
4	HPW 349 (C)	5R	R	TR
5	HS 277 (C)	5MR	5MS	20MS
6	HS 375 (C)	TMR	R	10MR
7	HS 490 (C)	0	15MS	TR
8	HS 507 (C)	0	10S	0
9	HS 542 (I) (C)	0	0	TR
10	VL 804 (C)	40S	20MS	50S
11	VL 829 (C)	TMR	TR	TMR
12	VL 892 (C)	TR	TR	TR
13	VL 907 (C)	5MR	15MR	TMR
II. NORTH WESTERN PLAIN ZONE				
14	HUW 666	TR	TR	TR
15	PBW 681	TR	0	TR
16	WH 1129	TR	10MS	0
17	WH 1138	20MR	5MR	5MR
18	WH 1142	10MR	0	20MR
19	DBW 88 (I) (C)	TR	R	0
20	DBW 90 (I) (C)	30MS	TR	10MS
20. A	INFECTOR	80S	100S	60S
21	DPW 621-50 (C)	TR	10MS	TR
22	HD 2967 (C)	0	R	TR
23	HD 3043 (C)	5R	0	5MS
24	HD 3059 (C)	TMR	10MS	TR
25	HD 3086 (I) (C)	10MR	10MS	5MR
26	PBW 590 (C)	TR	10S	TR
27	PBW 644 (C)	TR	10MS	0
28	PBW 660 (I) (C)	0	TR	TR
29	PDW 233 (C)	10MR	TR	5R
30	PDW 291 (C)	30MR	10MS	10MR
31	PDW 314 (C)	20MR	0	20MR
32	WH 1021 (C)	TR	0	TR
33	WH 1080 (C)	20MS	TR	20MR
34	WH 1105 (C)	10MS	10MS	5MR
35	WH 1124 (I) (C)	20MR	10MR	5MR
III. NORTH EASTERN PLAIN ZONE				
36	BRW 3723	0	0	TR
37	DBW 107	TR	5MR	5MR
38	HD 3118	TR	TR	TR
39	K 1114	5MR	5MR	TR
40	C 306 (C)	40S	30MS	30S
40. A	INFECTOR	90S	100S	70S
41	DBW 14 (C)	5R	R	5R
42	DBW 39 (C)	TR	R	TR
43	HD 2733 (C)	20MS	0	10MR

Sr. No.	Variety	77-5 Delhi	77-5 Powerkheda	104-2 Delhi
44	HD 2888 (C)	0	0	TR
45	HD 2985 (C)	30MS	10MS	10MR
46	HI 1563 (C)	TR	10MS	TMR
47	K 0307 (C)	5MR	TR	TR
48	K 1006 (I) (C)	TR	TR	5MR
49	K 8027 (C)	50S	30S	50S
50	NW 2036 (C)	5R	R	10MR
51	NW 5054 (I) (C)	10MR	15MS	10MS
IV. CENTRAL ZONE				
52	DBW 110	TR	TR	TR
53	HI 8736 (D)	20MR	R	10R
54	HI 8737 (D)	10MR	0	TMR
55	MP 3382	10MR	0	5MR
56	NIAW 1885	0	15MS	TR
57	PBW 689	TR	10MS	TR
58	A 9-30-1 (D) (C)	30MS	80S	60S
59	GW 322 (C)	0	R	0
60	HD 2864 (C)	TR	0	TR
60. A	INFECTOR	80S	100S	60S
61	HD 2932 (C)	60S	20MS	40S
62	HI 1500 (C)	0	5MS	TR
63	HI 1544 (C)	0	10MS	0
64	HI 8498 (D) (C)	10MR	0	5R
65	HI 8627 (D) (C)	10R	TR	5R
66	MP 3288 (C)	TR	10MR	TR
67	MP 3336 (C)	5R	R	10MR
68	MP 4010 (C)	TR	15MS	TR
69	MPO 1215 (d) (C)	10MR	0	10R
V. PENINSULAR ZONE				
70	NIAW 1994	0	5MS	TR
71	UAS 347	5R	TR	10MR
72	UAS 446 (D)	5R	TR	5R
73	AKDW 2997-16(d) (C)	10MR	0	5R
74	HD 3090 (I) (C)	TR	0	TR
75	MACS 6222 (C)	0	5MS	0
76	MACS 6478 (C)	0	10MR	0
77	NI 5439 (C)	60S	60S	40S
78	NIAW 1415 (C)	TR	0	TR
79	NIDW 295 (d) (C)	10MR	0	5R
80	Raj 4083 (C)	0	R	TR
80. A	INFECTOR	70S	90S	80S
81	UAS 428 (d) (C)	5R	5MS	5R
VI. SOUTHERN HILLS ZONE				
82	CoW(W) 1 (C)	TR	0	TR
83	HW 2044 (C)	TR	0	0
84	HW 5216 (C)	TR	0	TR
VII. SPECIAL TRIAL				
85	DDK 1042	-	-	-
86	MACS 5022	TR	0	0
87	DDK 1029 (C)	5R	0	0

Sr. No.	Variety	77-5 Delhi	77-5 Powerkheda	104-2 Delhi
88	HW 1098 (I) (C)	-	-	-
89	Kharchia 65 (C)	80S	10MS	70S
90	KRL 19 (C)	10MS	R	10MR
91	KRL 210 (C)	10MR	20MS	5MR
92	MACS 2496 (C)	60S	10MS	30MS
93	MACS 2971 (C)	TR	R	TR
93. A	INFECTOR	80S	100S	70S
AVT Ist Year				
I. NORTHERN HILL ZONE				
1	HPW 373	0	TR	0
2	HPW 400	10MS	5MS	5R
3	HPW 401	0	10MS	TR
4	HPW 410	TR	5MR	TMS
5	HPW 411	TR	TR	TMR
6	HPW 412	TR	0	TR
7	HS 547	TR	0	0
8	HS 558	TR	10MS	5MR
9	HS 562	10MR	10MS	10MR
10	HS 577	0	0	0
11	HS 590	0	TR	TR
12	HS 591	5R	TR	TR
13	HS 592	0	15MS	0
14	HS 593	TR	R	0
15	HS 594	0	0	TR
16	HS 595	TR	0	TR
17	UP 2890	10MR	TR	30S
18	UP 2891	TR	10MR	TR
19	VL 976	0	TR	TR
20	VL 977	TR	TR	0
20. A	INFECTOR	70S	80S	80S
21	VL 1003	0	0	TR
22	VL 1004	TR	0	0
23	VL 3002	TMR	5MS	5MR
24	VL 3004	TMR	0	0
25	VL 3005	5R	TR	0
26	VL 3006	5R	5MS	TR
II. NORTH WESTERN PLAIN ZONE				
27	DBW 95	TMR	10MR	5MR
28	DBW 128	5R	5MS	10MR
29	DBW 129	TR	10MS	TR
30	HD 3128	TR	0	10MR
31	HD 3132	TR	0	0
32	HD 3133	TR	0	TR
33	HD 3139	0	TR	TR
34	HD 4730	TR	TR	10R
35	HUW 675	0	10MS	TR
36	K 1204	0	10MS	TR
37	MP 1277	TR	5MS	0
38	PBW 677	TR	10S	TR
39	PBW 692	20S	5MR	30S
40	PBW 695	5R	R	TR

		77-5		104-2
Sr. No.	Variety	Delhi	Powerkheda	Delhi
40. A	INFECTOR	80S	100S	60S
41	PBW 697	0	10MS	TR
42	PBW 698	TR	10MS	TR
43	PBW 702	5MR	40MS	5MR
44	PBW 703	0	R	0
45	PBW 706	0	0	0
46	TL 2995	TR	0	TR
47	UAS 356	TMR	TR	TMR
48	WH 1154	20S	R	10MR
49	WH 1156	TR	10MS	0
50	WH 1157	TR	10MR	5R
51	WH 1164	TMR	R	TR
III. NORTH EASTERN PLAIN ZONE				
52	DBW 126	TMR	R	5MR
53	DBW 98	10MR	10MR	10MR
54	HD 3127	0	15MS	TR
55	HUW 661	TR	R	TMR
56	HUW 677	TR	0	TMR
57	HUW 679	0	0	0
58	PBW 693	0	TR	TR
59	PBW 701	TR	0	TR
60	PBW 704	TR	10MS	0
60. A	INFECTOR	80S	80S	70S
61	UP 2855	TR	15MS	TR
62	WH 1132	20MS	15MS	10MR
IV. CENTRAL ZONE				
63	CG 1010	0	10MS	5MR
64	DDW 30 (D)	10MR	R	5R
65	GW 451	0	0	TR
66	GW 455	0	0	0
67	HD 3146	TR	0	TMR
68	HD 4728 (D)	TR	10MR	5R
69	HI 8750 (D)	20MR	0	5R
70	HI 8755 (D)	10R	TR	5R
71	K 1215	5MR	0	5R
72	K 1217	5MR	0	10MR
73	MACS 3916 (D)	30MR	5MS	10MR
74	MACS 3927 (D)	30MR	10MR	10MR
75	MACS 6604	0	0	TR
76	MP 1279	TR	0	TR
77	NIAW 2030	TMR	0	TMR
78	UAS 451 (D)	TR	10MR	5R
V. PENINSULAR ZONE				
79	DDW 27 (D)	10MR	0	5MR
80	HI 8751 (D)	TR	0	5R
80. A	INFECTOR	70S	80S	60S
81	HI 8754 (D)	TMR	15MR	5MR
82	K 1213	TR	15MS	TR
83	UP 2864	TR	10MS	TR
VI. SOUTHERN HILLS ZONE				
84	MACS 6507	20MR	10MS	5R

		77-5		104-2
Sr. No.	**Variety**	**Delhi**	**Powerkheda**	**Delhi**
85	UAS 358	40MS	5MS	40MS
VII. SPECIAL TRIAL (Dicoccum and Sailinity and Alkalinity)				
86	DBW 154	10R	10MS	10R
87	DBW 155	TR	5MS	0
88	MACS 5040	0	0	0
89	MACS 5031	0	0	0
90	DDK 1046	0	R	5R
91	DDK 1044	TR	R	TR
92	HW 1099	5R	R	TR
III. SPECIAL TRIAL (TRITICALE)				
93	TL 2996	10R	0	5R
94	TL 2997	20MR	0	10MR
95	TL 2998	10R	0	10R
96	TL 2999	TR	0	TR
97	TL 3000	TR	0	TR
98	TL 2942 (C)	0	0	0
99	TL 2969 (C)	0	0	TR
IV. SPECIAL TRIAL (MABB/NIL ENTRIES)				
100	PBW 722	0	0	TR
100. A	INFECTOR	80S	80S	70S
101	PBW 723	TMR	R	TR
102	KB 2012-03	50S	10MS	60S
103	HD 2932+Sr26	50S	10MS	70S
104	HD 2932+Lr19/Sr25	TR	TR	TR
105	MMBL 283	TMR	0	10MR
106	HUW 234 (C)	TR	20MS	TR
107	PBW 343 (C)	30S	20MS	10MR
107. A	INFECTOR	70S	100S	70S
COOPERATORS				
	NAME		**CENTRE**	
(A) BROWN RUST				
	J.B. SHARMA		NEW DELHI	
	MADHU MEETA JINDAL		LUDHIANA	
	K.K. MISHRA		POWARKHEDA	
(B) BLACK RUST				
	B.K. HONRAO		PUNE	
	A.N. MISHRA, PRAKASHA, T.L., K. KAUSHAL,		INDORE	
	K.K. MISHRA		POWARKHEDA	
(C) YELLOW RUST				
	MADHU MEETA JINDAL		LUDHIANA	
	U.D. SINGH, V.K. SINGH		NEW DELHI	

Table 2.4. APR results of AVT genotypes against 40A and 117-6 stem rust pathotypes Under controlled condition at Mahabaleswar

Sr.No.	Genotype	40A	117-6	Sr. No.	Genotype	40A	117-6
AVT - I : Central Zone				**AVT - II : Central Zone**			
1	CG 1010	TS	20S	1	DBW 110	R	10S
2	DDW 30 (D)	40S	40S	2	HI 8736 (D)	R	R
3	GW 451	0	R	3	HI 8737 (D)	40S	20S
4	GW 455	R	R	4	MP 3382	NG	NG
5	HD 3146	20S	30S	5	NIAW 1885	30S	30S
6	HD 4728 (D)	40S	40S	6	PBW 689	0	R
7	HI 8750 (D)	40S	40S	7	A 9-30-1 (D) (C)	R	R
8	HI 8755 (D)	40S	40S	8	GW 322 (C)	10S	40S
9	K 1215	R	R	9	HD 2864 (C)	20S	20S
10	K 1217	0	R	10	INFECTOR	NG	NG
11	MACS 3916 (D)	20S	30S	11	HD 2932 (C)	20S	40S
12	MACS 3927 (D)	40S	60S	12	HI 1500 (C)	20S	40S
13	MACS 6604	R	R	13	HI 1544 (C)	R	R
14	MP 1279	R	R	14	HI 8498 (D) (C)	R	R
15	NIAW 2030	20S	10S	15	HI 8627 (D) (C)	40S	20S
16	UAS 451 (D)	40S	40S	16	MP 3288 (C)	10S	40S
AVT -I:Peninsular Zone				17	MP 3336 (C)	R	R
17	DDW 27 (D)	40S	40S	18	MP 4010 (C)	R	TS
18	HI 8751 (D)	0	R	19	MPO 1215 (d) (C)	30S	40S
19	INFECTOR	60S	60S	**AVT - II : Peninsular Zone**			
20	HI 8754 (D)	30S	40S	20	NIAW 1994	20S	20S
21	K 1213	R	R	21	UAS 347	20S	30S
22	UP 2864	5S	TS	22	UAS 446 (D)	30S	20S
				23	AKDW 2997-16(d) (C)	40S	40S
				24	HD 3090 (I) (C)	R	5S
				25	MACS 6222 (C)	20S	30S
				26	MACS 6478 (C)	R	10S
				27	NI 5439 (C)	0	R
				28	NIAW 1415 (C)	R	5S
				29	NIDW 295 (d) (C)	20S	40S
				30	Raj 4083 (C)	R	40S
				31	INFECTOR	60S	80S
				32	UAS 428 (d) (C)	20S	30S

2.2 IDENTIFICATION OF SLOW RUSTER LINES IN AVT MATERIAL 2013-14

Yellow rust

The delay in progress of epiphytotic development is attributed to several factors including latent period, number of uredosori per unit area, size of uredosori, rate of sporulation, etc. Chances of new variants or pathotypes are minimized due to reduced selection pressure. A convenient option of identifying slow ruster lines is the estimation of the Area Under Disease Progress Curve (AUDPC) which takes into account all the factors collectively leading to manifestation of slow rusting in a genotype. AVT entries were sown in single rows, each of 1 meter length with an interception of the spreader row after every 20th line for identifying the slow ruster lines at Karnal and Mahabaleshwar. For creating a load of inoculum pressure, four rows of mixture of susceptible genotypes were sown as border rows (infector/spreader). The infector/spreader rows were syringe inoculated at growth stage 37 (Zadoks growth scale for cereals) when flag leaf was just emerging out of boot. On appearance of rust pustules on flag leaf, the high humidity was maintained for rust development.

AUDPC was calculated for yellow rust data of Karnal centre and brown rust and stem rust data of Mahabaleshwar centres.

0: It represents high level of resistance controlled by major genes. This type of resistance exerts a strong selection pressure on pathogen, compelling it to mutate, resulting in short field life of a cultivar. Genotypes possessing this kind of resistance should be particularly avoided in inoculum source areas, however, they can be satisfactorily grown in target areas to seek protection against specified pathotypes.

1 - 10: This type of resistance also represents strong vertical resistance as described in group 0. This category includes those entries on which disease initiated as traces of resistant pustules (TR infection type) not exceeding 10R as terminal reaction. It may also not impart a durable protection and is likely to be lost owing to adaptations in the pathogen.

11 - 100: The incipient reaction appears as pustules of moderately susceptible (MS) infection type. Subsequent progression of disease occurs at a quite slower rate as compared to the fast ruster check genotype. Such genotypes possess adult plant resistance (APR) genes in addition to the vertical resistance genes. Such genotypes may exhibit a better field durability than those possessing the vertical resistance genes only.

101 - 200: Genotypes falling in this range of AUDPC truly represent the slow rusters. Disease initiates in the form of susceptible (S) type pustules on these genotypes but subsequent progression remains slower than the fast ruster check. The terminal severity in these genotypes does not exceed 20S as compared to 80 - 100S in fast rusting genotypes. Genotypes belonging to this category carry a long lasting field resistance and must be preferred while breeding to develop cultivars possessing durable resistance.

Entries showing various ranges of AUDPC are shown below:

A. DWR, Karnal

The data of stripe rust intensities recorded at different dates of equal intervals were subjected to AUDPC analysis. Coefficient of Infection (CI) was calculated. Entries were grouped according to their AUDPC values and are described below.

AVT IInd Year 2013-14

0	Nil
1-100	HI 8736 (D), HS 507 (C), HS 542 (I) (C), PBW 660 (I) (C), PBW 681, PDW 314 (C), UAS 446 (D) and WH 1105 (C).
101-200	DPW 621-50 (C), HD 3086 (I) (C), HI 8498 (D) (C), HI 8737 (D), HPW 349 (C), HS 490 (C), MPO 1215 (d) (C), NIDW 295 (d) (C), PDW 291 (C) and UAS 428 (d) (C).
201-500	AKDW 2997-16(d) (C), DBW 107, DBW 39 (C), HD 2967 (C), HD 3043 (C), HD 3059 (C), HD 3118, HI 8627 (D) (C), HPW 376, HUW 666, KRL 210 (C), MP 3288 (C), PDW 233 (C), VL 967,WH 1124 (I) (C) and WH 1129.
501-1000	A 9-30-1 (D) (C), C 306 (C), CoW(W) 1 (C), DBW 110, DBW 14 (C), DBW 88 (I) (C), DBW 90 (I) (C), DDK 1029 (C), DDK 1042, HD 2888 (C), HI 1500 (C), HS 375 (C), K 0307 (C), K 1006 (I) (C), MACS 2496 (C), MACS 2971 (C), MACS 5022, MACS 6222 (C), MACS 6478 (C), MP 3336 (C), MP 3382, NIAW 1415 (C), NW 2036 (C), NW 5054 (I) (C), PBW 644 (C), PBW 689, UAS 347, VL 804 (C), VL 829 (C), VL 892 (C), VL 907 (C), WH 1021 (C), WH 1080 (C), WH 1098 (C), WH 1138 and WH 1142.
>1000	BRW 3723, GW 322 (C), HD 2733 (C), HD 2864 (C), HD 2932 (C), HD 2985 (C), HD 3090 (I) (C), HI 1544 (C), HI 1563 (C), HPW 251 (C), HS 277 (C), HW 2044 (C), HW 5216 (C), K 1114, K 8027 (C), Kharchia 65 (C), KRL 19 (C), MP 4010 (C), NI 5439 (C), NIAW 1885, NIAW 1994, PBW 590 (C) and Raj 4083 (C).

AVT Ist Year 2013-14

0	HI 8755 (D), HS 592, HS 594, PBW 698, PBW 703, PBW 722, TL 2942 (C), TL 2969 (C), TL 2995, TL 2996, TL 2997, TL 2998, TL 2999 and TL 3000.
1-100	DDW 27 (D), DDW 30 (D), HD 4728 (D), HPW 373, HS 590, PBW 697, PBW 702 and PBW 723.
101-200	DBW 129, DBW 95, HS 562, HUW 661, K 1204, MACS 3916 (D), PBW 677, PBW 692, VL 3002, VL 3004 and WH 1157.
201-500	DBW 126, DBW 98, HI 8750 (D), HI 8751 (D), HPW 400, HPW 401, HPW 410, HPW 411, HPW 412, HS 547, HS 591, HS 593, HS 595, HUW 675, HUW 679, K 1215, K 1217, MACS 3927 (D), PBW 695, PBW 706, UAS 358, VL 1003, VL 1004, VL 976, WH 1132, WH 1156 and WH 1164.
501-1000	DBW 128, DBW 154, DBW 155, DDK 1044, DDK 1046, FLW 32-1, FLW 32-2, HD 3127, HD 3128, HD 3132, HD 3139, HD 4730, HI 8754 (D), HS 558, HS 577, HUW 677, KB 2012-03, MACS 5031, MACS 5040, MP 1277, PBW 693, PBW 701, PBW 704, UAS 356, UAS 451 (D), VL 3005, VL 977 and WH 1154.
>1000	CG 1010, FLW 32-3, GW 451, GW 455, HD 2932+Sr26, HD 2932+Lr19/Sr25, HD 3133, HD 3146, HUW 234 (C), K 1213, MACS 6507, MACS 6604, MMBL 283, MP 1279, NIAW 2030, PBW 343 (C), UP 2855, UP 2864, UP 2890, UP 2891 and VL 3006.

B. MAHABALESHWAR

AUDPC based identification of slow rusters

Genotypes showing AUDPC value below 200 for stem and leaf rust at Mahabaleshwar Centre are described below:

AUDPC value	Genotypes
Stem Rust, AVT - I year, 2013-14	
0	VL 1003 and UP 2864 (2)
01 - 100	HPW 401,HPW 411,HPW 412,HS 547,HS 595,VL 976,VL 977,VL 3006,HD 3132, HD 3146,HD 4728(D),TL 2996,TL 2999,TL 2942(C), PBW 723
101 - 200	HPW 373, HPW 410, HS 593, UP 2891, VL 3002, VL 3004, VL 3005, DBW 95, DBW 128, DBW 129, HD 3133, HUW 675, K 1204, PBW 677, PBW 692, PBW 698, PBW 706, TL 2995, DBW 126, HD 3127, PBW 704, UP 2855, DDW 30(D), GW 451, GW 455, K 1217, MACS 3916(D), MACS 6604, MP 1279, NIAW 2030, HI 8751(D), UAS 358, DBW 154, SPL-DIC-05, SPL-DIC-06, SPL-DIC-07, SPL-DIC-08, SPL-DIC-09, SPL-DIC-10, SPL-DIC-11, TL 2998, TL 3000, TL 2969(C), FLW32-1, FLW 32-2 and FLW32-3
Leaf Rust, AVT - I year, 2013-14	
0	Nil
1-100	HPW 373, HPW 400, HPW 401, HPW 410, HPW 411, HS 547, HS 558, HS 562, HS 577, HS 590, HS 591, HS 592, HS 593, HS 594, HS 595, UP 2890, UP 2891, VL 976, VL 977, VL 1003, VL 1004, VL 3002, VL 3004, VL 3005, VL 3006, DBW 95,DBW 128, DBW 129, HD 3128, HD 3132,HD 3133, HD 3139, HD 4730, HUW 675, K 1204, MP 1277, PBW 677, PBW 692, PBW 695, PBW 697, PBW 698, PBW 702, PBW 703, PBW 706, TL2995, UAS 356, WH 1154, WH 1156, WH 1157, WH 1164, DBW 126, DBW 98, HD 3127, HUW 661, HUW 677, HUW 679, PBW 693, PBW 701, PBW 704, UP 2855, WH 1132, CG 1010, DDW 30(D), GW 451, GW 455, HD 3146, HD 4728(D), HI 8750(D), HI 8755(D), K 1215, MACS 6604, MP 1279, NIAW 2030, UAS 451(D), HI 8751(D), HI 8754(D), K 1213, UP 2864, MACS 6507, UAS 358, DBW 154, DBW 155, SPL-DIC-01, SPL-DIC-02, SPL-DIC-03, SPL-DIC-04, SPL-DIC-05, SPL-DIC-06, SPL-DIC-07, SPL-DIC-08, SPL-DIC-09, SPL-DIC-10, SPL-DIC-11, TL 2996, TL 2997, TL 2998, TL 2999, TL 3000, TL 2942(C), TL 2969(C), PBW 722, PBW 723, KB 2012-03, HD 2932-Lr19/Sr25, MMBL 283, PBW 343(C), FLW32-1, FLW 32-2 and FLW32-3
101 - 200	K 1217, MACS 3916(D) and DDW 27(D)
Stem Rust, AVT - II year, 2013-14	
0	HS277(C), HS507(C), HS542 (1)(C), VL829(C) and PBW660(1)(C)
01 - 100	HPW251 (C), HS375(C), VL804(C), VL892(C), VL907(C), HUW666, DBW88(1)(C), DPW621-50(C), HD3059(C), PBW590(C), PBW644(C), DBW39(C), HD2888(C), HI8767(D), GW322(C), HD 3090(1)(C), NIAW 1415(C), RAJ 4083(C), HW2044(C), HW5216(C), MACS 5022, DDK 1029(C), MACS 2496 (C)
101 - 200	HPW 376, VL967, HPW349(C), HS490(C), DBW 107, WH1129, WH1142, HD2967(C), HD3043(C), HD2733(C), K 1006(1)(C), HI8736(D), HI 1500(C), HI 1544(C), HI 8498(D)(C), HI 8627(D)(C), MP 3336(C), NIAW 1994, MACS 6222(C), MACS 6478(C), NIDW 295 (d)(C) and MACS 2971 (C)
Leaf Rust, AVT - II year, 2013-14	
0	-Nil-

01 - 100	HPW 376, VL967, HPW251 (C), HPW349(C), HS277(C), HS375(C), HS490(C), HS507(C), HS542 (1)(C), VL804(C), VL829(C), VL892(C), VL907(C), HUW666, PBW681, WH1129, WH1138, WH1142, DBW88(1)(C), DBW90(1)(C), DPW621-50(C), HD2967(C), HD3043(C), HD3059(C), HD3086(1)(C), PBW590(C), PBW644(C), PBW660(1)(C), PDW233(C), PDW314(C), WH1021(C), WH1080(C), WH1105(C), WH1124(1)(C), BRW3723, DBW107, HD3118, K1114, DBW14(C), DBW39(C). , HD2733(C), HD2888(C), HD2985(C), HI1563(C), K 0307(C), NW 2036(C), K 1006(1)(C), NW 5054(1)(C), DBW110, HI8737(D), MP3382, NIAW1885, PBW689, GW322(C), HD2864(C), HI 1500(C) , HI 1544(C), HI 8498(D)(C), HI 8627(D)(C), MP 3288(C), MP 3336(C), MP 4010(C), MPO 1215(d)(C), NIAW 1994, UAS 347, UAS 446(D), HD 3090(1)(C), MACS 6222(C), MACS 6478(C), NIAW 1415(C), NIDW 295 (d)(C), RAJ 4083(C), UAS 428(d)(C), Co W (W) 1(C), HW2044(C), HW5216(C), MACS 5022, DDK 1029(C), KRL 19(C), KRL 210 (C), MACS 2496(C) and MACS 2971 (C)
101 - 200	PDW291(C), HD2932(C) and AKDW2997-16(d)(C)

COOPERATORS

NAME	**CENTRE**
M.S. SAHARAN	KARNAL
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2.3 SEEDLING RESISTANCE TEST AGAINST PATHOTYPES OF WHEAT RUSTS

A. Flowerdale, Shimla

(a) Rust resistance

To identify rust resistant lines of wheat and characterize rust resistance genes, 93 lines of AVT-II and 107 lines of AVT-I of wheat were evaluated against different pathotypes. A wide spectrum of pathotypes of black rust (*Puccinia graminis tritici*), Brown rust (*Puccinia triticina*) and Yellow rust (*Puccinia striiformis*) of wheat, having different avirulence/virulence structure were used in the studies. Resistance to all the rusts was observed on PBW703 of AVTI. Ten other lines were resistant to two of the rusts whereas 31 lines were resistant to one or other rust All the wheat lines possessing *Sr*31 resistant to black rust, whereas those possessing *Lr*24 and some with *Lr*26 were resistant to brown rust. Some of the lines with *Yr*9 were resistant to yellow rust pathotypes.

AVT II Year

Resistant to brown and black rusts : HI1544,HI1563

Resistant to brown and yellow rusts : PBW681

Resistant to yellow rust only : PBW660(I)(C)

Resistant to brown rust only : HD2864

AVT I Year

Resistance to all the rusts was observed in PBW703.

Resistant to brown and black rusts : UP2891,HUW677

Resistant to yellow and brown rusts : PBW697,PBW698, PBW722, PBW723

Resistant to yellow rust only : HD3128, HD4728, HPW411, HS592, HS593, HS594, HUW675, HUW693, HW1099, K1204, MACS3927(D), PBW692, PBW701, PBW702, VL1003,VL1004,VL3002

Resistant to black rust only: All the lines possessing Sr31, HPW401, HPW410, HS547, TL2942, TL2969, TL2998, TL2999 and TL3000 were resistant to black rust.
Resistant to brown rust only : HD3133, CG1010, GW451, GW455

(b) Rust resistance genes in AVT lines

Rust resistance genes (*Lr, Sr, Yr*) were characterized using gene matching technique. Rust resistance genes could be characterized only in the lines where differential host-pathogen interaction was present. However, genetic linkage, Morphological markers, characteristic infection types and pedigree also formed the basis for postulating rust resistance genes in absence of host pathogen differential reactions.

***Yr* genes**

AVT II

In AVT II material, 5 *Yr* genes/patterns were characterized in 71 lines (Table 2.5). *Yr*2 was found to confer resistance in maximum number of lines (46). However, this gene is susceptible to many of the virulent pathotypes. *Yr*9 which is linked to *Lr*26 and *Sr*31 was postulated in 21 lines. Other resistance genes like *Yr*A, *Yr*18, *Yr*27, were postulated in few lines only.

AVT I

Four *Yr* genes were postulated in 76 lines of AVT I material (Table 2.6). Among these, *Yr*2 was inferred in 47 lines. *Yr*9 which is linked to *Lr*26 and *Sr*31 was identified in 17 lines. *Yr*A was characterized in 15 lines whereas *Yr*27 was identified in 2 lines only.

***Sr* genes**

AVT II

Eleven *Sr* genes (*Sr*2,5,7b,8a,9b,9e,11,12,13,24,31) were characterized in 83 lines (Table 2.7). *Sr*11 was postulated in 33 lines followed by *Sr*2 and *Sr*31 in 27 and 21 lines, respectively. Postulation of *Sr*2 is based on characteristic micro-flecking. Postulation of *Sr*31 is based on its linkage to *Lr*26 and *Yr*9. *Sr*9b was identified in 12 lines, *Sr*7b in 9, *Sr*5 in 7, *Sr*8a and *Sr*9e in 6 lines each. *Sr* 24 was inferred in 5 lines whereas *Sr*12 and *Sr*13 in one line each. Most of the durum wheat varieties had resistance based on *Sr*7b, *Sr9e*, *Sr*11, *Sr* 12 and *Sr*13.

AVT I

Twelve *Sr* genes (*Sr*2,5,7b,8a,9b,9e,11,13, 25, 26,30,31) were characterized in 99 lines (Table 2.8). *Sr*11 was postulated in 50 lines followed by *Sr*2 and *Sr*9b in 42, 19 lines, respectively. Postulation of *Sr*31 is based on its linkage to *Lr*26 and *Yr*9 was identified in 17 lines whereas *Sr*7b in 17 lines. *Sr*13, *Sr*8a were postulated in 13 and 3 lines, respectively. Other resistance genes *Sr*9e, *Sr*25, *Sr*26 and *Sr*30 were postulated in one line each. Most of the durum wheat varieties had resistance based on *Sr*7b and *Sr*11.

***Lr* genes**

AVT II

Nine *Lr* genes (*Lr*1, 3, 10, 13, 18, 23, 24, 26, 34) were characterized in 77 lines (Table 2.9). Most of the lines possessed more than two resistance genes. *Lr*23 was the most common resistance gene and was characterized in 37% of the lines followed by *Lr*13 (28 lines). The proportion of lines with *Lr*26 has reduced and was identified in 21 lines only. Likewise *Lr*10 was inferred in 17 lines,*Lr*3 in 3 lines, whereas *Lr*24 and *Lr*34 were postulated in 5 lines each. *Lr*18 was inferred in one line only.

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AVT I

Ten *Lr* genes (*Lr*1, 2a, 10, 13, 14a, 18, 19, 20, 23, 26) were characterized in 87 lines (Table 2.10s). Many of the lines possessed combination of resistance genes. *Lr*13 was the most common resistance gene and was characterized in about 39% of the lines followed by *Lr*23 (28 lines), *Lr*10 was postulated in 20 lines, whereas *Lr*26 was characterized in 17 lines. The proportion of lines with *Lr*26 has reduced. *Lr*1, *Lr*18 were postulated in 12 and 4 lines, respectively. *Lr*2a, *Lr*14a, *Lr*19 and *Lr*20 were inferred in one line each.

Table 2.5. Postulation of *Yr genes* in AVT IInd material during 2013-14

S. No.	*Yr* genes	No. of Lines	Details of Lines
1	2+	46	BRW3723, DBW110, DBW90, GW322, HD2864, HD2888, HD2967, HD2985, HD3043, HD3086, HD3118, HI1500, HI1544, HI1563, HI8498, HI8736, HI8737, HPW349, HPW376, HS542, HW2044, K0307, K1006, K1114, K8027, MACS2971, MACS5022, MACS6478, MP3288, MP3336, MP4011, NI5439, NIAW1885, NW5054, PBW314, PBW644, PBW689 RAJ4083, UAS347, UAS446, VL967, WH1080, WH1105, WH1124, WH1129, WH1138
2	9+	14	CoW (w) 1, DBW39, DBW107, HD3090, HPW251, HS507, HW5216, MACS2496, NIAW1415, NW2036, PBW590, PBW660, WH1121, WH1142
3	9+18+	05	HD2733, HS277, HS375, VL804, VL829
4	9+27+	02	MACS6222, VL907
5	A+	04	HUW666, MP3382, NIAW1994, VL892
Total		71	

Table 2.6. Postulation of *Yr genes* in AVT Ist material during 2013-14

S. No.	*Yr* genes	No. of Lines	Details of Lines
1	2+	46	CG1010, DBW95, DBW128, DBW155, DDK1046, DDW27, DDW30, GW451, GW455, HD2932+*Lr*19+*Sr*26, HD2932+*Sr*26, HD3127, HD3139, HD4730, HI8754, HI8755, HPW400, HPW401, HPW410, HS547, HS558, HS577, HS595, HUW234, HUW661, HUW677, K1213, K1215, KB2012-03, MACS3916, MACS5040, MACS6507, MACS6604, MBBL283, MP1279, MP1277, NIAW2030, PBW677, PBW695, UAS356, UP2890, VL3006, WH1132, WH1154, WH1157, WH1164
2	9+	13	DBW154, HD3128, HD3133, HD3146, HUW579, K1217, PBW693, PBW701, UP2855, UP2864, VL976, VL977, VL1003
3	9+27+	01	PBW343
4	9+A+	03	HPW412, UAS358, VL3004
5	2+27+	01	PBW704
6	A+	12	DBW98, DBW126, DBW129, HD3132, HPW373, HS562, HS590, TL2995, UAS451, UP2891, VL3005, WH1156
Total		76	

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Table 2.7. Postulation of *Sr* genes in AVT II[nd] material during 2013-1.

S. No.	*Sr* genes	No. of Lines	Details of Lines
1.	2+	07	DBW14(C), HI1544, HI1563(C), K0307(C), HPW349(C), PBW644(C), VL892(C)
2.	5+	01	HPW376
3.	7b+2+	01	HD3086(I)(C)
4.	7b+11+2+	01	UAS347
5.	9b+2+	01	HS490(C)
6.	9e+2+	02	PBW233(C), WH1080(C)
7.	9e+12+2+	01	NIDW295(d)(C)
8.	11+2+	06	GW322(C), K1114, K8027(C), HI8498(D)(C), PBW681, UAS446(D)
9.	5+8a+9b+11+	01	HS542(I)(C)
10.	7b+	07	AKDW2997-16(d)(C), HD2985(I)(C), KRL210(C), NIAW1885, NW 5054(I)(C), WH1124(I)(C), WH1138
11.	8a+9b+11+	02	K1006(I)(C), VL967
12.	8a+11+	02	HD2864(C), HD2967(C)
13.	8b+9b+11+	01	KRL19(C)
14.	9b+11+	07	BRW3723, HD3118, HUW666, MP3382, NIAW1994, PBW689, WH1129
15.	9e+	03	HI8737(d), PDW291(C), PDW314(C)
16.	11+	13	A-9-30-1(D)(C), DBW88(I)(C), DDK1029(C), DDK1042, HD1098 (C)(C), HI8736(d), MACS2971(C), MACS5022, MPO1215(d)(C), NI5439(C), Raj4083(d), UAS428, WH1105(C)
17.	13+	01	DBW90(I)(C)
18.	24+	03	HD2888(C), HI1500(C), MP3288(C)
19.	24+2+	02	HW2044(C), MP4010(C)
20.	31+	11	Cow (W)(C), DBW39(C), DBW107, HD2733(C), HS277(C), HS507(C), HW5216(C), MACS6222(C), NIAW1415(C), NW2036(C), VL 907(C)
21.	31+2+	05	HD3090(I)(C), HPW251(C), MACS2496(C), WH1021(C), WH1142
22.	31+5+	04	HS375(C), PBW590(C), PBW660(I)(C), VL804(C)
23.	31+5+2+	01	VL829(C)
	Total	83	

Table 2.8. Postulation of *Sr* genes in AVT I[st] material during 2013-14

S.No.	*Sr* genes	No. of Lines	Details of Lines
1.	2+	08	CG1010, HUW677, PBW723, TL2942 (C), TL2969 (C), TL2999, TL3000, UP2891
2.	7b+2+	05	DBW129, GW451 (D), HD3139, HS594, VL3006
3.	7b+11+2+	02	HS577, HS591
4.	8a+13+2+	01	WH1164
5.	9b+11+2+	09	DBW95, HS595, PBW672, PBW695, PBW697, PBW698, VL1004, VL3005, WH1157
6.	11+2+	06	DDW27 (D), DDW30 (D), HD4730, HI8751 (D), HI8754

			(D), K1204
7.	11+13+2+	02	PBW722, WH1154
8.	13+2+	03	HI8755 (D), HPW411, VL3002
9.	7b+5+	01	DBW126
10.	5+9b+11+	01	HS562
11.	5+13+	01	MACS6604
12.	7b+	08	DBW98, GW455, HD3127, HD3132, HS590, HS593, UP2890, WH1132
13.	7b+11+	01	MP1277
14.	8a+11	01	MACS6507
15.	8a+11+13+	01	K1213
16.	9b+11+	09	DBW128, HPW400, HS558, HS592, PBW677, PBW702, PBW706, UAS356, WH1156
17.	9e+	01	DDK1044
18.	11+	15	DBW155, DDK1046, HD4728 (D), HI8750 (D), HPW373, HUW234 (C), HW1099, MACS3916 (D), MACS3927 (D), MACS5031, MACS5040, MMBL283, NIAW2030, TL2996, UAS451 (D)
19.	11+13+	03	HUW675, KB 2012-03, MP1279,
20.	13+	01	K1215
21.	25+2+	01	HD2932-*Lr*19/*Sr*25
22.	26+	01	HD2932+*Sr*26
23.	30+	01	HUW661
24.	31+	11	DBW154, HD3146, HPW412,HUW679, PBW693, PBW701, UAS358, UP2855, VL977, VL1003, VL3004
25.	31+2+	04	HD2138, HD3133, PBW343 (C), VL976
26.	31+5+	01	K1217
27.	31+5+2+	01	UP2864
Total		**99**	

Table 2.9. Postulation of *Lr genes* in AVT IInd material during 2013-14

S. No.	*Lr* genes	No. of Lines	Detail of Lines
1	13+	11	BRW3723, GW322(C), HD2932(C), HD3118, HI8627(d)(C), HPW349(C), K1114*, K8027(C), VL 967, WH1080(C), WH1105(C)
2	13+1+	1	PBW644(C)
3	13+3+	1	MP3382
4	13+10+	11	DBW88(I)(C), DBW110, DPBW621-50(C), HD2985(C), HD3043(C), HS542(I)(C), HUW666, KRL210(C), PBW689, WH1124(C), WH1129
5	13+10+3+	2	DBW90(I)(C), HD3086(I)(C)
6	18+	1	NIDW295(d)(C)
7	23+	18	A-9-30-1(d)(C), DBW14(C), HD2967(C), HI8736(d), HI8498(d)(C), HI8737(d), HS490(C), MACS6478(C), MP1215(d)(C), NW5054(I)(C), PDW233(d)(C), PDW291(d)(C), PDW314(d), Raj4083(C), UAS347, UAS428(d)(C), UAS446(d), WH1138

S. No.	*Lr* genes	No. of Lines	Detail of Lines
8	23+1+	2	KO307(C), NIAW1994
9	23+10	2	K1006(I)(C), NIAW1885
10	23+13+10+	2	HPW376, VL892(C)
11	24+	5	HD2888(C), HI1500(C), HW2044(C), MP3288(C), MP4010(C)
12	26+	3	COW(W)(I)(C), HW5216(C), NIAW1415(C)
13	26+1+	5	HD3090(I)(C), HS507(C), MACS6222(C), VL907(C), WH1081(C),
14	26+3+	2	DBW107*, PBW660(I)(C)
15	26+3+1+	1	WH1142
16	26+23+	3	HPW251(C), MACS2496(C), NW2036(C)
17	26+23+1+	2	DBW39(C), PBW590(C)
18	26+34+	5	HD2733(C), HS277(C), HS375(C), VL804(C), VL829(C)
TOTAL		77	

Table 2.10. Postulation of *Lr genes* in AVT I[st] material during 2013-14

S. No.	*Lr* genes	No. of Lines	Detail of Lines
1	13	22	DBW95, DBW126, DBW128, HD2932+*Sr*26 HD3127, HPW400, HPW401, HPW410, HS558, HS590, HS593, HS594, MACS6507, PBW692, PBW706, TL2997, TL2998, UP2890, VL3002, WH1154, WH1156, WH1164
2	13+1	1	HPW411
3	13+10	8	DBW98, DBW129, HD3132, HS596, HW1099, VL3006, WH1132, WH1157
4	13+10+1	3	HS547, HS592, HS595
5	14a+	1	HUW234(C)
6	18	3	HI8750(d), HI8755(d), MACS3927(d)
7	19	1	HD2932-*Lr*19/*Sr*25
8	20	3	DDK1046, DDW30(d), MACS5040
9	23+	19	DBW155, HD3139, HD4720(d), HD4730(d), HI8751(d), HI8754(d), HS562,K1215, KB2012-03, MACS3196(d), MACS6604, MMBL283, MP1279, NIAW2030, PBW677, PBW695, TL2967(C), UAS356, VL3005
10	23+1	1	K1204
11	23+3+	1	HS577
12	23+10+	4	HUW675, MP1277, PBW702, VL1004
13	23+10+1+	1	HPW373
14	23+10+2a+1+	1	HUW661
15	23+18+	1	DDW27(d)
16	26+	4	DBW154, HD3128, HD3133, PBW343(C)
17	26+1	2	HPW412, VL3004
18	26+10+	2	PBW693, UAS358
19	26+10+1+	1	HUW679

S. No.	*Lr* genes	No. of Lines	Detail of Lines
20	26+23+	6	HD3146, K1214, PBW701, UP2864, VL977, VL1003
21	26+23+1+	2	UP2855, VL976
TOTAL		87	

iii. Adult plant resistance to brown and yellow rusts

Lines of AVT II[nd] year were evaluated for identifying adult plant resistance. Pathotype 46S119 and 78S84 of yellow rust and 77-5 and 104-2 of leaf rust were used in the study. Optimum conditions for infection of rust and growth of wheat material were provided. HPW376, HPW349 (C), HS490 (C), HS507 (C), WH1080 (C), Raj4083 (C) and KRL210 (C) conferred considerable adult plant resistance to both yellow and brown rusts.

B. MAHABALESHWAR

AVT genotypes of CZ & PZ were tested against selective pathotypes of stem and leaf rusts under glass house condition. These were tested at seedling stage against 8 pathotypes of stem rust and 12 pathotypes of leaf rust as detailed below.

Pathotypes used :
Stem Rust : 11, 40A, 117, 117-1, 117-3, 117-4, 117-6 and 122
Leaf Rust : 77-2, 77-3, 77-4, 77-5, 104-1, 104-3, 104A, 104B 12-1, 12-2, 12-4 and 162-1

Wheat genotypes found resistant are depicted in Table 2.11

Table 2.11. Resistant genotypes of wheat from AVT trial against selective pathotypes at seedling stage under glass house condition.

Resistant genotypes		
Stem rust	**Leaf rust**	**Both the rusts**
DDW 30 (D), GW 451, HD 3146, HD 4728 (D), K 1217, MACS 3916 (D), MACS 6604, MP 1279, HI 8751 (D), UP 2864, DBW 110, HI 8737 (D), MP 3382, NIAW 1885, GW 322 (C), HD 2864 (C), HI 1500 (C), HI 1544 (C), HI 8498 (D) (C), HI 8627 (D) (C), MP 3288 (C), MP 3336 (C), MP 4010 (C), MPO 1215 (D) (C), NIAW 1994, AKDW 2997 16 (D) (C), MACS 6222 (C), MACS 6478 (C), NIAW 1415 (C), NIDW 295 (D) (C) and RAJ 4083(C)	DDW 30 (D), GW455, HD 3146, HI 8750(D), MACS 6604, HI 8751(D), DBW 110, NIAW 1885, PBW 689, HD 2864(C) , HI 1500(C), HI 1544 (C), MP 3288 (C) , MP 4010 (C) , MPO 1215 (d) (c), NIAW 1994, UAS 347, UAS 446 (D), HD 3090 (1) (C), MACS 6222 (C), MACS 6478 (C), NIAW 1415 (C), NIDW 295 (d) (c) and Raj4083(C)	DDW 30 (D), HD 3146, MACS 6604, HI 8751(D), DBW 110, NIAW 1885, HD 2864(C), HI 1500(C), HI 1544 (C), MP 3288 (C), MP 4010 (C) , MPO 1215 (d) (c), NIAW 1994, MACS 6222 (C), MACS 6478 (C), NIAW 1415 (C), NIDW 295 (d) (c) and Raj4083(C)

COOPERATORS NAME	CENTRES
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S.G. SAWASHE	MAHABALESHWAR

PROGRAMME 3. LEAF BLIGHT

3.1. LEAF BLIGHT SCREENING NURSERY (LBSN), 2013-14

Leaf blight (spot blotch) of wheat is a major disease of wheat in north eastern plains zone (NEPZ) and Peninsular zone (PZ). In recent years, the incidence in NWPZ is increasing when the temperature during crop season rises above 25°C. The grain yield losses may vary from 10-50%. In addition to yield losses, the quality also deteriorates depending on the level of susceptibility of a cultivar against the pathogen. Since leaf blight occurs in all the wheat growing agro-climatic zones, deployment of resistant cultivars remains the most effective strategy for the management of disease. The present chapter deals with the monitoring of the associated pathogens, status of resistance in advanced wheat entries against leaf blight, identification of stable sources of resistance and management of seed and soil borne inoculum using fungicidal seed treatment in popular wheat varieties.

Objective:
To know the status of resistance against leaf blight in the entries of advanced varietal trial (AVT I and II year) as well as retesting of other known resistant entries.

Composition:
This nursery was having 215 test entries comprising of previously identified promising leaf blight resistant entries (11 Nos.) and entries of AVT I year (111 entries) and II year (93 entries).

This nursery was planted at 15 centres listed below:

Zone	Test locations
NEPZ	Faizabad, Varanasi, Pusa (IARI), Coochbehar, Shillongani, Kalyani, Ranchi (7)
NWPZ	Karnal, Pantnagar, Ludhiana, Hisar, Kaul (5)
PZ	Dharwad (1)
SHZ	Wellington (1)
CZ	Gwalior (1)

One row of 1m length of each entry was planted and a row of a highly susceptible entry RAJ4015 was repeat planted after every 20 test entries. The inoculations of pathogens were done right from the month of January at 15 days intervals with frequent irrigations till development of disease. The recording of disease was done on 0-9 double digit scale at three stages, flowering, dough and hard dough stages to observe response of each entry against leaf blight at various stages. The left side digit indicates the score of blight on flag leaf (F) and right side digit of score represents the per cent blighted area of flag-1 leaf (F-1) and the score (0-9) was as follows:

0-No blight, **1**-Up to 10% leaf area blighted, **2**-11-20% leaf area blighted, **3**-21-30% leaf area blighted, **4**-31-40% leaf area blighted, **5**-41-50% leaf area blighted, **6**-51-60% leaf area blighted, **7**-61-70% leaf area blighted, **8**-71-80% leaf area blighted, **9**->80% leaf area blighted.

Amongst three stages, blight record at dough stage was most distinct in terms of giving clear comparison between resistant and susceptible stage and therefore data at dough stage was used for final categorization of resistance of test entries including AVT II year and data of AVT II year is also presented in Table 1.5 of chapter 1.

The highest as well as average blight score was also calculated at three growth stages separately and data are given in the following Table 3.1.

Table 3.1 Leaf blight score of different entries at three different growth stages 2013-14

S.No.	Entry	LEAF BLIGHT SCORE (dd)					
		Flowering		Dough stage		Hard dough stage	
		HS	AV	HS	AV	HS	AV
Source: AVT IInd Year 2013-14							
I. NORTHERN HILL ZONE							
1	HPW 376	35	12	68	24	69	36
2	VL 967	45	12	57	24	78	35
3	HPW 251 (C)	35	12	57	24	78	36
4	HPW 349 (C)	12	01	24	13	67	35
5	HS 277 (C)	13	01	24	13	67	35
6	HS 375 (C)	24	12	56	24	68	35
7	HS 490 (C)	23	12	38	24	58	36
8	HS 507 (C)	23	01	48	24	69	35
9	HS 542 (I) (C)	12	01	37	13	67	36
10	VL 804 (C)	37	13	68	35	79	46
11	VL 829 (C)	25	12	45	24	78	36
12	VL 892 (C)	45	13	78	35	99	46
13	VL 907 (C)	24	12	45	24	67	35
II. NORTH WESTERN PLAIN ZONE							
14	HUW 666	35	12	56	23	78	35
15	PBW 681	57	13	68	24	89	36
16	WH 1129	23	12	45	24	67	46
17	WH 1138	35	13	58	24	78	35
18	WH 1142	25	12	57	24	78	46
19	DBW 88 (I) (C)	35	12	57	23	68	36
20	DBW 90 (I) (C)	45	13	67	34	89	46
20. A	RAJ 4015 (Check)	68	34	78	46	99	68
21	DPW 621-50 (C)	35	12	57	23	78	46
22	HD 2967 (C)	13	11	29	13	67	35
23	HD 3043 (C)	16	01	79	24	79	35
24	HD 3059 (C)	35	12	57	23	79	46
25	HD 3086 (I) (C)	35	12	57	35	89	46
26	PBW 590 (C)	35	12	68	24	89	46
27	PBW 644 (C)	23	11	78	23	89	45
28	PBW 660 (I) (C)	23	11	35	13	79	35
29	PDW 233 (C)	23	12	57	24	89	46
30	PDW 291 (C)	13	01	46	23	69	35

S.No.	Entry	LEAF BLIGHT SCORE (dd)					
		Flowering		Dough stage		Hard dough stage	
		HS	AV	HS	AV	HS	AV
31	PDW 314 (C)	25	11	58	24	89	35
32	WH 1021 (C)	25	13	56	34	78	46
33	WH 1080 (C)	35	12	69	25	89	45
34	WH 1105 (C)	35	13	78	35	89	46
35	WH 1124 (I) (C)	35	12	78	34	78	46
III. NORTH EASTERN PLAIN ZONE							
36	BRW 3723	24	12	45	24	69	35
37	DBW 107	37	12	47	24	78	36
38	HD 3118	25	12	35	23	77	46
39	K 1114	37	12	47	24	89	46
40	C 306 (C)	34	12	45	24	79	46
40. A	RAJ 4015 (Check)	78	34	78	46	89	67
41	DBW 14 (C)	57	12	78	35	99	57
42	DBW 39 (C)	35	12	47	23	79	46
43	HD 2733 (C)	24	12	78	34	99	46
44	HD 2888 (C)	23	12	36	23	78	46
45	HD 2985 (C)	27	12	99	34	99	46
46	HI 1563 (C)	35	13	78	35	89	47
47	K 0307 (C)	38	13	78	24	79	46
48	K 1006 (I) (C)	24	12	89	24	99	46
49	K 8027 (C)	14	12	69	24	89	36
50	NW 2036 (C)	34	12	79	34	99	57
51	NW 5054 (I) (C)	23	12	68	24	99	56
IV. CENTRAL ZONE							
52	DBW 110	23	12	79	25	99	46
53	HI 8736 (D)	24	12	79	24	99	46
54	HI 8737 (D)	34	12	89	34	99	46
55	MP 3382	45	12	79	35	99	46
56	NIAW 1885	34	13	79	35	99	47
57	PBW 689	23	12	37	24	68	35
58	A 9-30-1 (D) (C)	57	24	99	56	99	67
59	GW 322 (C)	23	12	56	35	68	46
60	HD 2864 (C)	78	23	99	45	99	56
60. A	RAJ 4015 (Check)	56	34	89	56	99	67
61	HD 2932 (C)	45	12	79	35	99	46
62	HI 1500 (C)	25	12	79	35	89	46
63	HI 1544 (C)	45	12	89	35	99	46
64	HI 8498 (D) (C)	23	01	69	24	79	36
65	HI 8627 (D) (C)	23	12	79	35	79	46
66	MP 3288 (C)	45	13	79	35	79	57
67	MP 3336 (C)	56	23	99	46	99	57
68	MP 4010 (C)	79	24	99	45	99	56
69	MPO 1215 (d) (C)	35	12	57	25	79	46
V. PENINSULAR ZONE							
70	NIAW 1994	35	13	79	35	99	57
71	UAS 347	13	11	36	23	78	35
72	UAS 446 (D)	13	11	36	13	89	35
73	AKDW 2997-16(d) (C)	46	13	79	35	99	57
74	HD 3090 (I) (C)	45	13	67	35	99	56
75	MACS 6222 (C)	35	12	67	34	89	46
76	MACS 6478 (C)	23	12	35	24	79	35

S.No.	Entry	LEAF BLIGHT SCORE (dd)					
		Flowering		Dough stage		Hard dough stage	
		HS	AV	HS	AV	HS	AV
77	NI 5439 (C)	24	12	89	35	99	57
78	NIAW 1415 (C)	13	01	36	24	78	46
79	NIDW 295 (d) (C)	24	12	68	24	68	46
80	Raj 4083 (C)	35	13	89	45	99	57
80. A	RAJ 4015 (Check)	56	24	89	56	99	67
81	UAS 428 (d) (C)	35	12	57	35	79	46
VI. SOUTHERN HILLS ZONE							
82	CoW(W) 1 (C)	24	12	55	24	89	46
83	HW 2044 (C)	57	13	99	35	99	56
84	HW 5216 (C)	35	13	79	35	99	57
VII. SPECIAL TRIAL							
85	DDK 1042	56	13	79	24	99	46
86	MACS 5022	37	12	79	35	79	46
87	DDK 1029 (C)	23	11	89	35	89	56
88	HW 1098 (I) (C)	23	12	89	34	99	46
89	Kharchia 65 (C)	48	23	89	45	99	57
90	KRL 19 (C)	68	24	79	36	99	46
91	KRL 210 (C)	25	12	47	35	78	46
92	MACS 2496 (C)	35	12	67	24	78	46
93	MACS 2971 (C)	24	12	89	35	99	46
A. Resistant : (AV. SCORE RANGE 00-13, HIGHEST SCORE UP TO 35)							
Source: AVT IInd Year 2001-02							
94	KARAWANI/4NIF-/3/ SOTY// NAD63/ CHRIS	13	11	25	23	46	35
Source: AVT IInd Year 2010-11							
95	VL 829	24	12	35	23	56	35
B. Resistant : (AV. SCORE RANGE 14-35, HIGHEST SCORE UP TO 57)							
Source: AVT IInd Year 2008-09							
96	HP 1913	24	12	67	24	89	35
Source: AVT IInd Year 2009-10		00	24	0	0	0	0
97	DBW 51	13	01	25	13	67	35
Source: AVT IInd Year 2011-12							
98	PBW 660	13	01	34	13	57	35
Source: AVT Ist Year 2012-13							
99	HS 557	23	12	45	24	89	35
100	HS 575	23	12	45	24	67	35
100A	RAJ 4015 (Check)	56	34	78	46	89	67
101	UP 2872	25	12	47	24	79	46
102	VL 1001	13	02	34	24	58	35
103	VL 1002	14	02	25	23	67	35
104	DBW 101	24	12	48	24	79	35
Source: AVT Ist Year 2013-14							
I. NORTHERN HILL ZONE							
105	HPW 373	24	12	57	34	89	46
106	HPW 400	46	12	79	35	89	46
107	HPW 401	37	13	69	35	89	46
108	HPW 410	13	02	56	24	79	46
109	HPW 411	35	13	56	25	79	46
110	HPW 412	24	12	79	24	99	46
111	HS 547	12	01	35	23	57	35
112	HS 558	36	12	89	24	89	35
113	HS 562	14	12	57	24	67	35

S.No.	Entry	LEAF BLIGHT SCORE (dd)					
		Flowering		Dough stage		Hard dough stage	
		HS	AV	HS	AV	HS	AV
114	HS 577	57	23	79	35	99	46
115	HS 590	23	12	47	23	78	35
116	HS 591	25	12	67	24	89	46
117	HS 592	35	12	79	34	99	45
118	HS 593	23	11	79	24	99	45
119	HS 594	23	12	67	24	79	45
120	HS 595	45	12	68	34	89	46
121	UP 2890	47	13	89	35	99	46
122	UP 2891	67	23	89	35	99	46
123	VL 976	14	12	56	24	68	36
124	VL 977	35	12	57	34	79	46
125	VL 1003	47	12	58	13	89	35
126	VL 1004	12	2	77	24	89	35
127	VL 3002	35	12	79	35	99	46
128	VL 3004	25	12	68	35	99	46
129	VL 3005	35	12	68	36	99	56
130	VL 3006	79	23	99	45	99	56
II. NORTH WESTERN PLAIN ZONE							
131	DBW 95	24	12	69	34	99	45
132	DBW 128	34	12	79	35	99	46
133	DBW 129	24	12	57	24	89	36
134	HD 3128	14	01	89	23	99	35
135	HD 3132	35	12	78	34	99	45
136	HD 3133	34	12	89	35	99	46
137	HD 3139	35	12	67	34	89	46
138	HD 4730	14	12	89	24	99	46
139	HUW 675	34	12	57	24	79	46
140	K 1204	27	12	68	24	79	35
141	MP 1277	45	23	68	35	89	46
142	PBW 677	45	12	77	34	99	45
143	PBW 692	24	12	46	24	99	35
144	PBW 695	35	12	68	35	89	46
145	PBW 697	34	11	79	24	99	35
146	PBW 698	35	12	68	24	99	46
147	PBW 702	13	12	77	24	99	46
148	PBW 703	25	12	67	24	99	35
149	PBW 706	35	12	57	23	99	35
150	TL 2995	56	12	69	34	89	46
151	UAS 356	34	12	67	24	89	45
152	WH 1154	26	12	66	35	89	46
153	WH 1156	34	12	57	25	99	46
154	WH 1157	57	12	79	35	99	47
155	WH 1164	48	13	68	34	89	46
III. NORTH EASTERN PLAIN ZONE							
156	DBW 126	34	12	57	24	89	46
157	DBW 98	67	13	78	35	89	46
158	HD 3127	13	01	25	24	79	35
159	HUW 661	34	12	79	35	99	36
160	HUW 677	57	13	89	34	99	46
161	HUW 679	35	12	69	35	99	46
162	PBW 693	35	12	69	24	99	45

S.No.	Entry	LEAF BLIGHT SCORE (dd)					
		Flowering		Dough stage		Hard dough stage	
		HS	AV	HS	AV	HS	AV
163	PBW 701	35	12	67	24	99	46
164	PBW 704	35	12	79	35	89	46
165	UP 2855	57	13	79	34	99	46
166	WH 1132	35	13	68	35	89	46
IV. CENTRAL ZONE							
167	CG 1010	66	23	79	35	99	56
168	DDW 30 (D)	45	12	68	24	89	45
169	GW 451	35	13	79	35	89	56
170	GW 455	45	13	79	35	99	57
171	HD 3146	68	23	89	34	99	46
172	HD 4728 (D)	25	12	79	34	99	45
173	HI 8750 (D)	45	13	68	34	99	46
174	HI 8755 (D)	79	13	99	35	99	46
175	K 1215	69	13	99	24	99	46
176	K 1217	79	13	99	34	99	45
177	MACS 3916 (D)	37	13	99	35	99	46
178	MACS 3927 (D)	57	13	99	36	99	46
179	MACS 6604	67	13	89	34	89	46
180	MP 1279	13	11	69	24	99	46
181	NIAW 2030	37	12	79	24	99	46
182	UAS 451 (D)	69	13	89	24	99	46
V. PENINSULAR ZONE							
183	DDW 27 (D)	25	12	46	24	69	35
184	HI 8751 (D)	46	12	89	35	89	46
185	HI 8754 (D)	35	12	89	35	99	46
186	K 1213	67	13	89	35	99	46
187	UP 2864	69	13	89	35	99	46
VI. SOUTHERN HILLS ZONE							
188	MACS 6507	34	12	89	34	99	45
189	UAS 358	35	12	89	34	99	46
VII. SPECIAL TRIAL (Dicoccum and Salinity and Alkalinity)							
190	DBW 154	35	13	79	35	89	46
191	DBW 155	68	12	89	24	89	35
192	MACS 5040	34	12	89	24	99	46
193	MACS 5031	23	12	89	24	99	46
194	MACS 5022	89	12	89	24	99	46
195	DDK 1046	37	13	89	24	99	46
196	MACS 2971 (C)	23	12	89	24	99	46
197	DDK 1044	24	12	89	35	99	46
198	DDK 1029 (C)	23	12	79	35	99	46
199	HW 1099	28	13	67	35	69	46
200	MACS 2496 (aest.) (C)	35	12	56	24	99	57
III. SPECIAL TRIAL (TRITICALE)							
201	TL 2996	67	12	89	34	99	45
202	TL 2997	57	12	89	35	99	46
203	TL 2998	36	13	99	35	99	46
204	TL 2999	24	12	89	34	99	35
205	TL 3000	35	12	89	24	99	46
206	TL 2942 (C)	24	12	89	24	99	35
207	TL 2969 (C)	24	11	89	24	89	35
IV. SPECIAL TRIAL (MABB/NILs)							

S.No.	Entry	LEAF BLIGHT SCORE (dd)					
		Flowering		Dough stage		Hard dough stage	
		HS	AV	HS	AV	HS	AV
208	PBW 722	77	12	89	23	89	35
209	PBW 723	13	12	57	24	89	45
210	KB 2012-03	79	13	99	34	99	46
211	HD 2932+*Sr26*	67	13	89	35	99	57
212	HD 2932+*Lr19/Sr25*	34	12	79	35	99	46
213	MMBL 283	25	12	67	35	99	56
214	HUW 234 (C)	34	13	78	35	89	57
215	PBW 343 (C)	37	13	57	24	99	56

HS= Highest score, Av.= Average Score, dd=Double digit

The entry KARAWANI/4NIF-/3/SOTY//NAD63/CHRIS remains resistance within average score (35) and the HS of 46 whereas the VL 829 showed average score of 35 with HS up to 56. This is due to higher reaction at Ludhiana centre. The other entries also maintain their resistance to leaf blight with average score upto 35 but the highest score exceeded 57 due to high disease pressure either one location.
Among AVT I Year, the entries DBW 155, DDW 27 (D), HD 3127, HD 3128, HS 547, HS 558, HS 562, HS 590, K1204, PBW 692, PBW 697, PBW 703, PBW 706, PBW 722, TL 2942 (C), TL 2969 (C), TL 2999, VL 1003 and VL 1004 recorded aerage score up to 35 but the highest score reached more than 57.
Among AVT II year BRW 3723, HD 2967 (C), HD 3043 (C), HPW 349 (C), HS 277 (C), HS 375 (C), HS507(C), HUW 666, MACS 6478 (C), PBW 660 (I) (C), PBW 689, PDW 291 (C), PDW 314 (C), UAS 347, UAS 446 (D), VL 907 (C), VL 967 and WH 1138 recorded aerage score up to 35 but the highest score reached more than 57.
In general, ten entries were showing resistance to leaf blight (AV. 35 and HS 57) viz., DBW 129, DBW 155, HD 3043 (C), HD 3127, HP 1913, HS 375 (C), HS 490 (C), HS 547, HS 558, KARAWANI/4NIF-/3/SOTY//NAD63/CHRIS and PBW 660. Other than these entries eight entries viz., PBW 689, PBW 703, PBW 706, PBW 722, VL 1001, VL 1002, VL 1003, VL 1004 and VL 829 showed resistance in all locations but at one locations recorded highest reaction of 57.

COOPERATORS:

NAME	CENTRE
SUNITA MAHAPATRA	COOCHBEHAR
I.K. KALAPPANAWAR	DHARWAD
S. P. SINGH	FAIZABAD
V.S. KANDALKAR	GWALIOR
S.S. KARWASRA AND R. S. BENIWAL	HISAR
ASHISH KUMAR	IARI, PUSA
S.K. MUKHOPADHYAY AND S. DUTTA	KALYANI
D.S.DODAN	KAUL
MADHU MEETA JINDAL	LUDHIANA
J.KUMAR, DEEPSHIKHA, K. SRIVASTAVA	PANTNAGAR
H.C. LAL	RANCHI
UTPAL KUMAR DEKA	SHILLONGANI
S.S. VAISH	VARANASI
P. NALLATHAMBI AND C. UMA MAHESHWARI	WELLINGTON
R. SELVAKUMAR	KARNAL

3.2. Management of leaf blight using chemical sprays

During 2013-14, a field trial was conducted at Faizabad, Varanasi, Coochbehar, Kalyani, Pusa (Bihar), Karnal, Kanpur and Sabour for management of leaf blight of wheat using chemical fungicides.

All the treatments were done as mentioned in Tables 3.2 & 3.3. First spray of fungicide was given at the initiation of disease followed by 2nd and 3rd sprays at 20 and 10 days intervals respectively whenever required.

The seed treatment was also used alone and in combination with foliar sprays. The foliar sprays were given on initiation of disease and in few treatments repeated after 15 days interval.

In all the centres, seed treatment with Vitavax Power and two sprays of Tilt @0.1% reduced disease severity to significant level. The maximum disease was recorded upto 89 in untreated control plot in Coochbehar centre.

In Varnasi, Sabour and Kalyani centres three sprays with Dithane M-45@0.25% recorded lowest blight severity. In Coochbehar, Pusa (Bihar), Faizabad, Karnal and Kanpur, seed treatment with two sprays of Vitavax Power +Tilt @0.1% reduced disease severity.

In general, seed treatment with Vitavax Power and two sprays of Tilt @0.1% gave higher yield followed by seed treatment with Vitavax Power along with single spray of Tilt@0.1%. The lowest yield was recorded (20.20 Q/Ha) in the control plot not treated with any chemicals for the management of leaf blight.

COOPERATORS

NAME	CENTRE
SUNITA MAHAPATRA	COOCHBEHAR
S. P. SINGH	FAIZABAD
ASHISH KUMAR	IARI, PUSA
S.K. MUKHOPADHYAY AND S. DUTTA	KALYANI
JAVED BAHAR KHAN	KANPUR
C.S.AZAD	SABOUR
S.S. VAISH	VARANASI
R. SELVAKUMAR	KARNAL

Table 3.2. Effect of fungicidal sprays on leaf blight incidence during 2013-14 crop season

No.	Treatment	Leaf blight score (0-9, dd)							
		Varanasi	Cooch-behar	Pusa (Bihar)	Sabour	Faizabad	Kalyani	Karnal	Kanpur
1	Untreated seed	79	89	78	68	78	67	57	67
2	Seed treatment with Captaf @2.5g/Kg seed	56	79	78	47	46	57	35	24
3	Seed treatment with Vitavax Power @2.5g/Kg seed	46	68	78	35	57	57	35	24
4	Seed treatment with Vitavax Power + Tilt spray@0.1%	35	78	34	34	35	37	24	13
5	Seed treatment with Vitavax Power +Tilt @0.1%-two sprays	23	57	12	24	23	25	35	12
6	Tilt spray@0.1% - one spray	34	56	25	34	35	47	24	13
7	Tilt @0.1% - two sprays	35	47	23	23	24	25	24	12
8	Folicur spray @0.1% - one spray	36	68	34	22	45	57	24	12
9	Folicur @0.1%-two sprays	34	89	23	13	23	37	24	13
10	Dithane M-45@0.25% -three sprays	13	79	46	11	35	25	35	36

Table 3.3. Effect of fungicidal foliar sprays on grain yield of wheat during 2013-14 crop season

No.	Treatment	Yield (q/ha)							
		Varanasi	Cooch behar	Pusa (Bihar)	Sabour	Faizabad	Kalyani	Karnal	Kanpur
	Untreated seed	31.20	30.67	46.09	46.82	28.26	29.80	35.90	20.20
	Seed treatment with Captaf @2.5g/Kg seed	36.60	31.91	48.84	47.29	30.13	30.70	36.41	23.50
	Seed treatment with Vitavax Power @2.5g/Kg seed	42.00	32.62	50.18	47.88	31.78	31.10	35.52	24.50
	Seed treatment with Vitavax Power + Tilt spray@0.1%	45.20	34.89	60.71	50.24	33.30	35.10	35.67	35.20
	Seed treatment with Vitavax Power + Tilt @0.1% - two sprays	43.50	33.60	61.87	50.47	35.20	39.50	38.46	41.60
	Tilt @0.1% - one spray	46.20	33.16	55.33	52.82	33.06	32.90	38.49	28.50
	Tilt @0.1% - two sprays	47.40	34.76	55.82	49.18	34.56	36.40	37.71	27.50
	Folicur @0.1% - one spray	45.10	38.44	55.51	53.88	32.37	33.80	38.46	22.50
	Folicur @0.1% - two sprays	46.60	39.60	56.67	56.12	33.97	37.30	38.35	26.80
	Dithane M-45@0.25% -three sprays	41.80	37.33	46.09	56.24	30.93	36.00	37.95	24.60

PROGRAMME 4. KARNAL BUNT

4.1 KARNAL BUNT SCREENING NURSERY (KBSN) 2013-2014

Wheat entries alongwith checks were evaluated for resistance to Karnal bunt under Karnal Bunt Screening Nursery (KBSN) at multilocations (Hisar, Ludhiana, Dhaula Kuan, Karnal, Delhi & Jammu) during 2013-14 crop season under artificially inoculated conditions. Nursery was inoculated at boot stage of the crop with *Tilletia indica* (location -specific isolates). The per cent incidence was calculated by taking into account the number of infected grains of the inoculated spikes. Various aspects of KBSN are discussed below:

OBJECTIVE

- Characterization of resistance to Karnal bunt in wheat entries proposed to be identified as cultivars for Karnal Bunt prone areas
- To identify KB resistant genetic stocks through repetitive tests

SIZE AND COMPOSITION:

KBSN 2013-2014 was constituted as follows:

Component	No. of entries
AVT II Year, 2013-14	93
AVT II Year, 2012-13	10
Total	**103**

Test Locations: Hisar, Dhaulakuan, Ludhiana, Delhi, Karnal, Jammu and Pantnagar

Each entry was sown in one meter row. Recommended cultural practices were followed to grow the crop till harvest. To determine the response of genotypes to Karnal bunt, earheads were injected with hypodermic syringe with adequate amount of inoculum (10,000 allantoids/ml water) at crop growth stage 49. The local isolates were used at all the test centres. Five earheads were inoculated in each entry during evening hours. After inoculation, high humidity was maintained for proper development of disease. The disease incidence in the earheads was recorded at crop maturity and was calculated by reckoning the infected and the total number of grains (both diseased and healthy) of 5 earheads per entry. Disease development was very good at Ludhiana, Hisar, Delhi, Jammu, Karnal and Dhaula Kuan centres. At Pantnagar, disease development was poor so data was not considered. Entries showing response of upto 5 per cent coefficient of infection (average) were rated as resistant. KB incidence of AVT 2nd year entries of all centres is given in Table 4.1 and average KB incidence of all centres is given in Table 1.5. The resistant entries identified are listed below:

AVT IInd Year 2012-13
Resistant (Av. Incidence upto 5%): HD 3091 and UAS 334.

AVT IInd Year 2013-14
Resistant (Av. Incidence upto 5%): AKDW 2997-16(d) (C), DBW 110, DDK 1042, HD 2864 (C), HPW 251 (C), HPW 376, HS 375 (C), HS 490 (C), HS 507 (C), K 0307 (C), KRL 210 (C), MACS 2971 (C), MP 3336 (C), NIDW 295 (d) (C), NW 2036 (C), PDW 233 (C), PDW 291 (C), PDW 314 (C), UAS 428 (d) (C), UAS 446 (D), WH 1021 (C), and WH 1080 (C)

AVT 1st Year, 2013-14
Test Locations: Hisar, Dhaulakuan, Ludhiana, Delhi, Karnal, Pantnagar and Jammu.

AVT 1st year entries (107) were sown in one meter row at seven locations. Location specific *Tilletia indica* inoculum was used for inoculating each entry at Zadoks' stage 49. KB incidence of AVT 1st year entries of all centres and average KB incidence is given in Table 4.2. Disease development at Pantnagar was not good so data was not considered. Among AVT 1st year entries, following entries showed < 5 % KB incidence.

AVT Ist Year 2013-14
Resistant (Av. Incidence upto 5%): CG 1010, DDK 1044, DDW 27 (D), DDW 30 (D), GW 455, HD 2932+Sr26, HD 4728 (D), HD 4730, HI 8751 (D), HI 8754 (D), HI 8755 (D), HPW 373, HS 577, HS 590, HS 594, HUW 679, KB 2012-03, MACS 3916 (D), MACS 3927 (D), MP 1277, PBW 692, TL 2942 (C), TL 2969 (C), TL 2999, TL 3000, UAS 358, UAS 451 (D), VL 1003, VL 1004, VL 3002, VL 3004 and VL 3005.

NIVT entries were evaluated for KB resistance at Dhaulakuan and Ludhiana (Table 4.3).

COOPERATORS:

NAME	CENTRE
RITU BALA	LUDHIANA
ROBIN GOGOI AND RASHMI AGGARWAL	DELHI
S. S. KARWASARA, R. S. BENIWAL	HISAR
DHANBIR SINGH	DHAULAKUAN
J KUMAR, DEEP SHIKHA	PANTNAGAR
M K PANDEY	JAMMU
M. S. SAHARAN	KARNAL

Table 4.1: Karnal bunt incidence in KBSN entries evaluated under artificially inoculated condotions at multilocations during 2013-14

Sr. No.	Variety	% Karnal bunt incidence							
		Jammu	Hisar	Delhi	Dhaulakuan	Ludhiana	Karnal	HS	Av.
AVT II[nd] Year 2013-14									
I. NORTHERN HILL ZONE									
1	HPW 376	3.6	1.5	0.0	12.5	1.3	0.0	12.5	3.1
2	VL 967	6.8	0.0	0.0	1.6	3.1	26.4	26.4	6.3
3	HPW 251 (C)	0.6	0.5	0.0	6.7	3.6	0.0	6.7	1.9
4	HPW 349 (C)	3.6	4.5	11.4	3.1	29.3	35.9	35.9	14.6
5	HS 277 (C)	4.2	0.0	0.0	9.3	7.2	10.3	10.3	5.2
6	HS 375 (C)	8.2	4.1	0.0	3.3	1.7	0.0	8.2	2.9
7	HS 490 (C)	3.6	0.6	-	3.9	0.7	4.3	4.3	2.6
8	HS 507 (C)	0.0	2.9	-	4.0	0.0	13.4	13.4	4.1
9	HS 542 (I) (C)	3.0	0.2	0.0	8.8	15.0	46.6	46.6	12.3
10	VL 804 (C)	6.3	5.7	0.0	6.2	15.6	25.5	25.5	9.9
11	VL 829 (C)	7.0	2.3	1.9	8.4	0.8	16.1	16.1	6.1
12	VL 892 (C)	9.3	4.6	8.3	8.7	17.2	21.0	21.0	11.5
13	VL 907 (C)	0.0	0.4	6.9	3.7	2.9	19.8	19.8	5.6
II. NORTH WESTERN PLAIN ZONE									
14	HUW 666	6.2	7.1	0.0	14.8	11.5	67.9	67.9	17.9
15	PBW 681	11.2	-	-	28.1	3.2	41.0	41.0	20.9
16	WH 1129	1.3	8.6	0.0	8.5	1.1	23.9	23.9	7.2
17	WH 1138	13.2	20.8	0.0	38.8	10.4	68.9	68.9	25.3
18	WH 1142	6.2	9.4	0.0	33.4	16.2	25.8	33.4	15.2
19	DBW 88 (I) (C)	1.8	4.1	0.0	12.5	7.7	29.1	29.1	9.2
20	DBW 90 (I) (C)	3.0	5.0	0.0	7.7	5.2	25.2	25.2	7.7
20. A	INFECTOR	28.2	7.3	23.5	35.3	22.7	40.7	40.7	26.3
21	DPW 621-50 (C)	14.6	0.4	8.9	10.7	7.6	61.3	61.3	17.2
22	HD 2967 (C)	13.5	-	1.3	13.2	1.0	27.3	27.3	11.3
23	HD 3043 (C)	4.5	52.1	2.8	24.1	0.0	24.5	52.1	18.0
24	HD 3059 (C)	1.5	2.4	2.5	5.3	18.3	29.9	29.9	10.0
25	HD 3086 (I) (C)	7.2	5.8	7.1	4.6	8.0	56.1	56.1	14.8
26	PBW 590 (C)	10.5	4.0	20.0	9.1	8.0	30.3	30.3	13.7
27	PBW 644 (C)	1.3	0.0	0.0	39.2	8.4	29.1	39.2	13.0
28	PBW 660 (I) (C)	0.0	1.0	0.0	9.7	8.3	17.0	17.0	6.0
29	PDW 233 (C)	0.0	1.0	0.0	5.1	0.0	0.7	5.1	1.1
30	PDW 291 (C)	0.0	0.7	0.0	10.7	2.1	0.7	10.7	2.4
31	PDW 314 (C)	0.6	0.6	0.0	6.0	0.0	0.8	6.0	1.3
32	WH 1021 (C)	1.8	2.9	0.0	3.1	4.7	15.6	15.6	4.7
33	WH 1080 (C)	4.8	0.0	4.5	5.1	3.2	8.5	8.5	4.4
34	WH 1105 (C)	11.2	0.0	2.9	14.4	12.4	72.9	72.9	19.0
35	WH 1124 (I) (C)	4.2	13.1	0.0	7.9	0.0	23.8	23.8	8.2
III. NORTH EASTERN PLAIN ZONE									
36	BRW 3723	0.3	0.0	0.0	2.5	2.2	25.7	25.7	5.1
37	DBW 107	12.6	0.0	6.7	19.0	20.7	39.7	39.7	16.4
38	HD 3118	18.2	13.8	0.0	5.8	14.1	25.4	25.4	12.9
39	K 1114	11.6	2.0	12.0	12.5	18.7	31.1	31.1	14.7
40	C 306 (C)	9.2	2.0	-	19.8	20.8	40.4	40.4	18.4
40. A	INFECTOR	22.4	10.9	13.3	17.3	22.4	41.7	41.7	21.3
41	DBW 14 (C)	1.3	5.0	15.0	6.7	2.4	10.2	15.0	6.8
42	DBW 39 (C)	7.2	0.0	5.7	29.6	5.2	47.7	47.7	15.9
43	HD 2733 (C)	0.0	0.0	18.6	4.1	4.6	17.4	18.6	7.4
44	HD 2888 (C)	18.6	0.0	8.2	29.2	3.8	12.2	29.2	12.0
45	HD 2985 (C)	6.2	9.4	0.0	27.9	16.7	45.5	45.5	17.6
46	HI 1563 (C)	4.2	7.5	12.5	2.5	10.9	19.4	19.4	9.5
47	K 0307 (C)	1.2	1.2	0.0	5.4	4.5	7.3	7.3	3.3
48	K 1006 (I) (C)	7.3	0.8	3.3	4.6	3.2	22.8	22.8	7.0
49	K 8027 (C)	7.2	0.6	9.1	22.2	4.0	24.6	24.6	11.3
50	NW 2036 (C)	6.2	0.8	0.0	11.8	9.4	0.0	11.8	4.7
51	NW 5054 (I) (C)	8.2	9.1	31.1	8.2	1.6	45.3	45.3	17.3
IV. CENTRAL ZONE									
52	DBW 110	0.0	0.0	9.4	0.8	0.0	1.8	9.4	2.0

Sr. No.	Variety	% Karnal bunt incidence							
		Jammu	Hisar	Delhi	Dhaulakuan	Ludhiana	Karnal	HS	Av.
53	HI 8736 (D)	6.2	-	26.3	39.1	0.0	0.0	39.1	14.3
54	HI 8737 (D)	0.0	0.6	12.2	10.0	7.5	2.6	12.2	5.5
55	MP 3382	3.5	-	2.2	20.5	12.7	7.2	20.5	9.2
56	NIAW 1885	11.2	1.7	6.0	7.4	9.3	10.9	11.2	7.7
57	PBW 689	0.0	0.0	10.8	11.6	6.4	23.9	23.9	8.8
58	A 9-30-1 (D) (C)	3.5	3.6	7.8	5.3	7.1		7.8	5.5
59	GW 322 (C)	3.4	0.0	12.1	25.9	32.5	19.4	32.5	15.6
60	HD 2864 (C)	4.2	0.6	-	6.6	0.0	12.1	12.1	4.7
60. A	INFECTOR	21.2	6.9	16.7	45.5	25.5	33.8	45.5	24.9
61	HD 2932 (C)	7.2	1.4	2.4	4.4	8.3	18.3	18.3	7.0
62	HI 1500 (C)	6.4	-	2.6	26.3	15.0	69.2	69.2	23.9
63	HI 1544 (C)	10.2	13.8	7.3	24.8	13.0	27.7	27.7	16.1
64	HI 8498 (D) (C)	4.3	-	25.0	5.3	1.7	11.7	25.0	9.6
65	HI 8627 (D) (C)	7.6	10.1	12.5	20.0	5.0	5.9	20.0	10.2
66	MP 3288 (C)	11.0	1.5	7.0	13.0	0.5	4.2	13.0	6.2
67	MP 3336 (C)	7.8	3.9	4.8	4.1	3.3	1.6	7.8	4.2
68	MP 4010 (C)	10.2	2.1	22.2	11.7	10.0	8.8	22.2	10.8
69	MPO 1215 (d) (C)	4.6	0.0	46.7	1.7	0.0	2.6	46.7	9.3
V. PENINSULAR ZONE									
70	NIAW 1994	18.9	4.1	0.0	33.8	3.1	4.7	33.8	10.8
71	UAS 347	14.6	5.3	4.7	2.9	3.4	39.3	39.3	11.7
72	UAS 446 (D)	2.1	7.5	4.1	3.8	0.0	0.0	7.5	2.9
73	AKDW 2997-16(d)	0.0	0.6	3.3	1.9	0.0	0.0	3.3	1.0
74	HD 3090 (I) (C)	16.2	0.0	15.6	100.0	20.9	45.5	100.0	33.0
75	MACS 6222 (C)	0.0	3.8	17.1	10.7	3.1	32.8	32.8	11.3
76	MACS 6478 (C)	6.1	3.3	0.9	5.5	4.0	32.9	32.9	8.8
77	NI 5439 (C)	18.0	1.6	9.7	40.8	12.9	15.0	40.8	16.3
78	NIAW 1415 (C)	7.4	16.0	0.0	3.7	3.5	34.5	34.5	10.8
79	NIDW 295 (d) (C)	8.2	1.2	0.0	1.0	1.3	0.0	8.2	1.9
80	Raj 4083 (C)	2.1	0,0	0.0	20.0	8.0	25.2	25.2	9.2
80. A	INFECTOR	22.6	14.4	21.1	26.8	23.5	38.3	38.3	24.4
81	UAS 428 (d) (C)	6.2	9.8	4.0	1.8	0.0	6.2	9.8	4.7
VI. SOUTHERN HILLS ZONE									
82	CoW(W) 1 (C)	0.0	0.0	0.0	7.5	29.3	17.2	29.3	9.0
83	HW 2044 (C)	9.1	1.4	6.8	7.3	9.1	19.5	19.5	8.9
84	HW 5216 (C)	0.0	0.8	0.0	26.9	7.9	44.8	44.8	13.4
VII. SPECIAL TRIAL									
85	DDK 1042	0.0	0.0	0.0	0.0	5.0	20.8	20.8	4.3
86	MACS 5022	0.0	0.0	0.0	0.0	0.0	33.7	33.7	5.6
87	DDK 1029 (C)	1.2	7.5	0.0	0.0	0.0	27.6	27.6	6.1
88	HW 1098 (I) (C)	2.2	0.0	0.0	0.0	6.0	30.4	30.4	6.4
89	Kharchia 65 (C)	16.6	5.1	0.0	20.7	14.0	35.2	35.2	15.3
90	KRL 19 (C)	10.2	0.7	0.0	4.7	10.0	-	10.2	5.1
91	KRL 210 (C)	16.3	0.5	0.0	0.0	6.6	0.7	16.3	4.0
92	MACS 2496 (C)	0.0	9.2	0.0	1.9	10.9	22.9	22.9	7.5
93	MACS 2971 (C)	1.2	0.0	0.0	0.0	14.0	47.9	47.9	10.5
AVT IInd Year 2012-13									
94	DBW 74	2.1	2.3	13.0	6.1	0.6	19.4	19.4	7.3
95	DBW 93	1.3	1.3	8.6	1.0	15.6	31.6	31.6	9.9
96	HD 3091	5.5	2.3	2.4	9.3	3.3	3.3	9.3	4.3
97	HD 3093	6.2	0.0	7.1	3.3	8.6	48.3	48.3	12.3
98	HS 536	11.2	32.2	2.9	8.2	9.7	42.9	42.9	17.8
99	PBW 674	0.0	8.8	23.8	1.2	4.7	41.9	41.9	13.4
100	UAS 334	4.2	-	2.9	0.0	1.7	0.0	4.2	1.8
101	WH 1098	0.0	6.1	19.2	6.2	8.0	70.8	70.8	18.4
102	WH 1120	7.8	0.5	7.4	7.4	21.5	23.8	23.8	11.4
103	WH 1126	1.2	3.5	8.6	3.6	5.2	31.0	31.0	8.8
103. A	INFECTOR	23.4	-	3.3	22.6	40.5	33.3	40.5	24.6

Table 4.2: Karnal bunt incidence in KBSN entries evaluated under artificially inoculated condotions at multilocations during 2013-14

Sr. No.	Variety	% Karnal bunt incidence							
		Jammu	Hisar	Delhi	Dhaulakuan	Ludhiana	Karnal	HS	Av.
AVT Ist Year									
I. NORTHERN HILL ZONE									
1	HPW 373	10.5	3.7	0.0	0.8	9.3	23.0	23.0	7.9
2	HPW 400	4.2	6.5	0.0	0.4	7.8	25.2	25.2	7.3
3	HPW 401	3.7	11.5	11.8	0.0	12.5	41.1	41.1	13.4
4	HPW 410	4.8	0.0	13.9	11.3	3.3	18.1	18.1	8.6
5	HPW 411	2.8	3.8	0.0	3.2	8.1	36.2	36.2	9.0
6	HPW 412	2.1	0.8	0.0	10.3	6.3	23.9	23.9	7.2
7	HS 547	7.0	21.7	0.0	2.2	4.0	28.9	28.9	10.6
8	HS 558	2.1	6.9	8.3	6.0	9.4	11.8	11.8	7.4
9	HS 562	1.3	3.9	20.0	4.8	3.0	25.8	25.8	9.8
10	HS 577	1.6	0.0	4.9	4.0	5.4	5.7	5.7	3.6
11	HS 590	0.0	0.0	0.0	4.2	4.7	15.4	15.4	4.1
12	HS 591	5.6	0.5	0.0	6.9	25.2	35.8	35.8	12.3
13	HS 592	2.1	1.4	12.0	3.3	22.0	48.6	48.6	14.9
14	HS 593	5.6	0.5	6.1	3.2	2.4	25.0	25.0	7.1
15	HS 594	0.0	0.5	0.0	3.4	0.7	11.1	11.1	2.6
16	HS 595	0.0	10.5	0.0	8.2	1.0	16.1	16.1	6.0
17	UP 2890	5.2	12.8	0.0	16.7	13.3	46.8	46.8	15.8
18	UP 2891	0.0	1.6	3.3	8.2	2.1	32.0	32.0	7.9
19	VL 976	18.5	5.4	0.0	6.4	2.9	5.2	18.5	6.4
20	VL 977	16.2	10.5	0.0	12.6	0.0	53.4	53.4	15.4
20. A	INFECTOR	22.4	10.5	17.7	25.4	22.0	42.7	42.7	23.4
21	VL 1003	0.0	0.0	0.0	6.8	6.6	1.5	6.8	2.5
22	VL 1004	0.0	1.4	0.0	2.5	2.4	15.3	15.3	3.6
23	VL 3002	2.1	0.5	10.6	0.0	0.0	2.7	10.6	2.6
24	VL 3004	3.6	8.8	0.0	5.2	2.8	9.1	9.1	4.9
25	VL 3005	0.0	6.3	0.0	1.0	1.9	0.0	6.3	1.5
26	VL 3006	0.6	0.0	0.0	16.6	5.8	7.7	16.6	5.1
II. NORTH WESTERN PLAIN ZONE									
27	DBW 95	12.4	0.6	0.0	6.1	8.3	70.4	70.4	16.3
28	DBW 128	3.2	6.6	0.0	4.3	4.1	60.4	60.4	13.1
29	DBW 129	2.8	0.7	0.0	4.0	14.7	56.2	56.2	13.1
30	HD 3128	0.0	9.0	0.0	1.7	36.5	50.9	50.9	16.4
31	HD 3132	5.6	12.6	0.0	1.8	16.6	28.7	28.7	10.9
32	HD 3133	3.2	0.0	0.0	60.9	13.3	59.7	60.9	22.9
33	HD 3139	14.5	0.0	0.0	2.1	6.2	33.3	33.3	9.4
34	HD 4730	0.0	4.3	0.0	0.0	1.3	0.0	4.3	0.9
35	HUW 675	1.6	0.0	0.0	5.2	13.6	41.2	41.2	10.3
36	K 1204	2.3	1.6	0.0	12.0	21.0	12.4	21.0	8.2
37	MP 1277	8.6	0.0	0.0	1.3	7.6	0.0	8.6	2.9
38	PBW 677	11.3	8.8	0.0	15.0	9.3	45.6	45.6	15.0
39	PBW 692	0.0	0.0	0.0	2.2	3.5	12.1	12.1	3.0
40	PBW 695	0.0	3.9	3.4	5.4	18.5	38.6	38.6	11.6
40. A	INFECTOR	21.6	8.5	11.8	22.2	26.0	61.0	61.0	25.2
41	PBW 697	10.6	5.9	13.1	13.2	17.2	17.8	17.8	13.0

Sr. No.	Variety	% Karnal bunt incidence							
		Jammu	Hisar	Delhi	Dhaulakuan	Ludhiana	Karnal	HS	Av.
42	PBW 698	6.7	0.0	9.1	3.9	5.9	37.3	37.3	10.5
43	PBW 702	14.5	2.2	17.9	9.1	4.7	30.8	30.8	13.2
44	PBW 703	6.7	6.4	0.0	4.0	5.0	39.7	39.7	10.3
45	PBW 706	1.5	1.3	0.0	6.3	10.0	26.6	26.6	7.6
46	TL 2995	0.0	8.6	0.0	1.5	13.1	15.7	15.7	6.5
47	UAS 356	7.1	9.7	0.0	10.6	21.6	48.0	48.0	16.2
48	WH 1154	18.6	4.9	0.0	14.3	5.6	0.0	18.6	7.2
49	WH 1156	1.5	3.2	0.0	20.5	15.7	69.3	69.3	18.4
50	WH 1157	1.9	2.1	0.0	3.6	4.5	36.4	36.4	8.1
51	WH 1164	18.6	8.1	15.0	18.5	20.8	61.0	61.0	23.7
III. NORTH EASTERN PLAIN ZONE									
52	DBW 126	6.2	3.3	0.0	9.5	11.7	41.6	41.6	12.0
53	DBW 98	16.3	4.8	0.0	5.4	16.7	29.7	29.7	12.1
54	HD 3127	0.0	3.4	0.0	8.6	2.0	51.7	51.7	11.0
55	HUW 661	0.0	13.8	0.0	6.7	10.9	17.3	17.3	8.1
56	HUW 677	1.5	6.5	0.0	11.0	0.7	34.9	34.9	9.1
57	HUW 679	0.0	0.0	0.0	9.1	0.8	15.9	15.9	4.3
58	PBW 693	1.6	1.7	0.0	5.8	7.3	57.1	57.1	12.3
59	PBW 701	4.5	0.0	0.0	1.0	2.0	64.0	64.0	11.9
60	PBW 704	2.1	2.5	0.0	3.0	11.9	32.5	32.5	8.7
60. A	INFECTOR	24.6	9.4	9.8	35.4	26.7	69.7	69.7	29.3
61	UP 2855	0.0	0.0	0.0	4.8	3.3	53.8	53.8	10.3
62	WH 1132	5.2	2.9	2.5	12.5	7.5	37.9	37.9	11.4
IV. CENTRAL ZONE									
63	CG 1010	8.2	5.5	0.0	0.0	4.7	5.5	8.2	4.0
64	DDW 30 (D)	0.0	4.1	0.0	5.9	0.0	5.6	5.9	2.6
65	GW 451	6.7	0.5	0.0	7.6	9.3	17.2	17.2	6.9
66	GW 455	10.5	1.4	3.3	6.6	6.0	1.7	10.5	4.9
67	HD 3146	4.2	7.3	0.0	11.2	3.3	34.4	34.4	10.1
68	HD 4728 (D)	6.5	7.3	0.0	0.0	2.4	5.4	7.3	3.6
69	HI 8750 (D)	0.0	4.2	0.0	0.0	0.0	40.6	40.6	7.5
70	HI 8755 (D)	1.1	4.3	0.0	1.9	2.9	3.4	4.3	2.3
71	K 1215	18.5	3.4	0.0	10.2	7.2	15.7	18.5	9.2
72	K 1217	16.6	3.7	0.0	13.8	3.6	13.4	16.6	8.5
73	MACS 3916 (D)	2.1	1.5	0.0	0.4	0.9	0.0	2.1	0.8
74	MACS 3927 (D)	0.0	4.3	16.0	1.0	2.3	4.0	16.0	4.6
75	MACS 6604	10.8	15.9	0.0	8.7	4.3	0.0	15.9	6.6
76	MP 1279	12.6	0.0	0.0	2.7	12.9	49.6	49.6	13.0
77	NIAW 2030	16.3	3.7	0.0	5.0	8.5	44.5	44.5	13.0
78	UAS 451 (D)	-	2.1	5.0	0.0	0.0	0.0	5.0	1.4
V. PENINSULAR ZONE									
79	DDW 27 (D)	0.0	6.0	15.5	0.0	1.3	3.7	15.5	4.4
80	HI 8751 (D)	4.2	0.0	13.0	0.5	0.5	0.0	13.0	3.0
80. A	INFECTOR	24.5	19.6	8.8	18.1	21.2	64.3	64.3	26.1
81	HI 8754 (D)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
82	K 1213	1.6	0.0	33.8	2.4	14.3	62.7	62.7	19.1
83	UP 2864	12.6	16.4	0.0	8.1	8.0	36.8	36.8	13.6

Sr. No.	Variety	% Karnal bunt incidence							
		Jammu	Hisar	Delhi	Dhaulakuan	Ludhiana	Karnal	HS	Av.
VI. SOUTHERN HILLS ZONE									
84	MACS 6507	6.3	0.9	24.8	10.6	6.1	5.6	24.8	9.0
85	UAS 358	2.0	0.9	0.0	0.0	0.0	0.0	2.0	0.5
VII. SPECIAL TRIAL (Dicoccum and Sailinity and Alkalinity)									
86	DBW 154	0.0	0.5	10.0	9.5	15.3	46.5	46.5	13.6
87	DBW 155	2.1	2.7	5.4	0.9	1.7	26.3	26.3	6.5
88	MACS 5040	0.0	0.0	0.0	0.0	0.0	50.0	50.0	8.3
89	MACS 5031	0.5	0.0	34.5	0.0	0.0	15.4	34.5	8.4
90	DDK 1046	0.0	0.0	0.0	0.0	18.8	36.0	36.0	9.1
91	DDK 1044	5.2	0.0	0.0	0.0	4.0	0.0	5.2	1.5
92	HW 1099	2.2	0.0	0.0	0.0	0.0	59.4	59.4	10.3
III. SPECIAL TRIAL (TRITICALE)									
93	TL 2996	0.0	11.3	0.0	18.4	0.0	20.8	20.8	8.4
94	TL 2997	1.2	5.1	0.0	20.4	7.2	4.4	20.4	6.4
95	TL 2998	1.6	0.8	0.0	5.0	11.3	15.4	15.4	5.7
96	TL 2999	0.6	3.4	8.7	8.1	1.2	4.9	8.7	4.5
97	TL 3000	0.0	0.4	0.0	0.0	0.0	0.0	0.4	0.1
98	TL 2942 (C)	0.0	0.0	0.0	2.7	0.0	0.0	2.7	0.5
99	TL 2969 (C)	2.1	0.0	0.0	11.5	0.0	3.8	11.5	2.9
IV. SPECIAL TRIAL (MABB/NIL ENTRIES)									
100	PBW 722	0.0	18.2	0.0	1.0	3.6	15.3	18.2	6.3
100. A	INFECTOR	21.6	16.3	11.3	15.1	21.3	53.3	53.3	23.2
101	PBW 723	2.1	7.7	4.2	8.3	8.5	27.2	27.2	9.7
102	KB 2012-03	0.0	1.1	0.0	0.5	0.0	3.0	3.0	0.8
103	HD 2932+Sr26	0.0	0.0	0.0	3.2	1.8	10.6	10.6	2.6
104	HD 2932+Lr19/Sr2	0.0	4.4	0.0	3.5	0.0	35.3	35.3	7.2
105	MMBL 283	2.6	7.2	29.6	6.7	6.9	8.7	29.6	10.3
106	HUW 234 (C)	4.9	2.3	0.0	2.2	0.0	43.3	43.3	8.8
107	PBW 343 (C)	12.6	4.4	0.0	5.8	14.4	8.1	14.4	7.6
107. A	INFECTOR	24.3	9.8	9.3	15.9	21.1	56.8	56.8	22.9

Table 4.3: Evaluation of NIVT entries against KB (% incidence) under artificially inoculated conditions

Sr. No.	Variety	Ludhiana	Dhaulakuan	HS
NIVT 1A				
1	PBW 708	15.8	0.6	15.8
2	HD 3153	1.8	4.6	4.6
3	DBW 137	10.6	9.5	10.6
4	DBW 140	29.0	4.1	29.0
5	NW 6029	5.0	1.9	5.0
6	RAJ 4373	8.0	2	8.0
7	K 1302	2.0	10	10.0
8	NW 6036	3.3	4.1	4.1
9	JKW 203	28.3	19.8	28.3
10	HUW 680	25.0	2	25.0
11	DBW 139	0.0	1.1	1.1
12	HUW 681	12.9	6.8	12.9
13	WH 1172	2.3	4.7	4.7
14	UP 2873	20.5	5.8	20.5
15	BRW 3750	1.5	3.3	3.3
16	BRW 3742	3.0	6.8	6.8
17	HD 3158	3.5	6.7	6.7
18	HD 3151	7.1	10.7	10.7
19	UP 2874	13.8	9.4	13.8
20	JKW 193	11.1	0.1	11.1
20. A	INFECTOR	22.9	12.6	22.9
21	HD 3156	4.5	4.2	4.5
22	PBW 709	0.9	5.6	5.6
23	DBW 134	0.0	0.2	0.2
24	RAJ 4376	3.3	5.4	5.4
25	RAJ 4377	2.5	14.7	14.7
26	DBW 138	5.3	1.6	5.3
27	WH 1169	14.3	7.3	14.3
28	HD 3157	8.5	0.7	8.5
29	WH 1168	8.8	4.6	8.8
30	HD 3155	6.5	0.6	6.5
31	RAJ 4375	3.6	0.9	3.6
32	RAJ 4374	5.3	3.7	5.3
33	DBW 135	6.0	13.7	13.7
34	PBW 710	12.7	8	12.7
35	WH 1170	0.0	8	8.0
36	HD 3152	8.5	2.9	8.5
37	PBW 707	0.0	6.8	6.8
38	PBW 711	4.0	6.7	6.7
39	HD 3154	6.8	2	6.8
40	K 1301	0.0	3.6	3.6
40. A	INFECTOR	26.4	10.2	26.4
41	UP 2875	4.5	5.75	5.8
42	WH 1171	5.0	7.3	7.3
43	UP 2877	7.0	9.6	9.6
44	DBW 136	4.4	1.2	4.4
45	UP 2876	17.5	12.9	17.5
NIVT 1B				
46	BRW 3748	9.7	7.1	9.7
47	DBW 143	1.4	6.9	6.9
48	HUW 686	7.2	0.2	7.2
49	DBW 145	4.5	0.3	4.5
50	HUW 685	0.0	1.4	1.4
51	WH 1173	15.2	1.3	15.2
52	HD 3159	0.7	4.6	4.6

Sr. No.	Variety	Ludhiana	Dhaulakuan	HS
53	HD 3162	1.7	0	1.7
54	NW 6025	1.8	1.2	1.8
55	NW 6023	3.5	0.2	3.5
56	K 1306	0.0	6.1	6.1
57	PBW 714	1.0	2.3	2.3
58	HD 3160	2.4	19.4	19.4
59	PBW 712	3.2	2.2	3.2
60	UP 2878	5.6	5.6	5.6
60. A	INFECTOR	22.0	19.2	22.0
61	WH 1175	8.1	5.7	8.1
62	UP 2879	23.8	4.7	23.8
63	NW 6033	0.5	6.8	6.8
64	BRW 3743	12.5	17	17.0
65	DBW 144	5.5	-	5.5
66	DBW 141	1.4	0.8	1.4
67	DBW 142	0.0	1	1.0
68	NW 6031	11.3	1.8	11.3
69	WH 1174	12.6	5.3	12.6
70	KDW 2010	0.0	7.6	7.6
71	Ankur BW 249	0.0	1.1	1.1
72	BRW 3747	7.2	4.8	7.2
73	K 1305	2.5	2.6	2.6
74	K 1304	4.8	8.1	8.1
75	PBW 713	14.8	13.6	14.8
76	HUW 682	7.5	9.7	9.7
77	HD 3161	2.8	0	2.8
78	UP 2880	40.0	5.1	40.0
79	K 1307	1.3	1.2	1.3
80	HP 1956	34.3	5.5	34.3
80. A	INFECTOR	21.1	4.3	21.1
81	RAJ 4379	3.8	2.5	3.8
82	NW 6028	6.9	7	7.0
83	RAJ 4378	1.3	5.5	5.5
84	HUW 684	0.0	1.1	1.1
85	K 1308	1.3	3.8	3.8
86	HI 1606	2.5	11.2	11.2
87	HI 1599	1.3	19.3	19.3
88	HP 1957	0.0	11.6	11.6
89	HUW 683	9.2	10.1	10.1
90	RAJ 4380	0.6	1.2	1.2
NIVT 2				
91	HD 3164	20.9	2.1	20.9
92	UAS 363	4.1	3.4	4.1
93	GW 463	1.8	5.8	5.8
94	RVW 4205	8.4	0	8.4
95	JWS 530	3.0	2.6	3.0
96	GW 461	24.2	2.7	24.2
97	GW 459	0.0	0.9	0.9
98	UAS 361	17.4	3.8	17.4
99	GW 460	3.0	4.4	4.4
100	RAJ 4381	6.0	-	6.0
100. A	INFECTOR	21.4	18.6	21.4
101	RAJ 4382	0.0	3.2	3.2
102	UAS 362	13.0	3	13.0
103	DBW 146	1.0	4	4.0
104	HI 1600	0.0	3.7	3.7
105	UAS 360	2.8	1	2.8
106	MP 1296	18.0	4	18.0

Sr. No.	Variety	Ludhiana	Dhaulakuan	HS
107	MP 1297	4.3	3.9	4.3
108	HI 1602	3.5	8.3	8.3
109	MACS 6640	2.7	5.6	5.6
110	UP 2881	12.3	2	12.3
111	HI 1601	15.8	7.1	15.8
112	MP 3421	0.0	17	17.0
113	HI 1603	0.7	0.6	0.7
114	GW 458	5.1	7.3	7.3
115	PBW 715	2.4	1.7	2.4
116	LOK 72	5.3	2	5.3
117	MP 1298	10.8	12.3	12.3
118	MACS 6632	26.7	3.1	26.7
119	AKAW 4730	3.6	1	3.6
120	NIAW 2345	23.8	3.6	23.8
120. A	INFECTOR	24.0	3.5	24.0
121	K 1310	13.8	2.5	13.8
122	CG 1014	-	9.8	9.8
123	WH 1176	11.9	13.3	13.3
124	NIAW 2313	4.0	0.4	4.0
NIVT - 3				
125	HD 3170	5.9	8.8	8.8
126	GW 465	4.0	1.5	4.0
127	RVW 4204	5.9	3.8	5.9
128	HD 3167	4.7	2.3	4.7
129	HD 3169	5.0	4.1	5.0
130	UAS 364	6.0	2.7	6.0
131	PBW 718	20.3	25.6	25.6
132	PBW 716	15.0	5.8	15.0
133	WH 1178	11.6	6.6	11.6
134	WH 1179	4.0	2.8	4.0
135	HI 1604	2.4	0	2.4
136	GW 467	5.5	0.6	5.5
137	RAJ 4385	37.6	18.7	37.6
138	K 1313	12.9	8.5	12.9
139	DBW 148	24.3	7.4	24.3
140	UP 2884	3.5	2.3	3.5
140. A	INFECTOR	21.8	15.8	21.8
141	DBW 151	13.3	2.1	13.3
142	MP 1299	8.3	4.4	8.3
143	UP 2885	6.0	1.6	6.0
144	HUW 688	2.3	0.4	2.3
145	HI 8756 (d)	12.7	8.7	12.7
146	WH 1177	20.0	12.4	20.0
147	NW 6024	43.2	4.3	43.2
148	UP 2882	6.7	6.4	6.7
149	RAJ 4384	6.7	0.1	6.7
150	MP 3420	13.3	2.8	13.3
151	UP 2883	9.1	9.8	9.8
152	DBW 147	28.4	4.9	28.4
153	MP 1300	4.7	0.4	4.7
154	PBW 717	15.8	13.5	15.8
155	AKAW 4843	3.6	8.6	8.6
156	K 1312	2.7	3.2	3.2
157	CG 1015	2.9	0	2.9
158	BRW 967	0.8	3.8	3.8
159	K 1314	7.5	1.5	7.5
160	HUW 687	21.3	4.2	21.3
160. A	INFECTOR	45.7	13	45.7

Sr. No.	Variety	Ludhiana	Dhaulakuan	HS
161	HD 3166	25.3	4.4	25.3
162	HD 3168	15.3	2.5	15.3
163	HD 3165	8.7	3.8	8.7
164	RAJ 4383	7.9	2.1	7.9
165	NIAW 2304	0.0	6.3	6.3
166	GW 466	0.0	2.2	2.2
167	DBW 150	0.0	0	0.0
168	DBW 149	6.3	3.9	6.3
169	PBW 719	19.6	11.6	19.6
NIVT - 4				
170	PDW 341	4.1	0	4.1
171	WHD 955	10.5	2.9	10.5
172	PDW 339	0.0	0	0.0
173	GW 1310	2.0	1.1	2.0
174	HI 8759	9.1	0.7	9.1
175	PDW 340	8.2	0	8.2
176	HI 8761	14.0	2	14.0
177	UAS 452	0.0	0	0.0
178	RKD 280	0.0	0.4	0.4
179	HI 8757	4.5	0	4.5
180	MPO 1302	3.1	0	3.1
180. A	INFECTOR	36.7	18.1	36.7
181	UAS 453	0.0	4.2	4.2
182	HI 8758	16.2	0	16.2
183	RKD 279	0.0	3.9	3.9
184	PBND 5128	0.0	0	0.0
185	NIDW 841	0.0	0	0.0
186	NIDW 842	0.0	16	16.0
187	HI 8760	4.3	0.4	4.3
188	HD 4732	7.0	0.8	7.0
189	UPD 96	1.5	0	1.5
190	PDW 342	2.1	0.8	2.1
191	HD 4731	1.2	0.3	1.2
192	GW 1311	1.8	5.5	5.5
193	MACS 4024	0.0	0	0.0
194	DDW 31	0.0	0	0.0
195	GW 1308	0.0	0	0.0
196	MACS 3949	0.0	0	0.0
197	WHD 956	0.8	0.6	0.8
198	DDW 32	16.7	0.2	16.7
199	GW 1309	5.1	1.8	5.1
200	MPO 1301	0.0	9.3	9.3
200. A	INFECTOR	21.0	0.7	21.0
201	MACS 4023	0.0	0	0.0
NIVT - 5A				
202	HD 3171	0.0	25.7	25.7
203	UP 2887	6.4	0.9	6.4
204	HD 3174	8.0	16.3	16.3
205	MP 1290	12.2	11.7	12.2
206	MP 1293	2.5	0.9	2.5
207	HUW 689	2.0	10.1	10.1
208	WH 1166	2.0	15.7	15.7
209	UP 2886	1.5	9.7	9.7
210	MACS 6648	3.3	23	23.0
211	K 1316	9.4	7.5	9.4
212	CG 1012	6.0	4.6	6.0
213	UAS 365	4.9	11.7	11.7
214	K 1315	0.4	2.8	2.8

Sr. No.	Variety	Ludhiana	Dhaulakuan	HS
215	HI 1605	0.0	3.3	3.3
216	RAJ 4386	12.1	2.8	12.1
217	PBW 720	7.2	2.7	7.2
218	PBW 721	10.9	10.2	10.9
219	WH 1167	3.0	3.6	3.6
220	MP 3424	7.1	1	7.1
220. A	INFECTOR	19.3	17.6	19.3
221	NIAW 2325	0.0	4.2	4.2
222	BRW 3753	0.0	4.9	4.9
223	MP 1291	0.0	3.8	3.8
224	HD 3173	28.5	0.1	28.5
225	JWS 712	23.8	2.4	23.8
226	DBW 153	8.4	6.7	8.4
227	K 1317	2.8	0.5	2.8
228	MACS 6607	1.1	6.3	6.3
229	NW 6035	33.3	4.3	33.3
230	DBW 152	53.2	7	53.2
231	HD 3172	18.8	6.1	18.8
232	MP 1292	2.7	1.9	2.7
233	JAUW 621	3.5	7.8	7.8
NIVT - 5B				
234	UAS 455	2.0	0	2.0
235	GW 1313	0.0	0	0.0
236	RKD 268	0.0	0	0.0
237	HI 8764	0.8	0	0.8
238	RKD 270	0.0	1.7	1.7
239	MACS 3972	2.1	1.1	2.1
240	HI 8762	0.0	0	0.0
240. A	INFECTOR	24.2	15.5	24.2
241	MACS 3970	0.0	0.6	0.6
242	HI 8765	1.0	0	1.0
243	MPO 1294	0.0	0	0.0
244	DDW 34	0.0	0	0.0
245	GW 1316	35.0	0	35.0
246	NIDW 765	0.0	0	0.0
247	GW 1315	0.0	0	0.0
248	MACS 4020	0.0	0	0.0
249	MPO 1295	0.0	0	0.0
250	KD 1318	0.7	0.5	0.7
251	UAS 454	0.3	0	0.3
252	GW 1314	1.9	3.1	3.1
253	HI 8766	1.3	0	1.3
254	HI 8763	0.0	0.4	0.4
255	GW 1317	0.0	0.5	0.5
256	DDW 33	3.6	1.5	3.6
IVT				
I. NORTHERN HILL ZONE				
257	VL 2010	2.9	2.3	2.9
258	VL 2007	21.6	5.1	21.6
259	HS 587	0.7	4.1	4.1
260	HPW 406	64.8	14	64.8
260. A	INFECTOR	16.7	4.3	16.7
261	HS 583	32.6	3.2	32.6
262	VL 2008	8.5	14.1	14.1
263	HPW 405	7.7	4.7	7.7
264	HS 584	3.8	3.4	3.8
265	HS 585	4.0	1.3	4.0
266	HS 586	7.2	9.6	9.6

Sr. No.	Variety	Ludhiana	Dhaulakuan	HS
267	VL 2012	6.8	10	10.0
268	UP 2888	32.0	7.9	32.0
269	HPW 403	1.7	1.9	1.9
270	VL 2011	6.3	7.6	7.6
271	UP 2889	4.0	2.5	4.0
272	HPW 409	1.0	0.3	1.0
273	HPW 408	0.5	0	0.5
274	HS 581	5.0	3.6	5.0
275	HPW 407	7.1	3.3	7.1
276	VL 2009	3.5	11.2	11.2
277	HS 582	11.7	16.7	16.7
278	HPW 404	4.9	2.8	4.9
II. SOUTHERN HILLS ZONE				
279	HW 3620	1.7	0.5	1.7
280	HW 5801	10.0	0	10.0
280. A	INFECTOR	23.4	19	23.4
281	HS 589	10.0	4.3	10.0
282	HW 5049	7.5	1.5	7.5
283	UAS 368	0.0	3.5	3.5
284	HW 3608	0.0	3	3.0
285	HW 3627	5.0	5.1	5.1
286	HW 5802	8.8	0.6	8.8
287	HW 3607	0.0	3.8	3.8
288	HW 3906	17.8	5.6	17.8
289	UAS 367	20.0	7.6	20.0
290	HW 4215-1	6.0	4	6.0
291	HW 5047	10.5	2.9	10.5
292	HW 5048	4.7	5.2	5.2
III. SPECIAL TRIAL (Wheat Biofortification)				
293	SPL-WB-HD 3175	14.6	6.2	14.6
294	SPL-WB-HD 3176	6.0	0.8	6.0
295	SPL-WB-HD 3177	8.0	0	8.0
296	SPL-WB-HD 3178	0.0	2.3	2.3
297	SPL-WB-HD 3179	0.0	1.5	1.5
298	SPL-WB-HPBW 01	17.3	23.9	23.9
299	SPL-WB-HPBW 02	17.5	15.3	17.5
300	SPL-WB-HPBW 03	0.0	4	4.0
300. A	INFECTOR	21.8	5.1	21.8
301	SPL-WB-HPBW 04	3.8	1.8	3.8
302	SPL-WB-HPBW 05	5.6	14.6	14.6
303	SPL-WB-HPBW 06	0.5	0.9	0.9
304	SPL-WB-HUW-694	10.8	5.8	10.8
305	SPL-WB-HUW-695	6.0	14.9	14.9
306	SPL-WB-HUW-696	0.0	3.4	3.4
307	SPL-WB-WB-01	8.6	4.7	8.6
308	SPL-WB-WB-02	8.0	11.1	11.1
309	SPL-WB-WB-03	33.3	18.1	33.3
310	SPL-WB-WB-04	12.8	22	22.0
311	SPL-WB-WB-05	6.3	1.3	6.3
311. A	INFECTOR	27.3	17.9	27.3

PROGRAMME 5. LOOSE SMUT

5.1 EVALUATION OF AVT MATERIAL (2012-13) AGAINST *Ustilago segetum tritici*

Loose smut is an internally seed borne disease caused by *Ustilago segetum tritici* and mainly prevalent in northern hills and plains zone. Though the disease can be managed my seed treatment but resistant varieties are always liked by the farmers to manage loose smut as it is economical and convenient. Keeping in view of higher preference of host resistance, the entries of AVT I & II year (2012-13), were inoculated with local isolates of loose smut pathogen using 'Go go' method at hot spot locations like Hisar, Ludhiana, Durgapura and Almora. The disease data from Durgapura is not included. These inoculated seeds were sown again during 2013-14 crop season at these locations of NWPZ and NHZ for expression of disease. A total of 227 entries out of which 101 from AVT II year 2012-13 and 126 from AVT I year 2012-13 were screened. Both healthy as well as smutted tillers were counted and per cent infected tillers were calculated.

The variations were also observed amongst different genotypes at different locations under artificially inoculated conditions. The loose smut incidence in check variety 'Sonalika' was in the range of 15.5 -90.6% at different locations. The highest and average disease score was taken for each entry. The detailed data of AVT II year and AVT I year of 2012-13 are presented in Table 5.1 and Table 5.2, respectively. The promising entries in AVTs are:

AVT IInd year, 2012-13

Free (No infection at any location):
HI 8728, PDW 291 (C) (d), HI 8727 (d), A 9-30-1 (C) (d), HI 8498 (d) (C), HI 8627 (C), HI 8713 (d) (I) (C), NIDW 295 (d) (C), WHD 948 (d) (I) (C) and MACS 2971 (C).

Resistant (Average score: 0.1-5.0 % infection):
HS 542, HS 277 (C), HD 3086, K 1006 and MPO 1215 (d) (C).

AVT Ist Year, 2011-12

Free (No infection at any location):
VL 3001, VL 3003, HI 8735, HI 8736, HI 8738, HI 8739, MACS 3929, NIDW 706, UPD 94, HI 8742 (d), DDK 1042, DDK 1045, HW 1099, MACS 5022, VW0860 and VW0954.

Resistant (Average score: 0.1-5.0% infection):
WH 1138, DDW 23, HW 5237, VW0513, VW0752 and VW0855.

COOPERATORS:

NAME	CENTRE
RITU BALA	LUDHIANA
S. K. JAIN	ALMORA
S. S. KARWASRA, R.S. BENIWAL	HISAR
R.K. BANSAL & NITIN CHAWLA	DURGAPURA
SUDHEER KUMAR	DWR, KARNAL

Table 5.1. Per cent infected tillers due to loose smut in the entries of AVT IInd year 2012-13 expressed during 2013-14 crop season

S. No.	Entry	Ludhiana	Hisar	Almora	HS	AV.
NORTH HILL ZONE						
1	HS 536	37.2	20	29.8	37.2	29.0
2	HS 542	12.3	0	0	12.3	4.1
3	HPW 251 (C)	28.6	20.31	44.3	44.3	31.1
4	HPW 349 (I) (C)	0.0	50	43.3	50.0	31.1
5	HS 277 (C)	0.0	5.41	0	5.4	1.8
6	HS 490 (C)	18.8	50	36.3	50.0	35.0
7	HS 507 (C)	24.6	30.31	15.7	30.3	23.5
8	VL 804 (C)	19.2	0	61.5	61.5	26.9
9	VL 829 (C)	0.0	50.31	0	50.3	16.8
10	VL 892 (C)	30.2	0	53.2	53.2	27.8
11	VL 907 (C)	24.4	0	58.3	58.3	27.6
NORTH WESTERN PLAIN ZONE						
12	DBW 74	26.2	40.25	48.8	48.8	38.4
13	DBW 88	22.6	80	59.4	80.0	54.0
14	DBW 90	0.0	30.21	0	30.2	10.1
15	HD 3070	8.0	40	26.5	40.0	24.8
16	HD 3086	12.6	0	0	12.6	4.2
17	HD 3091	15.2	60.13	88.4	88.4	54.6
18	HI 8728	0.0	0	0	0.0	0.0
19	PBW 660	23.2	40.13	57.3	57.3	40.2
20	PBW 674	1.4	60.13	72.2	72.2	44.6
20A	SONALIKA (C)	33.3	90.6	82.2	90.6	68.7
21	PBW 675	14.8	20	48.9	48.9	27.9
22	WH 1098	36.2	60	34.4	60.0	43.5
23	WH 1124	0.0	50	0	50.0	16.7
24	WH 1126	0.0	50	70.1	70.1	40.0
25	WH 1127	2.6	50	8.3	50.0	20.3
26	C 306 (C)	23.5	80	29.5	80.0	44.3
27	DBW 17 (C)	5.5	60.13	40.2	60.1	35.3
28	DBW 71 (I) (C)	17.9	60.31	87.8	87.8	55.3
29	DPW 621-50 (C)	13.8	80	21.4	80.0	38.4
30	HD 2967 (C)	32.5	60.15	66	66.0	52.9
31	HD 3043 (C)	0.0	80	0	80.0	26.7
32	HD 3059 (I) (C)	13.5	80.13	85.7	85.7	59.8
33	PBW 175 (C)	19.7	80.31	50.8	80.3	50.3
34	PBW 373 (C)	14.3	50.15	88.8	88.8	51.1
35	PBW 590 (C)	28.0	50	78.6	78.6	52.2
36	PBW 644 (C)	24.8	60	22.7	60.0	35.8
37	PDW 291 (C) (d)	0.0	0	0	0.0	0.0
38	PDW 314 (C) (d)	11.0	60.13	0	60.1	23.7
39	WH 1021 (C)	24.3	50	64.5	64.5	46.3
40	WH 1080 (C)	35.2	50.15	41.8	50.2	42.4
40A	SONALIKA (C)	14.1	90.45	74.8	90.5	59.8
41	WH 1105 (I) (C)	27.9	80	72.2	80.0	60.0
NORTH EASTERN PLAIN ZONE						
42	HD 3076	8.0	20	9.6	20.0	12.5
43	K 1006	0.0	5.21	0	5.2	1.7
44	NW 5054	20.6	60	15.8	60.0	32.1

S. No.	Entry	Ludhiana	Hisar	Almora	HS	AV.
45	PBW 661	25.4	40.27	44.2	44.2	36.6
46	Raj 4250	13.0	60.14	65.7	65.7	46.3
47	WH 1120	0.0	30.14	0	30.1	10.0
48	DBW 14 (C)	0.0	40	29.3	40.0	23.1
49	DBW 39 (C)	0.0	40	17.7	40.0	19.2
50	HD 2733 (C)	39.2	70.23	19	70.2	42.8
51	HD 2888 (C)	12.5	30.13	11.9	30.1	18.2
52	HD 2985 (C)	24.2	40.43	39.4	40.4	34.7
53	HI 1563 (C)	18.5	30.25	35.1	35.1	27.9
54	K 0307 (C)	3.9	40.23	28.3	40.2	24.1
55	K 8027 (C)	35.7	40.31	54.4	54.4	43.5
56	NW 2036 (C)	46.3	60	30.5	60.0	45.6
57	RAJ 4229 (I) (C)	12.5	50.15	75.2	75.2	46.0
CENTRAL ZONE						
58	HD 3095	31.9	80	38.7	80.0	50.2
59	HI 8724 (d)	0.0	40.71	4	40.7	14.9
60	HI 8725 (d)	0.0	80.15	0	80.2	26.7
60A	SONALIKA (C)	38.8	90.15	85.3	90.2	71.4
61	HI 8727 (d)	0.0	0	0	0.0	0.0
62	HI 8731 (d)	0.0	30.21	0	30.2	10.1
63	MPO 1255 (d)	0.0	50	0	50.0	16.7
64	A 9-30-1 (C) (d)	0.0	0	0	0.0	0.0
65	GW 322 (C)	8.8	30.31	39.6	39.6	26.2
66	HD 2864 (C)	31.9	-	68	68.0	49.9
67	HI 1500 (C)	16.7	60.27	35.6	60.3	37.5
68	HI 1544 (C)	22.5	40..23	18.3	22.5	20.4
69	HI 8498 (d) (C)	0.0	0	0	0.0	0.0
70	HI 8627 (C)	0.0	0	0	0.0	0.0
71	HI 8713 (d) (I) (C)	0.0	0	0	0.0	0.0
72	MP 3288 (C)	23.3	40	38.4	40.0	33.9
73	MP 3336 (I) (C)	21.7	40.13	27.7	40.1	29.9
74	MP 4010 (C)	30.4	50	46.2	50.0	42.2
75	MPO 1215 (d) (C)	0.0	10	0	10.0	3.3
76	RAJ 4238 (I) (C)	25.7	30.27	56	56.0	37.3
PENNISULAR ZONE						
77	DBW 93	19.2	30.13	29.4	30.1	26.3
78	GW 432	11.1	30.21	30.2	30.2	23.8
79	HD 3090	19.4	40.25	20	40.3	26.6
80	HD 3093	15.5	0	10.3	15.5	8.6
80A	SONALIKA (C)	17.8	80.21	83.3	83.3	60.4
81	MACS 6478	16.7	30.11	64.6	64.6	37.1
82	UAS 334	23.3	50.25	39.8	50.3	37.8
83	AKDW 2997-16(d) (C)	2.5	50	0	50.0	17.5
84	HD 2932 (C)	27.6	60.75	61.3	61.3	49.9
85	MACS 6222 (C)	22.8	0	32.1	32.1	18.3
86	NI 5439 (C)	17.3	30.13	84.9	84.9	44.1
87	NIAW 1415 (C)	30.6	40.31	33.7	40.3	34.9
88	NIAW 34 (C)	18.6	30.13	24	30.1	24.2
89	NIDW 295 (d) (C)	0.0	0	0	0.0	0.0
90	Raj 4083 (C)	0.0	60	76.3	76.3	45.4
91	UAS 428 (d) (C)	0.0	50	0	50.0	16.7
92	WHD 948 (d) (I) (C)	0.0	0	0	0.0	0.0

S. No.	Entry	Ludhiana	Hisar	Almora	HS	AV.
SOUTH HILL ZONE						
93	HW 5224	0.0	40.15	0	40.2	13.4
94	CoW(W) 1 (C)	33.9	-	34.7	34.7	34.3
95	HW 2044 (C)	20.0	40.15	44.4	44.4	34.9
96	HW 5216 (I) (C)	1.7	20.25	10.8	20.3	10.9
SPECIAL TRIAL						
97	DDK 1029 (C)	0.0	40.15	7.5	40.2	15.9
98	Kharchia 65 (C)	20.0	60	20	60.0	33.3
99	KRL 210 (C)	0.0	50.61	0	50.6	16.9
100	MACS 2496 (C)	14.0	0	66.4	66.4	26.8
100A	SONALIKA (C)	18.2	50	69.1	69.1	45.8
101	MACS 2971 (C)	0.0	-	0	0.0	0.0

Table 5.2. Per cent infected tillers due to loose smut in the entries of AVT I[st] year 2012-13 expressed during 2013-14 crop season

S. No.	Entry	Ludhiana	Hisar	Almora	HS	AV.
NORTH HILL ZONE						
1	HPW 376	21.8	50	10.6	50.0	27.5
2	HPW 380	8.2	0	46.6	46.6	18.3
3	HPW 381	24.4	30.11	38.4	38.4	31.0
4	HPW 387	20.0	20.55	36.2	36.2	25.6
5	HPW 388	22.4	75.13	0	75.1	32.5
6	HPW 397	0.0	80	0	80.0	26.7
7	HPW 398	18.2	40.33	45.4	45.4	34.6
8	HPW 399	25.7	70.13	55.8	70.1	50.5
9	HS 557	6.7	0	15	15.0	7.2
10	HS 574	32.4	-	33.3	33.3	32.9
11	HS 575	11.4	80	39	80.0	43.5
12	HS 576	17.7	80	12.1	80.0	36.6
13	HS 577	31.8	20	55.5	55.5	35.8
14	HS 578	27.9	40.51	25.8	40.5	31.4
15	UP 2871	16.2	20	34.6	34.6	23.6
16	UP 2872	41.4	70.13	65.3	70.1	58.9
17	VL 1001	16.9	5.13	0	16.9	7.3
18	VL 1002	5.6	0	16.8	16.8	7.5
19	VL 3001	0.0	0	0	0.0	0.0
20	VL 3002	0.0	70.75	0	70.8	23.6
20A	SONALIKA (C)	18.9	90.13	83	90.1	64.0
21	VL 3003	0.0	0	0	0.0	0.0
22	VL 967	26.5	60.23	6.7	60.2	31.1
NORTH WESTERN PLAIN ZONE						
23	DBW 101	28.4	40	19	40.0	29.1
24	DBW 102	33.7	20.41	80.8	80.8	45.0
25	DBW 110	23.4	70	8.8	70.0	34.1
26	HD 3109	10.6	90.21	34	90.2	44.9
27	HD 3117	22.1	20.13	22.1	22.1	21.4
28	HD 3119	28.6	40.21	93.5	93.5	54.1
29	HD 3120	10.5	40	60.1	60.1	36.9
30	HD 3121	14.3	80	54.5	80.0	49.6
31	HD 3122	22.7	80	55.5	80.0	52.7
32	HD 3123	43.7	30.31	23.2	43.7	32.4
33	HI 8735	0.0	0	0	0.0	0.0

S. No.	Entry	Ludhiana	Hisar	Almora	HS	AV.
34	HI 8736	0.0	-	0	0.0	0.0
35	HI 8738	0.0	0	0	0.0	0.0
36	HI 8739	0.0	-	0	0.0	0.0
37	HUW 662	3.0	70.13	52.2	70.1	41.8
38	HUW 664	27.3	40	29.6	40.0	32.3
39	HUW 666	12.7	60.31	50	60.3	41.0
40	HUW 668	25.0	10	21.2	25.0	18.7
40A	SONALIKA (C)	29.2	90.15	85.8	90.2	68.4
41	HUW 669	18.4	60.21	34.5	60.2	37.7
42	JAUW 598	8.9	60	79.8	79.8	49.6
43	K 1114	12.8	70.21	78.9	78.9	54.0
44	MACS 3929	0.0	0	0	0.0	0.0
45	MP 3392	17.4	60	66.6	66.6	48.0
46	NIAW 1951	17.1	50	50.6	50.6	39.2
47	NIDW 706	0.0	0	0	0.0	0.0
48	PBW 681	11.5	60	71.2	71.2	47.6
49	PBW 683	14.6	60.15	61.9	61.9	45.6
50	PBW 689	20.7	20.13	24.3	24.3	21.7
51	UP 2841	20.2	60.33	12	60.3	30.8
52	UP 2843	5.9	60	68.1	68.1	44.7
53	UP 2847	17.8	50	65	65.0	44.3
54	UP 2848	26.0	40.23	59.6	59.6	42.0
55	UPD 94	0.0	0	0	0.0	0.0
56	WH 1128	23.7	80	24.4	80.0	42.7
57	WH 1129	24.8	80	25.4	80.0	43.4
58	WH 1130	34.8	0	23.6	34.8	19.5
59	WH 1138	0.0	10.31	0	10.3	3.4
60	WH 1139	11.0	40	27.1	40.0	26.0
60A	SONALIKA (C)	23.5	44.21	58	58.0	41.9
61	WH 1142	10.6	90	23.2	90.0	41.3
NORTH EASTERN PLAIN ZONE						
62	BRW 3723	25.3	30.23	33.3	33.3	29.6
63	DBW 107	25.4	20	84.1	84.1	43.2
64	HD 3110	10.0	60.31	12.6	60.3	27.6
65	HD 3111	3.3	80	65.3	80.0	49.5
66	HD 3118	20.9	30.71	47.2	47.2	32.9
67	HUW 667	35.5	20	32.5	35.5	29.3
68	K1105	15.6	80	64.1	80.0	53.2
69	NW 5064	9.7	20	51.8	51.8	27.2
70	PBW 688	21.0	40.21	67.1	67.1	42.8
71	UAS 347	21.4	20	45	45.0	28.8
72	UP 2844	25.4	60	63	63.0	49.5
73	WH 1136	8.3	30.33	43.1	43.1	27.2
74	WH 1137	14.7	20	22	22.0	18.9
CENTRAL ZONE						
75	DDW 23	3.0	0	0	3.0	1.0
76	GW 1292 (d)	8.8	0	14.7	14.7	7.8
77	GW 440	25.3	0	88.7	88.7	38.0
78	HD 3114	23.9	0	17.8	23.9	13.9
79	HI 1588Q	11.1	60	6.8	60.0	26.0
80	HI 8737 (d)	0.0	80	0	80.0	26.7
80A	SONALIKA (C)	36.2	90.13	67.7	90.1	64.7
81	HI 8742 (d)	0.0	0	0	0.0	0.0

S. No.	Entry	Ludhiana	Hisar	Almora	HS	AV.
82	K 1116	9.4	30.23	50.7	50.7	30.1
83	MACS 3915 (d)	0.0	50	7.2	50.0	19.1
84	MACS 6568	8.0	0	14.8	14.8	7.6
85	MP 3379	23.3	40.21	63.4	63.4	42.3
86	MP 3382	26.7	0	0	26.7	8.9
87	NIAW 1885	23.0	80.13	35.2	80.1	46.1
88	Raj 4295	10.5	60	18.7	60.0	29.7
89	UAS 348	20.0	0	42.8	42.8	20.9
90	UAS 446 (d)	0.0	20	0	20.0	6.7
PENNISULAR ZONE						
91	GW 446	12.5	20.12	26.2	26.2	19.6
92	HD 3116	3.1	70.31	29.8	70.3	34.4
93	MACS 6583	18.5	50	53.9	53.9	40.8
94	MP 1270Q	23.6	10	53.1	53.1	28.9
95	NIAW 1994	21.5	60.25	59.2	60.3	47.0
96	NIDW 699(d)	3.1	30.11	21.7	30.1	18.3
97	UAS 342	9.5	40	28.4	40.0	26.0
98	UAS 447(d)	0.0	30.21	0	30.2	10.1
99	UP 2845	7.1	30.14	28.5	30.1	21.9
SOUTH HILL ZONE						
100	HW 1900	30.9	60.25	3	60.3	31.4
100A	SONALIKA (C)	18.2	80	54.9	80.0	51.0
101	HW 4013	17.7	40.25	28.3	40.3	28.7
102	HW 4042	21.8	50	13.8	50.0	28.5
103	HW 5235	12.3	50.21	17.3	50.2	26.6
104	HW 5237	4.3	0	4.5	4.5	2.9
SPECIAL TRIAL						
105	DBW 131	27.3	-	62	62.0	44.6
106	DDK 1042	0.0	0	0	0.0	0.0
107	DDK 1044	0.0	80.13	-	80.1	40.1
108	DDK 1045	0.0	0	0	0.0	0.0
109	HW 1099	0.0	0	0	0.0	0.0
110	KLP 1006	1.4	40.25	13.3	40.3	18.3
111	KRL 330	60.3	50	84.2	84.2	64.8
112	KRL 345	31.5	50.13	43.6	50.1	41.7
113	KRL 346	21.3	60.25	52.8	60.3	44.8
114	KRL 347	11.6	60	40.8	60.0	37.5
115	KRL 348	31.0	50	40	50.0	40.3
116	MACS 5022	0.0	0	0	0.0	0.0
117	MACS 5031	0.0	30.21	0	30.2	10.1
118	MACS 5032	0.0	30.13	0	30.1	10.0
119	RAJ 4324	30.8	40.25	25.9	40.3	32.3
120	WH 1145	15.2	40.15	46.4	46.4	33.9
120A	SONALIKA (C)	15.5	-	62.6	62.6	39.1
Source : Dr. S.K Jain Almora						
121	VW0513	0.0	10.51	0	10.5	3.5
122	VW0636	5.6	10.33	0	10.3	5.3
123	VW0752	0.0	10.13	0	10.1	3.4
124	VW0855	0.0	5	0	5.0	1.7
125	VW0860	0.0	0	0	0.0	0.0
126	VW0954	0.0	0	0	0.0	0.0

PROGRAMME 6. POWDERY MILDEW

6.1: POWDERY MILDEW SCREENING NURSERY (PMSN)

Presently, almost all the popularly grown varieties of wheat in NWPZ are susceptible to this disease. Powdery mildew is emerging as an important disease of wheat in NWPZ and NHZ during cool years and may cause heavy losses in susceptible varieties. During favourable environment, the varieties are prone to powdery mildew and may suffer heavily if infected at early stage of their growth. Keeping in view the importance of powdery mildew, during 2013-14 crop season, 215 entries including AVT I and II year along with entries found resistant during previous crop seasons were screened against powdery mildew at 7 hot spot locations in NHZ and NWPZ. The data of seven locations, viz., Shimla, Bajaura, Almora, Pantnagar, Malan, Wellington and Dhaulakuan were taken into consideration whereas disease did not appear at Kaul centre. Inoculations were done with the local isolate by dusting the inoculum on the test entries. Scoring was done at dough stage on 0-9 scale representing incidence of disease vertically in height of plants. The disease scores of AVT entries along with check varieties, have been presented in Table 1.5 of chapter 1 and that of resistant entries identified during previous years in Table 6.1. The highest powdery mildew score on check entry PBW 343 was 9 whereas on test entries it ranged from 1-9. The entries found promising against powdery mildew are:

RESISTANT ENTRIES:

Seventeen entries were showed resistance (Av. Score 0-3 score; highest score up to 5): against powdery mildew are *viz.*, DDK 1029 (dic.), DDK 1042, DDK 1044, DDK 1046, HW 1095, MACS 5022, MACS 5031, MACS 5040, TL 2934 (T), TL 2942 (T), TL 2969 (C), TL 2995, TL 2996, TL 2997, TL 2998, TL 2999 and TL 3000

S.No.	Entry	Pantnagar	Shimla	Malan	Almora	Dhaulakuan	Wellington	Bajaura	AV.	HS
I. NORTHERN HILL ZONE										
1	HPW 376	0	4	6	5	0	1	5	3	6
2	VL 967	0	4	6	7	0	3	5	4	7
3	HPW 251 (C)	5	2	5	5	3	0	5	4	5
4	HPW 349 (C)	1	5	5	5	2	1	5	3	5
5	HS 277 (C)	1	4	5	7	3	0	5	4	7
6	HS 375 (C)	3	5	5	9	2	2	6	5	9
7	HS 490 (C)	5	5	6	7	2	2	5	5	7
8	HS 507 (C)	7	7	7	9	3	0	6	6	9
9	HS 542 (I) (C)	7	5	6	7	2	1	5	5	7
10	VL 804 (C)	0	7	7	9	9	2	4	5	9
11	VL 829 (C)	5	3	6	9	7	2	4	5	9
12	VL 892 (C)	0	5	7	5	4	3	0	3	7
13	VL 907 (C)	5	6	7	7	6	2	5	5	7
II. NORTH WESTERN PLAIN ZONE										
14	HUW 666	7	8	7	7	3	0	6	5	8
15	PBW 681	3	7	7	9	0	2	3	4	9
16	WH 1129	3	7	7	7	0	1	4	4	7
17	WH 1138	0	7	7	9	7	1	5	5	9

S.No.	Entry	Pantnagar	Shimla	Malan	Almora	Dhaulakuan	Wellington	Bajaura	AV.	HS
18	WH 1142	5	7	7	7	3	4	3	5	7
19	DBW 88 (I) (C)	5	6	7	9	6	2	4	6	9
20	DBW 90 (I) (C)	3	7	7	9	6	3	5	6	9
20. A	PBW 343 (Check)	7	8	8	9	6	6	5	7	9
21	DPW 621-50 (C)	7	8	6	9	8	4	5	7	9
22	HD 2967 (C)	5	7	6	7	6	2	5	5	7
23	HD 3043 (C)	5	6	3	3	6	2	5	4	6
24	HD 3059 (C)	5	8	5	7	4	2	6	5	8
25	HD 3086 (I) (C)	5	6	7	5	4	4	5	5	7
26	PBW 590 (C)	3	7	7	7	9	2	6	6	9
27	PBW 644 (C)	5	7	7	5	5	1	5	5	7
28	PBW 660 (I) (C)	7	6	5	5	5	0	4	5	7
29	PDW 233 (C)	7	7	7	5	5	0	5	5	7
30	PDW 291 (C)	0	3	6	5	6	2	5	4	6
31	PDW 314 (C)	3	7	7	5	7	2	6	5	7
32	WH 1021 (C)	7	6	7	5	5	0	5	5	7
33	WH 1080 (C)	5	6	6	5	6	0	6	5	6
34	WH 1105 (C)	5	4	7	5	9	0	5	5	9
35	WH 1124 (I) (C)	7	3	7	5	9	1	4	5	9
III. NORTH EASTERN PLAIN ZONE										
36	BRW 3723	7	5	7	5	5	3	5	5	7
37	DBW 107	7	7	7	3	0	2	4	4	7
38	HD 3118	7	3	7	5	0	0	5	4	7
39	K 1114	7	5	7	5	0	3	6	5	7
40	C 306 (C)	7	7	7	3	5	1	5	5	7
40. A	PBW 343 (Check)	7	6	7	7	7	6	4	6	7
41	DBW 14 (C)	3	3	7	5	9	3	5	5	9
42	DBW 39 (C)	7	7	7	5	9	3	5	6	9
43	HD 2733 (C)	5	6	7	7	9	2	6	6	9
44	HD 2888 (C)	7	7	7	5	7	0	3	5	7
45	HD 2985 (C)	5	5	7	9	8	0	6	6	9
46	HI 1563 (C)	7	7	7	9	4	0	5	6	9
47	K 0307 (C)	7	3	7	3	5	1	4	4	7
48	K 1006 (I) (C)	5	3	7	5	9	1	5	5	9
49	K 8027 (C)	7	7	7	5	6	0	5	5	7
50	NW 2036 (C)	0	3	7	5	8	1	6	4	8
51	NW 5054 (I) (C)	3	5	7	5	7	2	5	5	7
IV. CENTRAL ZONE										
52	DBW 110	7	3	7	3	0	0	4	3	7
53	HI 8736 (D)	1	3	7	3	0	0	4	3	7
54	HI 8737 (D)	3	1	7	5	9	2	5	5	9
55	MP 3382	5	1	7	3	0	0	6	3	7
56	NIAW 1885	3	5	7	7	0	2	0	3	7
57	PBW 689	0	6	7	5	0	0	3	3	7

S.No.	Entry	Pantnagar	Shimla	Malan	Almora	Dhaulakuan	Wellington	Bajaura	AV.	HS
58	A 9-30-1 (D) (C)		7	8	5	9	1	5	6	9
59	GW 322 (C)	5	5	7	3	8	3	3	5	8
60	HD 2864 (C)	1	5	7	3	8	3	2	4	8
60. A	PBW 343 (Check)	5	5	8	5	9	6	5	6	9
61	HD 2932 (C)	0	7	7	5	9	1	3	5	9
62	HI 1500 (C)	7	7	7	3	6	0	5	5	7
63	HI 1544 (C)	3	5	7	5	9	1	5	5	9
64	HI 8498 (D) (C)	5	3	7	7	9	0	6	5	9
65	HI 8627 (D) (C)		5	7	5	9	0	5	5	9
66	MP 3288 (C)	3	4	7	5	9	0	6	5	9
67	MP 3336 (C)	3	5	7	7	9	1	5	5	9
68	MP 4010 (C)	5	5	7	5	9	3	4	5	9
69	MPO 1215 (d) (C)	5	3	7	3	8	2	5	5	8
V. PENINSULAR ZONE										
70	NIAW 1994		3	7	3	0	3	5	4	7
71	UAS 347	5	5	7	5	9	1	3	5	9
72	UAS 446 (D)	0	4	7	5	9	0	5	4	9
73	AKDW 2997-16(d) (C)	3	5	7	5	9	3	6	5	9
74	HD 3090 (I) (C)	5	5	7	5	9	1	5	5	9
75	MACS 6222 (C)	1	6	7	5	9	0	6	5	9
76	MACS 6478 (C)	3	5	7	5	9	0	5	5	9
77	NI 5439 (C)	0	5	5	3	9	0	2	3	9
78	NIAW 1415 (C)	0	5	5	5	9	4	5	5	9
79	NIDW 295 (d) (C)	1	5	0	3	9	1	4	3	9
80	Raj 4083 (C)	3	5	7	3	9	5	5	5	9
80. A	PBW 343 (Check)	9	5	8	7	9	6	6	7	9
81	UAS 428 (d) (C)	7	5	7	5	9	3	5	6	9
VI. SOUTHERN HILLS ZONE										
82	CoW(W) 1 (C)	5	5	5	5	8	2	6	5	8
83	HW 2044 (C)	3	5	7	5	8	1	4	5	8
84	HW 5216 (C)	3	-	6	5	8	0	5	5	8
VII. SPECIAL TRIAL										
85	DDK 1042	0	-	0	5	0	2	5	2	5
86	MACS 5022	0	0	0	3	0	2	5	1	5
87	DDK 1029 (C)	0	1	0	5	5	2	5	3	5
88	HW 1098 (I) (C)	7	-	5	1	0	2	6	4	7
89	Kharchia 65 (C)	5	8	7	9	8	3	4	6	9
90	KRL 19 (C)	5	5	7	7	6	1	5	5	7
91	KRL 210 (C)	0	7	7	7	8	2	5	5	8
92	MACS 2496 (C)	5	7	5	5	6	2	5	5	7

S.No.	Entry	Pantnagar	Shimla	Malan	Almora	Dhaulakuan	Wellington	Bajaura	AV.	HS
93	MACS 2971 (C)	0	5	5	3	6	3	6	4	6
A. Resistant to PM (Av.0-3 Score, Highest Score up to 5)										
Source: AVT II Year 2004-05										
94	TL 2934 (T)	5	0	0	1	0	2	0	1	5
Source: AVT II Year 2007-08										
95	HW 1095	0	0	0	1	0	3	5	1	5
96	DDK 1029 (dic.)	0	0	0	1	0	0	4	1	4
Source : AVT II Year 2010-11										
97	TL 2942 (T)	0	0	0	1	0	0	0	0	1
Source : AVT I Year 2011-12										
98	HPW 376	0	3	7	5	0	1	5	3	7
Source : AVT II Year 2012-13										
99	GW 432	-	7	7	5	0	0	5	4	7
100	HD 3093	3	5	7	5	7	0	5	5	7
100. A	PBW 343 (Check)	7	5	7	7	9	6	5	7	9
101	HD 3095	5	7	5	7	0	3	5	5	7
102	HW 5224	0	6	7	5	0	3	4	4	7
103	PBW 661	0	8	3	7	0	5	3	4	8
104	WH 1124	3	5	6	7	0	0	5	4	7
Source : AVT I Year 2013-14										
I. NORTHERN HILL ZONE										
105	HPW 373	0	3	7	7	0	1	5	3	7
106	HPW 400	3	5	5	7	0	0	5	4	7
107	HPW 401	3	1	6	7	0	4	4	4	7
108	HPW 410	3	5	7	7	0	1	5	4	7
109	HPW 411	5	5	7	7	5	2	6	5	7
110	HPW 412	1	5	5	7	5	0	4	4	7
111	HS 547	1	5	7	9	0	0	5	4	9
112	HS 558	1	7	7	9	0	1	5	4	9
113	HS 562	3	5	7	9	0	4	4	5	9
114	HS 577	5	5	7	7	0	3	5	5	7
115	HS 590	7	5	7	5	0	0	6	4	7
116	HS 591	1	7	7	5	0	0	4	3	7
117	HS 592	1	7	7	7	0	2	5	4	7
118	HS 593	5	7	7	7	0	2	5	5	7
119	HS 594	5	3	7	7	0	0	4	4	7
120	HS 595	5	7	7	7	2	0	5	5	7
120 A	PBW 343 (Check)	7	7	8	7	9	6	6	7	9
121	UP 2890	7	9	7	7	0	2	4	5	9
122	UP 2891	7	8	7	9	0	3	5	6	9
123	VL 976	-	7	7	7	0	3	5	5	7
124	VL 977	3	7	7	5	0	1	4	4	7
125	VL 1003	0	7	7	5	0	0	5	3	7
126	VL 1004	3	3	7	9	9	4	6	6	9

S.No.	Entry	Pantnagar	Shimla	Malan	Almora	Dhaulakuan	Wellington	Bajaura	AV.	HS
127	VL 3002	0	5	7	5	0	5	4	4	7
128	VL 3004	3	3	8	9	0	4	5	5	9
129	VL 3005	0	5	7	5	0	3	5	4	7
130	VL 3006	5	6	7	7	0	1	4	4	7
II. NORTH WESTERN PLAIN ZONE										
131	DBW 95	0	6	7	5	2	1	5	4	7
132	DBW 128	0	6	7	5	2	0	4	3	7
133	DBW 129	0	6	7	5	0	0	5	3	7
134	HD 3128	7	7	7	7	0	3	6	5	7
135	HD 3132	3	6	7	5	6	6	4	5	7
136	HD 3133	0	6	7	7	0	4	5	4	7
137	HD 3139	0	5	7	5	0	7	5	4	7
138	HD 4730	0	3	8	5	0	3	4	3	8
139	HUW 675	5	6	7	5	0	1	5	4	7
140	K 1204	5	5	8	5	6	1	6	5	8
140 A	PBW 343 (Check)	7	3	8	9	9	6	6	7	9
141	MP 1277	5	3	7	5	0	6	5	4	7
142	PBW 677	0	5	5	3	0	2	5	3	5
143	PBW 692	7	5	7	3	3	1	4	4	7
144	PBW 695	5	5	5	5	0	0	6	4	6
145	PBW 697	3	5	8	5	0	0	4	4	8
146	PBW 698	5	3	8	5	8	2	5	5	8
147	PBW 702	9	6	8	3	9	2	5	6	9
148	PBW 703	1	6	8	5	0	2	4	4	8
149	PBW 706	0	4	7	5	0	3	5	3	7
150	TL 2995	0	0	0	1	0	0	6	1	6
151	UAS 356	0	5	7	5	9	3	0	4	9
152	WH 1154	0	5	7	5	0	5	5	4	7
153	WH 1156	7	-	7	5	0	3	5	5	7
154	WH 1157	5	-	7	3	0	3	4	4	7
155	WH 1164	0	-	7	5	0	0	4	3	7
III. NORTH EASTERN PLAIN ZONE										
156	DBW 126	3	-	7	5	9	0	4	5	9
157	DBW 98	0	-	7	5	0	1	4	3	7
158	HD 3127	1	-	8	5	3	2	6	4	8
159	HUW 661	5	-	8	5	0	1	4	4	8
160	HUW 677	5	-	7	5	0	1	5	4	7
160 A	PBW 343 (Check)	9	-	8	7	9	6	5	7	9
161	HUW 679	3	-	5	5	0	1	6	3	6
162	PBW 693	3	-	7	5	9	1	5	5	9
163	PBW 701	0	-	7	5	9	3	6	5	9
164	PBW 704	1	-	7	7	9	3	0	5	9
165	UP 2855	0	-	7	7	9	3	5	5	9
166	WH 1132	0	-	7	7	9	3	5	5	9

S.No.	Entry	Pantnagar	Shimla	Malan	Almora	Dhaulakuan	Wellington	Bajaura	AV.	HS
IV. CENTRAL ZONE										
167	CG 1010	3	-	7	9	9	2	5	6	9
168	DDW 30 (D)	0	-	7	9	9	1	4	5	9
169	GW 451	7	-	7	7	9	1	6	6	9
170	GW 455	3	-	7	7	9	0	4	5	9
171	HD 3146	5	-	7	7	9	1	5	6	9
172	HD 4728 (D)	1	-	7	5	0	5	5	4	7
173	HI 8750 (D)	0	-	6	5	9	0	6	4	9
174	HI 8755 (D)	0	-	7	7	0	5	5	4	7
175	K 1215	0	-	7	7	8	1	6	5	8
176	K 1217	0	-	7	7	9	3	0	4	9
177	MACS 3916 (D)	0	-	7	7	0	0	5	3	7
178	MACS 3927 (D)	0	-	7	7	0	5	5	4	7
179	MACS 6604	1	-	7	7	5	5	4	5	7
180	MP 1279	1	-	7	7	0	2	4	4	7
180 A	PBW 343 (Check)	5	-	7	9	9	6	6	7	9
181	NIAW 2030		-	5	5	0	0	5	3	5
182	UAS 451 (D)	0	-	7	7	9	4	5	5	9
V. PENINSULAR ZONE										
183	DDW 27 (D)	3	-	7	7	9	2	6	6	9
184	HI 8751 (D)	0	-	7	5	9	2	5	5	9
185	HI 8754 (D)	0	-	7	5	0	0	6	3	7
186	K 1213	3	-	7	7	0	2	0	3	7
187	UP 2864	0	-	7	5	9	3	5	5	9
VI. SOUTHERN HILLS ZONE										
188	MACS 6507	0	-	7	5	9	3	4	5	9
189	UAS 358	0	-	7	5	9	3	4	5	9
VII. SPECIAL TRIAL (Dicoccum and Sailinity and Alkalinity)										
190	DBW 154	5	-	7	7	9	3	4	6	9
191	DBW 155	0	-	7	5	0	3	4	3	7
192	MACS 5040	0	-	5	3	0	2	5	3	5
193	MACS 5031	0	-	0	1	0	2	5	1	5
194	MACS 5022	0	-	0	1	0	1	4	1	4
195	DDK 1046	0	-	5	5	0	3	4	3	5
196	MACS 2971 (C)	0	-	5	7	0	1	6	3	7
197	DDK 1044	0	-	0	1	0	1	5	1	5
198	DDK 1029 (C)	0	-	0	1	0	2	5	1	5
199	HW 1099	0	-	0	3	0	4	6	2	6
200	MACS 2496 (aest.) (C)	0	-	7	7	0	2	4	3	7
200 A	PBW 343 (Check)	7	-	8	9	9	6	5	7	9
III. SPECIAL TRIAL (TRITICALE)										

S.No.	Entry	Pantnagar	Shimla	Malan	Almora	Dhaulakuan	Wellington	Bajaura	AV.	HS
201	TL 2996	0	-	0	1	0	2	0	1	2
202	TL 2997	0	-	0	1	0	0	0	0	1
203	TL 2998	0	-	0	1	0	0	0	0	1
204	TL 2999	0	-	0	1	0	0	0	0	1
205	TL 3000	0	-	0	1	0	0	0	0	1
206	TL 2942 (C)	0	-	0	1	5	2	0	1	5
207	TL 2969 (C)	0	-	0	1	2	2	0	1	2
IV. SPECIAL TRIAL (MABB/NILs)										
208	PBW 722	3	-	8	7	9	1	5	6	9
209	PBW 723	3	-	7	7	4	4	4	5	7
210	KB 2012-03	0	-	7	9	0	2	5	4	9
211	HD 2932+*Sr26*	0	-	7	7	9	1	5	5	9
212	HD 2932+*Lr19/Sr25*	0	-	7	7	0	0	5	3	7
213	MMBL 283	0	-	7	7	0	3	5	4	7
214	HUW 234 (C)	0	-	7	7	0	2	4	3	7
215	PBW 343 (C)	5	-	8	5	9	2	4	6	9

COOPERATORS:

NAME	**CENTRE**
S. K. JAIN	ALMORA
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J. KUMAR, DEEPSHIKHA, K SRIVASTAVA	PANTNAGAR
DEVLASH KUMAR	BAJAURA
R. SELVAKUMAR	DWR, KARNAL (COORDINATING UNIT)

PROGRAMME 7. REGION SPECIFIC DISEASES OF LIMITED IMPORTANCE

7.1 FUSARIUM HEAD BLIGHT (FHB) OR HEAD SCAB

Fusarium graminearum **Schwabe (*Gibberella zeae* (Schwein) Petch.)**
Evaluation of AVT materials

Test Locations: Karnal , Dhaulakuan and Gurdaspur

AVT entries alongwith checks were evaluated under artificially inoculated conditions at Karnal and Dhaula Kuan in polyhouse. *Fusarium graminearum* culture was supplied to Dhaulakuan center by D W R, Karnal for artificial inoculation. Disease development was good at Karnal and Dhaula kuan. The above material was also evaluated at Gurdaspur under natural conditions but there was no disease incidence. Disease scoring scale (0-5) has been used. Entry-wise reaction of AVT-II and AVT-Ist year entries (2013-2014) has been given in Tables 7.1 and 7.2, respectively. Data for 2nd year entries has also been given in Table 1.5. On the basis of highest score, none of the genotype was found resistant or moderately resistant.

COOPERATORS

NAME	CENTRE
M .S. SAHARAN	KARNAL
DHANBIR SINGH	DHAULAKUAN
MADHU MEETA JINDAL	GURDASPUR

Table 7.1. Performance of AVT 2nd year material against head scab under multilocational testing during 2013-2014

S. No.	Entry	Karnal	Dhaulakuan	HS	AV.
I. NORTH HILL ZONE					
1	HPW 376	3	3	3	3
2	VL 967	4	5	5	4.5
3	HPW 251 (C)	4	4	4	4
4	HPW 349 (C)	3	5	5	4
5	HS 277 (C)	3	5	5	4
6	HS 375 (C)	3	5	5	4
7	HS 490 (C)	3	5	5	4
8	HS 507 (C)	3	5	5	4
9	HS 542 (I) (C)	3	5	5	4
10	VL 804 (C)	4	5	5	4.5
11	VL 829 (C)	3	5	5	4
12	VL 892 (C)	5	5	5	5
13	VL 907 (C)	3	5	5	4
II. NORTH WESTERN PLAIN ZONE					
14	HUW 666	3	4	4	3.5
15	PBW 681	3	5	5	4
16	WH 1129	3	3	3	3
17	WH 1138	4	5	5	4.5
18	WH 1142	3	5	5	4
19	DBW 88 (I) (C)	3	5	5	4
20	DBW 90 (I) (C)	3	5	5	4
21	DPW 621-50 (C)	3	3	3	3
22	HD 2967 (C)	3	3	3	3
23	HD 3043 (C)	3	5	5	4

S. No.	Entry	Karnal	Dhaulakuan	HS	AV.
24	HD 3059 (C)	3	5	5	4
25	HD 3086 (I) (C)	4	5	5	4.5
26	PBW 590 (C)	4	5	5	4.5
27	PBW 644 (C)	3	3	3	3
28	PBW 660 (I) (C)	3	5	5	4
29	PDW 233 (C)	3	5	5	4
30	PDW 291 (C)	3	5	5	4
31	PDW 314 (C)	3	4	4	3.5
32	WH 1021 (C)	4	5	5	4.5
33	WH 1080 (C)	3	5	5	4
34	WH 1105 (C)	3	5	5	4
35	WH 1124 (I) (C)	4	5	5	4.5
III. NORTH EASTERN PLAIN ZONE					
36	BRW 3723	3	0	3	1.5
37	DBW 107	5	2	5	3.5
38	HD 3118	5	5	5	5
39	K 1114	3	5	5	4
40	C 306 (C)	5	3	5	4
41	DBW 14 (C)	4	5	5	4.5
42	DBW 39 (C)	3	5	5	4
43	HD 2733 (C)	3	5	5	4
44	HD 2888 (C)	5	5	5	5
45	HD 2985 (C)	4	5	5	4.5
46	HI 1563 (C)	4	5	5	4.5
47	K 0307 (C)	4	5	5	4.5
48	K 1006 (I) (C)	3	5	5	4
49	K 8027 (C)	3	5	5	4
50	NW 2036 (C)	5	5	5	5
51	NW 5054 (I) (C)	3	5	5	4
IV. CENTRAL ZONE					
52	DBW 110	3	2	3	2.5
53	HI 8736 (D)	4	0	4	2
54	HI 8737 (D)	3	0	3	1.5
55	MP 3382	3	5	5	4
56	NIAW 1885	4	0	4	2
57	PBW 689	3	5	5	4
58	A 9-30-1 (D) (C)	5	5	5	5
59	GW 322 (C)	4	5	5	4.5
60	HD 2864 (C)	4	5	5	4.5
61	HD 2932 (C)	3	5	5	4
62	HI 1500 (C)	5	5	5	5
63	HI 1544 (C)	3	5	5	4
64	HI 8498 (D) (C)	3	5	5	4
65	HI 8627 (D) (C)	3	5	5	4
66	MP 3288 (C)	3	5	5	4
67	MP 3336 (C)	4	5	5	4.5
68	MP 4010 (C)	4	5	5	4.5
69	MPO 1215 (d) (C)	3	5	5	4
V. PENINSULAR ZONE					
70	NIAW 1994	3	5	5	4
71	UAS 347	3	3	3	3
72	UAS 446 (D)	3	5	5	4
73	AKDW 2997-16(d) (C)	3	5	5	4

S. No.	Entry	Karnal	Dhaulakuan	HS	AV.
74	HD 3090 (I) (C)	3	5	5	4
75	MACS 6222 (C)	3	5	5	4
76	MACS 6478 (C)	5	5	5	5
77	NI 5439 (C)	4	5	5	4.5
78	NIAW 1415 (C)	5	5	5	5
79	NIDW 295 (d) (C)	4	5	5	4.5
80	Raj 4083 (C)	3	5	5	4
81	UAS 428 (d) (C)	4	5	5	4.5
VI. SOUTHERN HILLS ZONE					
82	CoW(W) 1 (C)	3	4	4	3.5
83	HW 2044 (C)	4	5	5	4.5
84	HW 5216 (C)	3	5	5	4
VII. SPECIAL TRIAL					
85	DDK 1042	3	5	5	4
86	MACS 5022	4	5	5	4.5
87	DDK 1029 (C)	4	5	5	4.5
88	HW 1098 (I) (C)	3	4	4	3.5
89	Kharchia 65 (C)	4	5	5	4.5
90	KRL 19 (C)	4	5	5	4.5
91	KRL 210 (C)	4	5	5	4.5
92	MACS 2496 (C)	4	5	5	4.5
93	MACS 2971 (C)	3	5	5	4

Table 7.2. Performance of AVT 1st year material against head scab (% incidence) under multilocational testing during 2013-2014

S. No.	Entry	Karnal	Dhaulakuan	HS	AV.
I. NORTHERN HILL ZONE					
1	HPW 373	3	0	3	1.5
2	HPW 400	3	5	5	4
3	HPW 401	3	5	5	4
4	HPW 410	3	3	3	3
5	HPW 411	3	2	3	2.5
6	HPW 412	3	0	3	1.5
7	HS 547	3	3	3	3
8	HS 558	3	5	5	4
9	HS 562	2	5	5	3.5
10	HS 577	3	3	3	3
11	HS 590	3	0	3	1.5
12	HS 591	3	0	3	1.5
13	HS 592	3	5	5	4
14	HS 593	3	5	5	4
15	HS 594	3	5	5	4
16	HS 595	3	0	3	1.5
17	UP 2890	3	5	5	4
18	UP 2891	3	5	5	4
19	VL 976	3	0	3	1.5
20	VL 977	3	5	5	4
21	VL 1003	3	0	3	1.5
22	VL 1004	3	0	3	1.5
23	VL 3002	3	4	4	3.5
24	VL 3004	3	3	3	3
25	VL 3005	3	4	4	3.5

S. No.	Entry	Karnal	Dhaulakuan	HS	AV.
26	VL 3006	3	5	5	4
II. NORTH WESTERN PLAIN ZONE					
27	DBW 95	3	3	3	3
28	DBW 128	3	5	5	4
29	DBW 129	3	5	5	4
30	HD 3128	3	5	5	4
31	HD 3132	3	3	3	3
32	HD 3133	3	5	5	4
33	HD 3139	3	5	5	4
34	HD 4730	3	5	5	4
35	HUW 675	3	5	5	4
36	K 1204	3	5	5	4
37	MP 1277	3	5	5	4
38	PBW 677	3	5	5	4
39	PBW 692	3	5	5	4
40	PBW 695	3	5	5	4
41	PBW 697	4	5	5	4.5
42	PBW 698	3	5	5	4
43	PBW 702	3	5	5	4
44	PBW 703	3	5	5	4
45	PBW 706	3	5	5	4
46	TL 2995	3	5	5	4
47	UAS 356	3	5	5	4
48	WH 1154	3	3	3	3
49	WH 1156	3	3	3	3
50	WH 1157	3	3	3	3
51	WH 1164	3	5	5	4
III. NORTH EASTERN PLAIN ZONE					
52	DBW 126	3	5	5	4
53	DBW 98	3	4	4	3.5
54	HD 3127	3	0	3	1.5
55	HUW 661	3	1	3	2
56	HUW 677	3	5	5	4
57	HUW 679	3	2	3	2.5
58	PBW 693	3	5	5	4
59	PBW 701	3	5	5	4
60	PBW 704	3	5	5	4
61	UP 2855	3	5	5	4
62	WH 1132	3	0	3	1.5
IV. CENTRAL ZONE					
63	CG 1010	4	3	4	3.5
64	DDW 30 (D)	3	0	3	1.5
65	GW 451	3	5	5	4
66	GW 455	3	0	3	1.5
67	HD 3146	3	0	3	1.5
68	HD 4728 (D)	3	2	3	2.5
69	HI 8750 (D)	3	0	3	1.5
70	HI 8755 (D)	3	3	3	3
71	K 1215	3	2	3	1.5
72	K 1217	3	4	4	3.5
73	MACS 3916 (D)	3	5	5	4
74	MACS 3927 (D)	4	5	5	4
75	MACS 6604	4	5	5	4

S. No.	Entry	Karnal	Dhaulakuan	HS	AV.
76	MP 1279	3	5	5	4
77	NIAW 2030	3	5	5	4
78	UAS 451 (D)	3	5	5	4
V. PENINSULAR ZONE					
79	DDW 27 (D)	3	5	5	4
80	HI 8751 (D)	3	5	5	4
81	HI 8754 (D)	3	5	5	4
82	K 1213	3	5	5	4
83	UP 2864	3	5	5	4
VI. SOUTHERN HILLS ZONE					
84	MACS 6507	3	5	5	4
85	UAS 358	3	5	5	4
VII. SPECIAL TRIAL (Dicoccum and Sailinity and Alkalinity)					
86	DBW 154	3	5	5	4
87	DBW 155	3	3	3	3
88	MACS 5040	3	3	3	3
89	MACS 5031	3	5	5	4
90	DDK 1046	3	2	3	2.5
91	DDK 1044	3	5	5	4
92	HW 1099	3	5	5	4
III. SPECIAL TRIAL (TRITICALE)					
93	TL 2996	3	0	3	1.5
94	TL 2997	3	5	5	4
95	TL 2998	3	3	3	3
96	TL 2999	3	3	3	3
97	TL 3000	4	0	4	2
98	TL 2942 (C)	4	5	5	4.5
99	TL 2969 (C)	4	5	5	4.5
IV. SPECIAL TRIAL (MABB/NIL ENTRIES)					
100	PBW 722	3	5	5	4
101	PBW 723	4	2	4	3
102	KB 2012-03	4	5	5	4.5
103	HD 2932+Sr26	3	5	5	4
104	HD 2932+Lr19/Sr25	4	5	5	4.5
105	MMBL 283	5	5	5	5
106	HUW 234 (C)	4	5	5	4.5
107	PBW 343 (C)	3	5	5	4

7.2 FLAG SMUT, *Urocystis agropyri* (Preuss) Sch.

Test Locations: Karnal, Hisar, Ludhiana and Durgapura

Flag smut is soil and externally seed bone disease caused by *Urocyctis agropyri*. The spore of the pathogen can survive for longer period in the soil. Disease development was good at all the centres except Durgapura. In AVT-2nd year genotypes (2013-2014), the highest disease level of 71.4 per cent was observed in check variety C 306 at Ludhiana. Entry-wise reaction of AVT-II and AVT-Ist year entries (2013-2014) has been given in Tables 7.3 and 7.4, respectively. Data for 2nd year entries has also been given in Table 1.5. The entries mentioned below were found resistant (upto 10 % average disease incidence) at all the three centres.

AVT IInd Year 2013-14
Free: VL 967, HPW 251 (C), HS 277 (C), HS 542 (I) (C), VL 804 (C), VL 829 (C), VL 907 (C), HD 3043 (C), PDW 233 (C), PDW 291 (C), PDW 314 (C), WH 1080 (C), WH 1105 (C), DBW 39 (C), K 0307 (C), K 1006 (I) (C), NW 2036 (C), DBW 110, HI 8736 (D), HI 8737 (D), MP 3382, NIAW 1885, PBW 689, A 9-30-1 (D) (C), HD 2932 (C), HI 8498 (D) (C), HI 8627 (D) (C), NIAW 1994, UAS 446 (D), AKDW 2997-16(d) (C), NIDW 295 (d) (C), UAS 428 (d) (C), CoW(W) 1 (C), DDK 1042*, MACS 5022, DDK 1029 (C), HW 1098 (I) (C), KRL 19 (C) and KRL 210 (C)

Resistant (upto 10% infection): HPW 376, HS 375 (C), HS 490 (C), HS 507 (C), VL 892 (C), HUW 666, WH 1129, WH 1138, WH 1142, DBW 88 (I) (C), DBW 90 (I) (C), DPW 621-50 (C), HD 2967 (C), HD 3059 (C), HD 3086 (I) (C), PBW 590 (C), PBW 660 (I) (C), WH 1021 (C), WH 1124 (I) (C), BRW 3723, HD 3118, DBW 14 (C), HD 2733 (C), HD 2888 (C), HD 2985 (C), K 8027 (C), NW 5054 (I) (C), GW 322 (C), HD 2864 (C), MP 3288 (C), MP 3336 (C), MP 4010 (C), MPO 1215 (d) (C), UAS 347, HD 3090 (I) (C), MACS 6222 (C), MACS 6478 (C), NIAW 1415 (C), Raj 4083 (C), MACS 2496 (C) and MACS 2971 (C)

AVT Ist Year 2013-14
Free: HPW 373, HPW 400, HPW 401, HPW 410, HPW 411, HPW 412, HS 547, HS 562, HS 590, HS 593, VL 1003, VL 3002, VL 3005, DBW 95, DBW 128, HD 3128, HD 3139, HD 4730, PBW 692, PBW 698, PBW 706, TL 2995, UAS 356, WH 1157, WH 1164, HUW 679, DDW 30 (D), GW 451, HD 4728 (D), HI 8750 (D), HI 8755 (D), MACS 3927 (D), MACS 6604, MP 1279, DDW 27 (D), HI 8751 (D), HI 8754 (D), MACS 6507, MACS 5040, MACS 5031, MACS 5022*, DDK 1046, MACS 2971 (C), DDK 1044, HW 1099, TL 2996, TL 2997, TL 2998, TL 2999, TL 3000, TL 2942 (C), TL 2969 (C) and HD 2932-Lr19/Sr25

Resistant (upto 10% infection): HS 558, HS 577, HS 591, HS 594, HS 595, UP 2890, VL 976, VL 977, VL 3004, DBW 129, HD 3132, HD 3133, HUW 675, K 1204, MP 1277, PBW 677, PBW 695, PBW 697, PBW 702, PBW 703, DBW 98, HD 3127, HUW 661, PBW 693, PBW 704, WH 1132, CG 1010, K 1215, K 1217, MACS 3916 (D), UAS 451 (D), UAS 358, DBW 155, DDK 1029 (C), MACS 2496 (aest.) (C), HD 2932+Sr26, MMBL 283 and HUW 234 (C)

COOPERATORS

NAME	CENTRE
S. S. KARWASARA	HISAR
R K BANSAL AND R.S. BENIWAL	DURGAPURA
MADHU MEETA	LUDHIANA
M. S. SAHARAN AND SUDHEER KUMAR	KARNAL

7.3 FOOT ROT (*Sclerotium rolfsii*)

Test Locations: Sagar and Dharwad

AVT entries along with checks were evaluated at Sagar and Dharwad centres. Disease data of Sagar was not received. Entry-wise reaction of AVT-IInd and AVT-Ist year entries (2013-2014) has been given in Tables 7.5 and 7.6, respectively. Data for 2nd year entries has also been given in Table 1.5. The entries showing upto 5 and 10.00 per cent incidence were categorized as highly resistant and resistant, respectively and are listed below:

AVT IInd Year 2013-14

Free: HPW 349 (C), DBW 90 (I) (C), HD 3090 (I) (C), MACS 5022 and MACS 2971 (C).

Highly Resistant (1-5 % disease): HPW 376, HPW 251 (C), HS 542 (I) (C), VL 907 (C), WH 1129, DPW 621-50 (C), DBW 107, K 8027 (C), NW 2036 (C), NIAW 1885, PBW 689, HD 2932 (C), NIAW 1994, MACS 6478 (C) and NIDW 295 (d) (C).

Resistant (5-10 % disease): PBW 681, K 1006 (I) (C), NW 5054 (I) (C), MP 3382, MP 4010 (C), UAS 347 and MACS 6222 (C).

AVT Ist Year 2013-14

Free: DBW 95, DBW 128, PBW 697, PBW 698, PBW 702, PBW 701, MACS 3927 (D), MACS 6604, MACS 5040, DDK 1046, MACS 2971 (C), HW 1099, PBW 722 and PBW 723.

Highly Resistant (1-5 % disease): HPW 373, HS 562, HS 590, VL 3005, HD 3132, PBW 703, PBW 704, WH 1132, MACS 3916 (D), HD 2932-Lr19/Sr25, MMBL 283, HUW 234 (C) and PBW 343 (C).

Resistant (5-10 % disease): HS 547, HS 558, DBW 129, DBW 98, HUW 661, UP 2855, DDW 30 (D), K 1215, DBW 154, MACS 5022 and MACS 2496 (aest.) (C).

COOPERATORS

NAME	CENTER
I. K. KALAPPANAVAR	DHARWAD
SUDHEER KUMAR	KARNAL

7.4 HILL BUNT (*Tilletia foetida, T. caries*)

Test Locations: Almora, Bajoura and Malan

AVT entries were evaluated at three locations and disease development was good at all centres. The data was taken by counting infected and healthy ear heads, for calculating per cent infected ear heads. Among genotypes, HS 277 (C) showed least average disease score of 2.68 in AVT II[nd] year while four genotypes were completely free from disease. There were differences in the disease incidence at three locations, hence the highest disease level as well as average was considered and has been given in Table 7.7.

AVT II[nd] Year 2013-14
Free: Nil
Resistant (1-10 % disease): HPW 251 (C), HS 277 (C), HS 375 (C), HS 490 (C), VL 804 (C) and VL 892 (C).
AVT I[st] Year 2013-14
Free: VW 0636, VW 0752, VW 0810 and VW 0855.

Resistant (1-10 % disease): HPW 401, HPW 411, HPW 412, HS 558, HS 590, VL 1003, VL 1004, VL 3002, VL 3006, VW 0565, and VW 0912.

COOPERATORS

NAME	CENTRE
S. K. JAIN	ALMORA
S. K. RANA	MALAN
DEVLASH KUMAR	BAJAURA
SUDHEER KUMAR	KARNAL

Table 7.3. Performance of AVT 2[nd] year material against flag smut (% incidence) under multilocational testing during 2013-2014

S. No.	Entry	Karnal	Hisar	Ludhiana	HS	AV.
I. NORTH HILL ZONE						
1	HPW 376	0.0	0.0	7.1	7.1	2.4
2	VL 967	0.0	0.0	0.0	0.0	0.0
3	HPW 251 (C)	0.0	0.0	0.0	0.0	0.0
4	HPW 349 (C)	1.4	4.7	25.0	25.0	10.4
5	HS 277 (C)	0.0	0.0	0.0	0.0	0.0
6	HS 375 (C)	0.6	0.0	6.3	6.3	2.3
7	HS 490 (C)	5.6	0.0	16.7	16.7	7.4
8	HS 507 (C)	0.0	0.0	4.0	4.0	1.3
9	HS 542 (I) (C)	0.0	0.0	0.0	0.0	0.0
10	VL 804 (C)	0.0	0.0	0.0	0.0	0.0
11	VL 829 (C)	0.0	0.0	0.0	0.0	0.0
12	VL 892 (C)	0.9	0.0	26.7	26.7	9.2
13	VL 907 (C)	0.0	0.0	0.0	0.0	0.0
II. NORTH WESTERN PLAIN ZONE						
14	HUW 666	0.0	6.9	0.0	6.9	2.3
15	PBW 681	3.6	5.5	27.8	27.8	12.3
16	WH 1129	0.0	0.0	5.3	5.3	1.8

S. No.	Entry	Karnal	Hisar	Ludhiana	HS	AV.
17	WH 1138	0.0	0.0	16.7	16.7	5.6
18	WH 1142	0.0	3.6	4.3	4.3	2.6
19	DBW 88 (I) (C)	0.0	0.0	3.8	3.8	1.3
20	DBW 90 (I) (C)	0.0	2.1	14.3	14.3	5.4
21	DPW 621-50 (C)	0.0	0.0	5.9	5.9	2.0
22	HD 2967 (C)	1.1	11.9	15.8	15.8	9.6
23	HD 3043 (C)	0.0	0.0	0.0	0.0	0.0
24	HD 3059 (C)	0.0	0.0	5.3	5.3	1.8
25	HD 3086 (I) (C)	1.1	0.0	7.1	7.1	2.7
26	PBW 590 (C)	2.2	2.0	15.4	15.4	6.5
27	PBW 644 (C)	1.9	4.8	27.8	27.8	11.5
28	PBW 660 (I) (C)	0.0	1.7	19.0	19.0	6.9
29	PDW 233 (C)	0.0	0.0	0.0	0.0	0.0
30	PDW 291 (C)	0.0	0.0	0.0	0.0	0.0
31	PDW 314 (C)	0.0	0.0	0.0	0.0	0.0
32	WH 1021 (C)	0.0	0.0	13.6	13.6	4.5
33	WH 1080 (C)	0.0	0.0	0.0	0.0	0.0
34	WH 1105 (C)	0.0	0.0	0.0	0.0	0.0
35	WH 1124 (I) (C)	0.9	0.0	11.1	11.1	4.0
III. NORTH EASTERN PLAIN ZONE						
36	BRW 3723	0.0	0.0	15.8	15.8	5.3
37	DBW 107	11.9	4.1	27.8	27.8	14.6
38	HD 3118	0.0	0.0	11.8	11.8	3.9
39	K 1114	14.1	1.6	31.3	31.3	15.7
40	C 306 (C)	7.5	11.9	71.4	71.4	30.3
41	DBW 14 (C)	0.0	4.4	0.0	4.4	1.5
42	DBW 39 (C)	0.0	0.0	0.0	0.0	0.0
43	HD 2733 (C)	1.7	0.0	0.0	1.7	0.6
44	HD 2888 (C)	9.8	3.7	13.6	13.6	9.0
45	HD 2985 (C)	0.9	0.0	6.3	6.3	2.4
46	HI 1563 (C)	25.5	7.8	33.3	33.3	22.2
47	K 0307 (C)	0.0	0.0	0.0	0.0	0.0
48	K 1006 (I) (C)	0.0	0.0	0.0	0.0	0.0
49	K 8027 (C)	0.0	0.0	8.3	8.3	2.8
50	NW 2036 (C)	0.0	0.0	0.0	0.0	0.0
51	NW 5054 (I) (C)	2.4	0.0	6.3	6.3	2.9
IV. CENTRAL ZONE						
52	DBW 110	0.0	0.0	0.0	0.0	0.0
53	HI 8736 (D)	0.0	0.0	0.0	0.0	0.0
54	HI 8737 (D)	0.0	0.0	0.0	0.0	0.0
55	MP 3382	0.0	0.0	0.0	0.0	0.0
56	NIAW 1885	0.0	0.0	0.0	0.0	0.0
57	PBW 689	0.0	0.0	0.0	0.0	0.0
58	A 9-30-1 (D) (C)	0.0	0.0	0.0	0.0	0.0
59	GW 322 (C)	1.1	0.0	0.0	1.1	0.4
60	HD 2864 (C)	0.0	0.0	29.4	29.4	9.8
61	HD 2932 (C)	0.0	0.0	0.0	0.0	0.0
62	HI 1500 (C)	8.6	5.5	35.3	35.3	16.4
63	HI 1544 (C)	4.2	2.5	71.4	71.4	26.1
64	HI 8498 (D) (C)	0.0	0.0	0.0	0.0	0.0
65	HI 8627 (D) (C)	0.0	0.0	0.0	0.0	0.0
66	MP 3288 (C)	2.4	4.5	16.7	16.7	7.9
67	MP 3336 (C)	0.0	2.3	5.9	5.9	2.7

S. No.	Entry	Karnal	Hisar	Ludhiana	HS	AV.
68	MP 4010 (C)	0.8	0.0	13.6	13.6	4.8
69	MPO 1215 (d) (C)	0.0	0.0	7.1	7.1	2.4
V. PENINSULAR ZONE						
70	NIAW 1994	0.0	0.0	0.0	0.0	0.0
71	UAS 347	0.0	0.0	5.9	5.9	2.0
72	UAS 446 (D)	0.0	0.0	0.0	0.0	0.0
73	AKDW 2997-16(d) (C)	0.0	0.0	0.0	0.0	0.0
74	HD 3090 (I) (C)	0.9	0.0	20.0	20.0	7.0
75	MACS 6222 (C)	0.0	0.0	8.0	8.0	2.7
76	MACS 6478 (C)	0.0	0.0	28.6	28.6	9.5
77	NI 5439 (C)	6.8	0.0	40.0	40.0	15.6
78	NIAW 1415 (C)	0.0	0.0	5.3	5.3	1.8
79	NIDW 295 (d) (C)	0.0	0.0	0.0	0.0	0.0
80	Raj 4083 (C)	7.3	0.0	12.5	12.5	6.6
81	UAS 428 (d) (C)	0.0	0.0	0.0	0.0	0.0
VI. SOUTHERN HILLS ZONE						
82	CoW(W) 1 (C)	0.0	0.0	0.0	0.0	0.0
83	HW 2044 (C)	11.9	0.0	37.5	37.5	16.5
84	HW 5216 (C)	19.4	3.3	61.1	61.1	27.9
VII. SPECIAL TRIAL						
85	DDK 1042	0.0	0.0	0.0	0.0	0.0
86	MACS 5022	0.0	0.0	0.0	0.0	0.0
87	DDK 1029 (C)	0.0	0.0	0.0	0.0	0.0
88	HW 1098 (I) (C)	0.0	0.0	0.0	0.0	0.0
89	Kharchia 65 (C)	16.3	0.0	33.3	33.3	16.5
90	KRL 19 (C)	0.0	0.0	0.0	0.0	0.0
91	KRL 210 (C)	0.0	0.0	0.0	0.0	0.0
92	MACS 2496 (C)	0.0	0.0	10.0	10.0	3.3
93	MACS 2971 (C)	0.0	16.0	0.0	16.0	5.3

Table 7.4. Performance of AVT 1st year material against flag smut (% incidence) under multilocational testing during 2013-2014

S. No.	Entry	Karnal	Hisar	Ludhiana	HS	AV.
I. NORTHERN HILL ZONE						
1	HPW 373	0.0	0.0	0.0	0.0	0.0
2	HPW 400	0.0	0.0	0.0	0.0	0.0
3	HPW 401	0.0	0.0	0.0	0.0	0.0
4	HPW 410	0.0	0.0	0.0	0.0	0.0
5	HPW 411	0.0	0.0	0.0	0.0	0.0
6	HPW 412	0.0	0.0	0.0	0.0	0.0
7	HS 547	0.0	0.0	0.0	0.0	0.0
8	HS 558	0.0	0.0	7.7	7.7	2.6
9	HS 562	0.0	0.0	0.0	0.0	0.0
10	HS 577	0.0	0.0	13.3	13.3	4.4
11	HS 590	0.0	0.0	0.0	0.0	0.0
12	HS 591	0.0	0.0	11.8	11.8	3.9
13	HS 592	9.6	4.8	28.6	28.6	14.3
14	HS 593	0.0	0.0	0.0	0.0	0.0
15	HS 594	0.0	0.0	6.3	6.3	2.1
16	HS 595	0.0	0.0	9.5	9.5	3.2
17	UP 2890	0.0	0.0	5.9	5.9	2.0
18	UP 2891	7.3	7.9	25.0	25.0	13.4

S. No.	Entry	Karnal	Hisar	Ludhiana	HS	AV.
19	VL 976	1.1	0.0	0.0	1.1	0.4
20	VL 977	0.0	0.0	11.1	11.1	3.7
21	VL 1003	0.0	0.0	0.0	0.0	0.0
22	VL 1004	12.9	2.6	18.2	18.2	11.2
23	VL 3002	0.0	0.0	0.0	0.0	0.0
24	VL 3004	1.2	3.8	10.0	10.0	5.0
25	VL 3005	0.0	0.0	0.0	0.0	0.0
26	VL 3006	0.7	2.1	30.8	30.8	11.2
II. NORTH WESTERN PLAIN ZONE						
27	DBW 95	0.0	0.0	0.0	0.0	0.0
28	DBW 128	0.0	0.0	0.0	0.0	0.0
29	DBW 129	2.9	3.2	23.5	23.5	9.9
30	HD 3128	0.0	0.0	0.0	0.0	0.0
31	HD 3132	0.0	0.0	5.0	5.0	1.7
32	HD 3133	0.8	0.0	4.5	4.5	1.8
33	HD 3139	0.0	0.0	0.0	0.0	0.0
34	HD 4730	0.0	0.0	0.0	0.0	0.0
35	HUW 675	0.0	0.0	7.1	7.1	2.4
36	K 1204	0.0	0.0	8.3	8.3	2.8
37	MP 1277	3.3	0.0	0.0	3.3	1.1
38	PBW 677	0.0	0.0	25.0	25.0	8.3
39	PBW 692	0.0	0.0	0.0	0.0	0.0
40	PBW 695	0.0	0.0	13.3	13.3	4.4
41	PBW 697	5.8	2.9	10.5	10.5	6.4
42	PBW 698	0.0	0.0	0.0	0.0	0.0
43	PBW 702	8.7	0.0	12.5	12.5	7.1
44	PBW 703	1.5	0.0	5.9	5.9	2.5
45	PBW 706	0.0	0.0	0.0	0.0	0.0
46	TL 2995	0.0	0.0	0.0	0.0	0.0
47	UAS 356	0.0	0.0	0.0	0.0	0.0
48	WH 1154	1.4	0.0	30.0	30.0	10.5
49	WH 1156	3.6	2.3	30.8	30.8	12.2
50	WH 1157	0.0	0.0	0.0	0.0	0.0
51	WH 1164	0.0	0.0	0.0	0.0	0.0
III. NORTH EASTERN PLAIN ZONE						
52	DBW 126	4.3	1.9	54.5	54.5	20.3
53	DBW 98	0.8	0.0	22.2	22.2	7.7
54	HD 3127	0.0	3.1	8.3	8.3	3.8
55	HUW 661	0.0	4.9	0.0	4.9	1.6
56	HUW 677	5.1	0.0	25.0	25.0	10.0
57	HUW 679	0.0	0.0	0.0	0.0	0.0
58	PBW 693	5.0	4.0	20.0	20.0	9.7
59	PBW 701	4.3	6.0	27.3	27.3	12.5
60	PBW 704	3.0	0.0	11.1	11.1	4.7
61	UP 2855	2.3	1.7	41.7	41.7	15.2
62	WH 1132	1.4	0.0	22.2	22.2	7.9
IV. CENTRAL ZONE						
63	CG 1010	0.0	1.8	15.0	15.0	5.6
64	DDW 30 (D)	0.0	0.0	0.0	0.0	0.0
65	GW 451	0.0	0.0	0.0	0.0	0.0
66	GW 455	18.8	6.0	77.8	77.8	34.2
67	HD 3146	2.9	4.1	57.1	57.1	21.4
68	HD 4728 (D)	0.0	0.0	0.0	0.0	0.0

S. No.	Entry	Karnal	Hisar	Ludhiana	HS	AV.
69	HI 8750 (D)	0.0	0.0	0.0	0.0	0.0
70	HI 8755 (D)	0.0	0.0	0.0	0.0	0.0
71	K 1215	0.0	0.0	10.0	10.0	3.3
72	K 1217	0.0	1.7	26.7	26.7	9.4
73	MACS 3916 (D)	1.5	0.0	0.0	1.5	0.5
74	MACS 3927 (D)	0.0	0.0	0.0	0.0	0.0
75	MACS 6604	0.0	0.0	0.0	0.0	0.0
76	MP 1279	0.0	0.0	0.0	0.0	0.0
77	NIAW 2030	0.0	0.0	36.4	36.4	12.1
78	UAS 451 (D)	0.0	0.0	16.7	16.7	5.6
V. PENINSULAR ZONE						
79	DDW 27 (D)	0.0	0.0	0.0	0.0	0.0
80	HI 8751 (D)	0.0	0.0	0.0	0.0	0.0
81	HI 8754 (D)	0.0	0.0	0.0	0.0	0.0
82	K 1213	9.0	1.5	40.0	40.0	16.8
83	UP 2864	4.2	3.6	30.8	30.8	12.9
VI. SOUTHERN HILLS ZONE						
84	MACS 6507	0.0	0.0	0.0	0.0	0.0
85	UAS 358	0.0	0.0	10.0	10.0	3.3
VII. SPECIAL TRIAL (Dicoccum and Sailinity and Alkalinity)						
86	DBW 154	7.4	3.3	21.4	21.4	10.7
87	DBW 155	1.4	1.1	0.0	1.4	0.8
88	MACS 5040	0.0	0.0	0.0	0.0	0.0
89	MACS 5031	0.0	0.0	0.0	0.0	0.0
90	DDK 1046	0.0	0.0	0.0	0.0	0.0
91	DDK 1044	0.0	0.0	0.0	0.0	0.0
92	HW 1099	0.0	0.0	0.0	0.0	0.0
III. SPECIAL TRIAL (TRITICALE)						
93	TL 2996	0.0	0.0	0.0	0.0	0.0
94	TL 2997	0.0	0.0	0.0	0.0	0.0
95	TL 2998	0.0	0.0	0.0	0.0	0.0
96	TL 2999	0.0	0.0	0.0	0.0	0.0
97	TL 3000	0.0	0.0	0.0	0.0	0.0
98	TL 2942 (C)	0.0	0.0	0.0	0.0	0.0
99	TL 2969 (C)	0.0	0.0	0.0	0.0	0.0
IV. SPECIAL TRIAL (MABB/NIL ENTRIES)						
100	PBW 722	3.1	17.3	15.8	17.3	12.1
101	PBW 723	5.4	8.6	22.2	22.2	12.1
102	KB 2012-03	1.7	15.5	20.0	20.0	12.4
103	HD 2932+Sr26	3.3	2.7	0.0	3.3	2.0
104	HD 2932-Lr19/Sr25	0.0	0.0	0.0	0.0	0.0
105	MMBL 283	0.0	0.0	10.0	10.0	3.3
106	HUW 234 (C)	0.0	2.3	10.5	10.5	4.3
107	PBW 343 (C)	9.8	12.3	27.3	27.3	16.5

Table 7.5. Performance of AVT 2nd year material against foot rot (% incidence) under multilocational testing during 2013-2014

S. No.	Entry	Dharwad
I. NORTH HILL ZONE		
1	HPW 376	5
2	VL 967	20
3	HPW 251 (C)	5
4	HPW 349 (C)	0
5	HS 277 (C)	35
6	HS 375 (C)	20
7	HS 490 (C)	55
8	HS 507 (C)	20
9	HS 542 (I) (C)	5
10	VL 804 (C)	25
11	VL 829 (C)	15
12	VL 892 (C)	55
13	VL 907 (C)	5
II. NORTH WESTERN PLAIN ZONE		
14	HUW 666	35
15	PBW 681	10
16	WH 1129	5
17	WH 1138	15
18	WH 1142	15
19	DBW 88 (I) (C)	15
20	DBW 90 (I) (C)	0
21	DPW 621-50 (C)	5
22	HD 2967 (C)	25
23	HD 3043 (C)	15
24	HD 3059 (C)	25
25	HD 3086 (I) (C)	15
26	PBW 590 (C)	35
27	PBW 644 (C)	20
28	PBW 660 (I) (C)	15
29	PDW 233 (C)	25
30	PDW 291 (C)	45
31	PDW 314 (C)	30
32	WH 1021 (C)	35
33	WH 1080 (C)	15
34	WH 1105 (C)	35
35	WH 1124 (I) (C)	25
III. NORTH EASTERN PLAIN ZONE		
36	BRW 3723	25
37	DBW 107	5
38	HD 3118	20
39	K 1114	20
40	C 306 (C)	35
41	DBW 14 (C)	30
42	DBW 39 (C)	25
43	HD 2733 (C)	30
44	HD 2888 (C)	55
45	HD 2985 (C)	20
46	HI 1563 (C)	20
47	K 0307 (C)	20
48	K 1006 (I) (C)	10
49	K 8027 (C)	5
50	NW 2036 (C)	5
51	NW 5054 (I) (C)	10
IV. CENTRAL ZONE		
52	DBW 110	15
53	HI 8736 (D)	25
54	HI 8737 (D)	15
55	MP 3382	10
56	NIAW 1885	5
57	PBW 689	5
58	A 9-30-1 (D) (C)	20
59	GW 322 (C)	25
60	HD 2864 (C)	15
61	HD 2932 (C)	5
62	HI 1500 (C)	45
63	HI 1544 (C)	15
64	HI 8498 (D) (C)	45
65	HI 8627 (D) (C)	25
66	MP 3288 (C)	20
67	MP 3336 (C)	25
68	MP 4010 (C)	10
69	MPO 1215 (d) (C)	35
V. PENINSULAR ZONE		
70	NIAW 1994	5
71	UAS 347	10
72	UAS 446 (D)	15
73	AKDW 2997-16(d) (C)	15
74	HD 3090 (I) (C)	0
75	MACS 6222 (C)	10
76	MACS 6478 (C)	5
77	NI 5439 (C)	35
78	NIAW 1415 (C)	30
79	NIDW 295 (d) (C)	5
80	Raj 4083 (C)	40
81	UAS 428 (d) (C)	40
VI. SOUTHERN HILLS ZONE		
82	CoW(W) 1 (C)	35
83	HW 2044 (C)	65
84	HW 5216 (C)	25
VII. SPECIAL TRIAL		
85	DDK 1042	30
86	MACS 5022	0
87	DDK 1029 (C)	15
88	HW 1098 (I) (C)	25
89	Kharchia 65 (C)	15
90	KRL 19 (C)	15
91	KRL 210 (C)	15
92	MACS 2496 (C)	40
93	MACS 2971 (C)	0

Table 7.6. Performance of AVT 1st year material against foot rot (% incidence) under multilocational testing during 2013-2014

S. No.	Entry	Dharwad
I. NORTHERN HILL ZONE		
1	HPW 373	5
2	HPW 400	35
3	HPW 401	30
4	HPW 410	30
5	HPW 411	40
6	HPW 412	55
7	HS 547	10
8	HS 558	10
9	HS 562	5
10	HS 577	20
11	HS 590	5
12	HS 591	30
13	HS 592	60
14	HS 593	55
15	HS 594	30
16	HS 595	20
17	UP 2890	25
18	UP 2891	20
19	VL 976	35
20	VL 977	25
21	VL 1003	45
22	VL 1004	45
23	VL 3002	45
24	VL 3004	45
25	VL 3005	5
26	VL 3006	30
II. NORTH WESTERN PLAIN ZONE		
27	DBW 95	0
28	DBW 128	0
29	DBW 129	10
30	HD 3128	15
31	HD 3132	5
32	HD 3133	55
33	HD 3139	40
34	HD 4730	20
35	HUW 675	45
36	K 1204	40
37	MP 1277	25
38	PBW 677	20
39	PBW 692	45
40	PBW 695	15
41	PBW 697	0
42	PBW 698	0

S. No.	Entry	Dharwad
43	PBW 702	0
44	PBW 703	5
45	PBW 706	25
46	TL 2995	25
47	UAS 356	40
48	WH 1154	15
49	WH 1156	15
50	WH 1157	25
51	WH 1164	35
III. NORTH EASTERN PLAIN ZONE		
52	DBW 126	25
53	DBW 98	10
54	HD 3127	25
55	HUW 661	10
56	HUW 677	35
57	HUW 679	25
58	PBW 693	15
59	PBW 701	0
60	PBW 704	5
61	UP 2855	10
62	WH 1132	5
IV. CENTRAL ZONE		
63	CG 1010	30
64	DDW 30 (D)	10
65	GW 451	30
66	GW 455	40
67	HD 3146	20
68	HD 4728 (D)	25
69	HI 8750 (D)	20
70	HI 8755 (D)	40
71	K 1215	10
72	K 1217	20
73	MACS 3916 (D)	5
74	MACS 3927 (D)	0
75	MACS 6604	0
76	MP 1279	25
77	NIAW 2030	15
78	UAS 451 (D)	45
V. PENINSULAR ZONE		
79	DDW 27 (D)	35
80	HI 8751 (D)	35
81	HI 8754 (D)	15
82	K 1213	15
83	UP 2864	25
VI. SOUTHERN HILLS ZONE		

S. No.	Entry	Dharwad
84	MACS 6507	20
85	UAS 358	20
VII. SPECIAL TRIAL (Dicoccum and Sailinity and Alkalinity)		
86	DBW 154	10
87	DBW 155	20
88	MACS 5040	0
89	MACS 5031	25
90	DDK 1046	0
91	DDK 1044	20
92	HW 1099	0
III. SPECIAL TRIAL (TRITICALE)		
93	TL 2996	35
94	TL 2997	40
95	TL 2998	15
96	TL 2999	15
97	TL 3000	15
98	TL 2942 (C)	25
99	TL 2969 (C)	25
IV. SPECIAL TRIAL (MABB/NIL ENTRIES)		
100	PBW 722	0
101	PBW 723	0
102	KB 2012-03	25
103	HD 2932+Sr26	30
104	HD 2932+Lr19/Sr25	5
105	MMBL 283	5
106	HUW 234 (C)	5
107	PBW 343 (C)	5

Table 7.7. Performance of AVT material against hill bunt (% incidence) under multilocational testing during 2013-2014

S. No.	Entry	Almora	Malan	Bajaura	HS	Av.
AVT IInd year						
I. NORTH HILL ZONE						
1	HPW 376	8.7	22.9	10.4	22.9	14.00
2	VL 967	4.8	13.76	46	46	21.52
3	HPW 251 (C)	9.7	2.21	0	9.7	3.97
4	HPW 349 (C)	15.4	13.11	9.6	15.4	12.70
5	HS 277 (C)	5.3	2.75	0	5.3	2.68
6	HS 375 (C)	4.2	6.34	0	6.34	3.51
7	HS 490 (C)	5.4	10.37	2.1	10.37	5.96
8	HS 507 (C)	11.6	11.28	45.7	45.7	22.86
9	HS 542 (I) (C)	2.3	27.97	9.5	27.97	13.26
10	VL 804 (C)	1.0	22.09	0	22.09	7.70
11	VL 829 (C)	4.2	5.24	40.0	40	16.48
12	VL 892 (C)	1.2	14.6	13.5	14.6	9.77
13	VL 907 (C)	1.5	35.95	46.8	46.8	28.08

S. No.	Entry	Almora	Malan	Bajaura	HS	Av.
AVT I[st] year						
14	HPW 373	3.8	29.75	14.8	29.75	16.12
15	HPW 400	0	18.03	15.0	18.03	11.01
16	HPW 401	1.4	26.5	0	26.5	9.30
17	HPW 410	6.3	46.82	6.9	46.82	20.01
18	HPW 411	0	29.2	0	29.2	9.73
19	HPW 412	2.7	11.43	0	11.43	4.71
20	HS 547	9	26.47	0	26.47	11.82
21	HS 558	0	2.5	25.9	25.9	9.47
22	HS 562	5.8	1.75	51.3	51.3	19.62
23	HS 577	11.4	15.56	17.4	17.4	14.79
24	HS 590	0	24.58	0	24.58	8.19
25	HS 591	10.0	50.75	9.5	50.75	23.42
26	HS 592	3.2	0	42.2	42.2	15.13
27	HS 593	0	12.42	31.2	31.2	14.54
28	HS 594	5.8	50.0	8.9	50	21.57
29	HS 595	0	23.02	50.0	50	24.34
30	UP 2890	12.2	24.11	17.2	24.11	17.84
31	UP 2891	4.9	12.33	13.3	13.3	10.18
32	VL 976	0	54.74	25.6	54.74	26.78
33	VL 977	1.4	34.78	0	34.78	12.06
34	VL 1003	0	21.55	0	21.55	7.18
35	VL 1004	1.5	12.07	0	12.07	4.52
36	VL 3002	10.5	5.56	11.5	11.5	9.19
37	VL 3004	0	30.41	25.0	30.41	18.47
38	VL 3005	2.7	32.28	61.9	61.9	32.29
39	VL 3006	0	19.05	0	19.05	6.35
Almora material						
40	VW 0565	0	7.79	3.7	7.79	3.83
41	VW 0636	0	0	0	0	0.00
42	VW 0752	0	0	0	0	0.00
43	VW 0810	0	0	0	0	0.00
44	VW 0855	0	0	0	0	0.00
45	VW 0912	0	6.58	0	6.58	2.19

PROGRAMME 8. CROP HEALTH

8.1 PRE- HARVEST CROP HEALTH MONITORING

Crop health was rigorously monitored during the crop season as well during the off season in the high hills of Himachal Pradesh (Lahaul, Spiti, Kullu), Nilgiri hills (Tamil Nadu) and J & K (Ladakh). Major focus was on the occurrence of yellow rust and surveillance for the stem rust pathotype, Ug99. Status of other diseases, including leaf rust was also monitored during these survey trips. The extensive surveys were also conducted by the wheat crop protection scientists of different cooperating centers including DWR Karnal. Special teams of scientists were also constituted during the 52nd All India Wheat Workers' Meet held at CSAUA&T during Sept. 1-4, 2013. Advisory for stripe rust management was issued during December-March regularly. Information on wheat crop health was disseminated through the "*Wheat Crop Health Newsletter*", Vol. 19 which was issued on monthly basis during the crop season. This was also put on DWR website (http://www.dwr.in). All the issues of the Newsletter brought out during the crop season, are given as an annexure at the end of this report. Except for the yellow rust in NHZ and NWPZ, the overall crop health status was satisfactory in the country.

Stripe rust occurrence in northern states

Haryana: Upto February, 2014, stripe rust was observed at 40 farmers fields in 25 villages in Yamunanagar, 15-20 farmers fields in Karnal, five villages (Darba, Paniwala Mota, Bhagsar, Audhan and Bara Gurha) in the periphery of 5-10 km in Sirsa (small foci of yellow rust in the range of 20-30S) and one village in Ambala. The total area from where the disease has been reported in patches is 97.5 acres in Yamunanagar. The disease was observed on wheat varieties, WH 711, HD 2932, HD 2851, HD 2967, DPW 621-50, Shri Ram 271, DBW 16, DBW 17 and Barbat. In Sirsa in the stripe rust infected fields, the farmers have planted the varieties HD 2851, WH 147 and PBW 343.

Yamunanagar

- January 1, 2014: Stripe rust was observed 1st time on in village Ratangarh in Yamunanagar district of Haryana on variety WH 711.
- January 9: In village Khurdban in Yamunanagar in var. HD 2967
- January 10: In village Hanshumajra (Karnal) in var. HD 2967
- January 14: Guglo (Yamunanagar) where two small patches of stripe rust upto 60S infecton were found in the field of two farmers (Haridat s/ Sawan Ram of village Guglo, Block Jagadhari and Sh. Balinder s/ Sarda Ram in wheat variety HD 2894. The variety was sown in two acres on 1st Nov, 2013.
- January 22: In the field of Sh. Dharmender in village HaripurJatan (Jagadhri, Yamunanagar) in varieties, DPW 621-50 and Shri Ram 271. These varieties have been sown in 2 acres.
- January 22: In the field of Sh. VirenderSinghb in village KotarKhana (Moradabad, Yamunanagar) in var. HD 2967. The variety has been sown in 1 acre.
- January 25: In the field of Sh. Isham Singh S/o Sh Mangat Ram in village Mandebar (Jagadhri) in var. HD 2967. The variety has been sown in 2 acres.
- January 25: In the field of Sh. Narender Kumar in village Pipliwala (Bilaspur) in var. Barbat. The variety has been sown in 1 acre.
- January 25: In the field of Sh. Rishipal in village Mugalwali (Bilaspur) in var. Super 172. The variety has been sown in 1 acre.
- January 27: In the field of Sh. Manipal in village Madhubans (Radur) in var. HD 2967. The variety has been sown in 1 acre.
- January 28: In the field of Sh. Kuldeep in village Manbharwala (Chhachhrauli) in var. DBW 16. The variety has been sown in 7 acres.

- January 29: In the field of Sh. Parveen Kumar in village Salempur Kohi (Chhachhrauli) in var. HD 2851, HD 2898, Barbat..The varieties have been sown in 1 acre.
- January 30: In the field of Sh. Vikas Kumar in village Nagal (Jagadhri) in var. HD 2967. The variety have been sown in 2 acres.
- January 30: In the field of Sh. Sarabjeet in village Kaptan Majri (Sadhaura) in var. DBW 17. The variety have been sown in 2 acres.
- January 30: In the field of Sh. Kadam Singh in village Bhattuwala (Bilaspur) in vars. HD 2967 and Super 172.The varieties have been sown in 3 acres.
- February 3: In the field of Sh. Sarabjeet Singh in village Kaptan Majri (Sadhaura) in var. DBW 17.The variety has been sown in 1 acre.
- February 3: In the field of Sh. Dalip Singh in village Tapu Kamalpur (Jagadhri) in var. HD 2967.The variety has been sown in 5 acres.
- February 4: In the field of Sh. Rampal in village Khera Brahman (Bilaspur) in vars. PBW 550 and HD 2967. The varieties have been sown in 2 acres.
- February 5: In the field of Sh. Nathu Ram in village Thaska (Sadhaura) in var. Barbat. The variety has been sown in 1 acre.
- February 5: In the field of Sh. Roshan in village Thaska (Sadhaura) in var. HD 2967. The variety has been sown in 1.5 acres.
- February 5: In the field of Sh. Krishan in village Sadhaura in var. HD 2967. The variety has been sown in 1.5 acres.
- February 6: In the field of Sh. Surender Kumar in village Sandhali (Radur) in var. HD 2967. The variety has been sown in 4 acres.
- February 8: In the field of Sh. Jai Singh in village Barsan (Radur) in var. DBW 17. The variety has been sown in 1 acre.
- February 10: In the field of Sh. Sukhwinder Singh in village Alahar (Radur) in vars. WH 711 and HD 2967. The variety has been sown in 3.5 acres.
- February 10: In the field of Sh. Gurnam Singh in village Peerbholi (Sadhoura) in var. super 172. The variety has been sown in 1 acre.
- February 10: In the field of Sh. Pawan Kumar in village Rattulwala (Sadhoura) in var. HD 2851. The variety has been sown in 2 acres.
- February 10: In the field of Sh. Naresh Kumar in village Sabri (Sadhoura) in var. DPW 621-50. The variety has been sown in 1 acre.
- February 10: In the field of Sh. Mai Chand in village Sabri (Sadhoura) in vars. DBW 17 and HD 2851. The varieties have been sown in 1 acre.
- February 10: In the field of Sh. Ramesh in village Sarawan (Sadhoura) in vars. Super 232, HD 2733 and Harbeer 603. The varieties have been sown in 3 acres.
- February 11: In the field of Sh. Neeraj Kumar in village Chanda Kheri (Bilaspur) in var. HD 2733. The variety has been sown in 1 acre.
- Feb 17: In village Bakana (Radur, Y Nagar) in var HD 2967 sown in 1 acre
- Feb 17: In village Kartarpur (Radur, Y Nagar) in vars HD 2967 and HD 2894 sown in 6 acres
- Feb 18: In village Doulatpur (Mustafabad, Y Nagar)in var WH 711 sown in one acre.
- Feb 20-21: Stripe rust foci were observed in villages Khajuri, Masana Rangran, Radouri and Bubka in vars. HD 2967, PBW 550, WH 711, HD 2851 planted in 21 acres at different farmers fields.
- On March 13, 2014, in Yamunanagar, 20-40S stripe rust severity was observed.

Sirsa: Stripe rust was observed in five villages (Darba, Paniwala Mota, Bhagsar, Audhan and Bara Gurha) in the periphery of 5-10 km in Sirsa (small foci of yellow rust in the range of 20-30S) on Feb. 19, 2014. In the stripe rust infected fields, the farmers have planted the varieties HD 2851, WH 147 and PBW 343.

Ambala: January 19: In Ambala at farm of Capt. Swarn Singh of village Seevan Majra in Barara block. The disease has been observed in one small patch of around 15-20 plants in variety, Barbat.

Karnal: Upto 10th Feb., 2014: The disease has been observed in ten villages: Nalipur, Modipur, Nasirpur, Biana, Hansu Majra, Manglora, Gadhi Birbal, Dhakwala Rodan, Randoli, Kalsora. Most of the varieties in which disease has been observed are: HD 2932, Shri Ram 231, PBW 550, DBW 17, HD 2851, HD 2894 and HD 2967. On March 3, 2014, farmer Sh.Sanjeev Kumar of village Chorpura (Near Indri), has informed that his crop in 25 acres was affected by yellow rust. On March 5, 2014, stripe rust was observed on one plant of HD 2967 in village Churpur. On March 12, 2014, moderate termite damage was recorded in some parts of Karnal (Basthali) and Kaithal (Batta) while minor incidence of Pink Stem Borer was observed in village Bilaspur (Dabwali). In village, Ahawri near Ambala, stripe rust (20MS to 20S) was observed. On 13.3.2014 , stripe rust infection (20-40S) was observed in patches in Karnal.

Jammu region of J & K

- January 21: Stripe rust was observed in village Tahlar, Zone Arnia, RS Pura in var. DPW 621-50 with stripe rust (1.25 ha) with 5S to 40S.
- January 25: Stripe rust was observed in one field of Devigarh village (RS Pura) infected (20S) on variety PBW-550 about in 2 Kanal areas and in one field of Saikalan village, rust foci (2 sqm, 20S) was noticed on HD 2967.
- January 26: Stripe rust was observed in field of Sh. Surinder Kumar, village Kotli (40S) in variety PBW-343 (4-5 Kanal) and one field of Matkali (Ramghar) on variety PBW-550 (30S) in 2-3 meter patch.
- January 27: Stripe rust was observed in village Sultanpur (Kathua) on variety WH 711 (20S) on one acre field.
- During 26th to 28th Feb., 2014, stripe rust was observed in every field of Jammu district especially in Udhaywalla, Marh, Chinor, Akhnoor, Jammu, RS Pura, Bishna (Jammu district) and Vijaypur (Samba District) with 5 to 60 per cent intensity. Varieties viz. PBW 343, Sonalika, WH-711, PBW-550, PBW-175, RAJ-3077 and RAJ-3765 were infected with yellow rust (20-80 per cent severity) in affected fields but varieties *viz.*, DPW-621-50 and HD-2967 were affected upto 20% severity. In other areas of Samba and Kathua districts, yellow rust was less (severity and intensity).
- On 5th March, 2014, Jammu and Samba districts in Jammu region were found more severely infected by yellow rust. In this area, yellow rust infection (trace-80S) was observed in almost in all the fields. However, yellow rust in about 10% of wheat fields in both the districts was upto 40S. Comparatively, Kathua wheat fields had less yellow rust ranged from traces to 10S severity. The varieties grown were Raj 3077, Raj 3765, PBW 175, PBW 550 and HD 2967.

Punjab: Stripe rust occurrence in Punjab during 2013-14 crop season has been given in Table 8.1.

Table 8.1. Stripe rust occurrence in Punjab during 2013-14 crop season

Date of recording	Village	District	Variety
6-1-2014	Dabkherаupralla	Ropar	HD 2967 two foci of infection in one field of Sh. BahuLal
-do-	Bare Bajwara	Hoshiarpur	PBW 550 on few plants in Sh. Sony field
10-1-2014	FatepurTherri	Mohali	HD 2733 in a patch of about $4m^2$ in one field of Sh. Dharminder Singh S/o Sh.Raghubir Singh
10-1-2014	Bham	Hoshiarpur	HD 2967, one patch in few plants in Sh. Mohan Singh S/o Sh. Kora Singh field
13-1-2014	Surewal	Ropar	HD 2967 in one patch on few plants In the field of Sh. Rohit Sharma S/o Sh. Ram Parkash
14-1-2014	Ram Nagar	Patiala (Block Rajpura)	HD-2894 in a patch in one field of Sh. Kulwant Singh S/o Sh. Chand Singh
15-1-2014	Balachaur	Balachaur	HD 2967 one patch in one field of Sh. Vasudev S/o Sh. Beli Ram
16-1-2014	JhallianKalan	Ropar	HD 2967 one patch in one field of Sh. Jatinder Singh
16. 1. 2014 and 17. 1. 2014	Kiltran,Donal	Ropar	HD 2932, WH 711, PBW 550 About 100 acres in Kiltran and 2 acres in Donal
17-1-2014	Takhani	Hoshiarpur	HD 2967 one patch in one field Capt. Kuldeep Singh
Last Week of January	Rainsara, Nurpur Bedi	Roop Nagar	PBW 621 (40S foci)
	Surewal	Roop Nagar	HD 2967 (40S)
	Hardo Chanian	Gurdaspur	PBW 550 (40S)
	Naushehra	Gurdaspur	HD 2967 (40S)
	Bhagtena Tulian	Gurdaspur	HD 2967 (20S)
4-2-2014	Chamkaur Sahib	Roop Nagar	10 meter patch on variety HD 2967 (20 to 40S). Stripe rust was also observed in var DPW 621-50 (20S)
4-2-2014	Rasidpur	Roop Nagar	5 meter patch on variety HD 2967 (10 to 20S).
4-2-2014	Phool Khurd	Roop Nagar	Trace severity of yellow rust
4-3-2014	At Ladowal seed farm, one foci of yellow rust ($100m^2$) having disease severity of 80S was observed in HD 2967. Stripe rust was observed in traces in fields in Fatehgarh Sahib, Pathankhot, Kishangarh and Jallandhar. In village Pada (Gurdaspur), stripe rust was upto 20S in some fields.		
12-13 March	Moderate to severe incidence of wheat aphid was observed in some villages of Karnal (Bastli), Kaithal (Batta and Dakala), Jind (Danola), Hisar (DWR research Farm), Mukatsar (Chakdiwala), Sarenaga (Sekha Kalan) and Moga.		

Western UP: Stripe rust, leaf rust, powdery mildew were observed in last week of March and 1st week of April in Western UP on most of the varieties grown.

Himachal Pradesh

Nahan: On 17.1.2014, stripe rust was noticed in TPN (Kharchia mutant) and SAARC (Agra Local) nurseries including infector rows planted at HAREC (Hill Agricultural Research and Extention Centre), Dhaulakuan, Himachal Pradesh.

Mandi: Feb 1, 2014: Yellow rust foci were observed in farmers fields in villages, Kot, Drogan, Neri Blata, Khirki and Jangal Berry.

Una: Yellow rust foci were observed in farmers fields in villages, Chaksarai, Jubehar, Suri, Nandpur, Katohar, Kalan, Chururu, Baheri, Tanoh, Tihra, Sohari, Talmera, Bhadsali, Saloh, Badehra, Kangar, Palkawah, Panjawar, Khad, Ispur, Pandoga, Basal, Rampur, Dangoli and Lamlehri.

Hamirpur: Feb 2, 2014: Yellow rust foci were observed in farmers fields in villages, Kot, Drogan, Neri Blata, Khirki and Jangal Berry.

Bilaspur

- January 28: Stripe rust was observed in var. HD 2733 in 4 sq m in two fields in village Kalol.
- January 28: The disease was observed in var. HPW 236 in traces in village Jaddu Kulzar.
- January 28: In village Bakain, stripe rust was observed in var. HD 2967 in one field in traces.
- In 3rd week of February, 2014, three foci of stripe rust were observed at Kandraur in Bilaspur in var. DPW 621-50. Stripe rust was further spreading to other parts of the field which was about 0.5 hectare. This area was very near to the Bhakra resrvior (200M) with less of drainage and was quite humid and cool.

Sirmour

- On Feb. 21, 2014, incidence of yellow rust was noticed in three fields of village Kolar in Sirmour district of HP. The incidence of yellow rust in fields of Shri .Sanjay Kumar was recorded to the tune of 25% with severity of 50S (6 Bigha). In other fields incidence was about 2% with a severity of 30S. In village Rukhree, disease was noticed in fields of Sh. Prem Dass (3 Bighas) with incidence of less than 1% and severity of 50S. In the fields (2 Bigha) of Shri Dinesh Bansal village Rukhree, yellow rust was recorded with less than 0.5% with a severity of 10S.
- On 25.2.2014, disease was recorded on wheat varieties HD2894 (60S), Barbett (100S), PBW 343 (40S) and unknown variety (40-80S) in village Barotiwala (El.409 m, location N30^{0}27.063, E 077^{0}39.776). About 50 bighas area was sown with non-recommended varieties were badly infected in above village. However, in village Nawada (El.427 m, Loc.N 30^{0}28.032, E 077^0 40.918), yellow rust was recorded on wheat variety WH711 (70S) in about 30 bighas. Yellow rust severity to the tune of 20S was also recorded on wheat variety HPW236. Incidence of yellow rust on this variety was less than 1% in three bighas.

Stripe rust occurrence in HP during March-June: Stripe rust was observed on 10 wheat varieties at Seed Multiplication Farm, Auhar on 4.3.2014. The stripe rust was observed in traces in areas such as Chandpur, Majari, Bassi Dabt, Auhar, Bhaani, Reshikesh, Luharwin and Tikkri in Bialspur district in 2nd fortnight of March. The stripe rust in patches was observed in districts *viz.*, Hamirpur, Kullu, Mandi, Sirmour, Shimla, Solan, Una and Kangra. Dr. Satyavir Singh Bajwa (DWR, Karnal), Dr. S. K. Ghabru (KVK, Berthin) and Dr. Akhilesh Singh (Bilaspur) monitored wheat FLDs at Malan (Kangra), Bajaura (Kullu) and Berthin (Bilaspur) centers in HP on March 11, 2014. In April, 2014, stripe rust was recorded in severe form on susceptible wheat varieties *viz.*, HPW 251, VL 829, VL 616, HS 277 (early sown vars), HPW 184, HPW 211, HS 240, VL 738, VL 804, DBW 17, Raj 3765, PBW 343, PBW 502, PBW 550, WH 711, Super 369, Sonak, Kanaku, Local (varietal mixture) (timely sown vars), HPW 42, HS 295, HS 420, VL 892, Raj 3777, Sonalika (late sown vars) etc. at farmers' fields and severity ranged from 40-80S. Wheat varieties *viz.*, HPW 89, HPW 147, HPW 236 and HPW 249 which were earlier resistant - moderately resistant to stripe rust recorded severity up to 60S at HAREC Bajaura, RWRC Malan and KVK Sunder Nagar due to delayed winter season. These varieties however, overall recorded 5-20S severity in majority of foot and mid hill areas. Wheat varieties of recent times *viz.*, HPW 349, HPW 360, HS 542, HS 507 and VL 907 recorded overall 5-20S severity however, at hot spots (Bajaura, Malan, Sunder Nagar) for stripe rust, they recorded high severity up to 40-60S in isolated plants/ foci. Wheat varieties HPW 155, HS 490 and WH 1080 recorded 5-30S severity at three hot spots and farmers' fields. HD 2967 and DPW 621-50/ PBW 621 recorded severity (40-60S) at some locations in mid and foot hill areas where farmers have not gone for propiconazole spray. The stripe rust severity remained comparatively low in foot hills due to warmer climate/ rise in temperature in March-April and the wheat varieties *viz.*, HPW 236, HPW 211, HPW 249, VL 829, VL 616 etc. which succumbed to stripe rust in mid hills (Bajaura, Malan, Sunder Nagar) recorded less severity 5-20S in foot hill areas (Akrot, Una, Dhaulakuan). Since, the area under resistant varieties has gone up in the state as well as farmers have become vigilant against stripe rust and spraying their crop with propiconazole at the appearance of yellow rust so, the overall severity of yellow rust remained moderate not causing much loss to the wheat crop. Leaf rust with severity 20-60S was recorded at few locations viz. Una, Nalagarh, Kunihar, Malan, Kangra etc. Flag smut with incidence ranging from 3-11% was recorded at some locations in foot and mid hill areas. Powdery mildew with high intensity/ severity up to 8 (on 0-9 scale) was recorded on susceptible varieties at some locations, otherwise, its overall intensity/ severity remained low to moderate (3-5) during current *rabi* season. The farmer's fields were surveyed on 13th June, 2014 for presence of rusts in Kullu Valley of Himachal Pradesh. In Kullu area, yellow rust was observed but most of the pustules were converted in to teliopustules. However under shade some leaves were green and there urediopustules were observed. The severity was 20 - 30 S. Leaf rust was also observed but most of the pustules are converted in to teliopustules. However under shade some leaves were green and there urediopustules were observed. The severity was 40-60 S. In village Bhutti (Kullu), yellow rust was observed (20S). Loose smut was also observed but incidence was very low. In village Bhalayani, yellow rust severity was more (60-80S). Powdery mildew was also observed under apple trees. Leaf rust was also observed (20S) in villages Bhutti and Bhalayani. During June 20-22, 2014, survey was conducted in villages in Leh (Ladakh) No rust was observed in wheat crop.

Uttarakhand: Tarai/Plains of Uttarakhand were surveyed on February 11, 2014. for stripe rust of wheat in different wheat growing areas, en route Bazpur, Kashipur, Gadarpur, Deneshpur, Rudrapur and Kichcha. Overall crop was good and no rust was observed till February 13, 2014 between Pantnagar to Haldwani. Stripe rust (traces) was observed in last week of February in Khatima block of Udham Singh Nagar on varieties PBW 343, PBW 502, HD 2967, PBW 550 and DPW 621-50. On May 19, 2014, heavy infection of all three rusts was observed on most of the collections planted at Bhowali (Uttarakhand). Surprisingly, there was high (60-80S) stem rust infection on about 50 % of the collections. Wheat rusts like symptoms were noticed on about 20 grasses.

Peninsular Zone (PZ)

Leaf rust in TPN nursery was observed on 22nd January in varieties WL 711(TS), C 306 (5S), and Agra Local (TS) planted at Pune. By 3rd February, it spread on more varieties and ARI germplasm viz. WL 711, HD 2329, Agra Local. Lal Bahadur, C 306, WH 147, HD 2160, BARI 82, BARI 102, Kenphad 25 and *T. sphaerococuum* and level on infection increased and severity varied from TS to 40S. Leaf rust was also observed in ARI germplasm nursery on varieties viz; Bari-82, Bari-102, Gulab, Kenphad 25 and *Tritium sphaerococcum* with severity ranging from 5S to 40S. No Natural incidence of black rust was observed under field condition as well as Trap plot nursery till February 28, 2014. Incidence of foliar blight was observed in many varieties viz; Agra local, Lal Bhahdur, Bijaga yellow, A 206, NI 146, Lok-1, Gold 21, ARI breeding material etc. with severity ranging from 12 to 79. Some traces of stem borer were observed in late sown crop at Hol farm. On Feb. 6-7, natural incidence of leaf rust was observed on varieties DWR 162 and off type mixtures in MACS 6222 with severity ranging from 30S to 60S. On Jan. 13, leaf blight was observed in varieties, Kharchia mutant, Bijaga Yellow, A 206, NI 973 and NI 146 at ARI, Pune. On 30^{th} Jan., leaf blight was observed at farmers fields on varieties, Gold 21 and Gold in villages Sakharwadi and Phadtarwadi (Satara). Laf rust (TS-40S) was observed in off types plants at farmers fields in Western Maharashtra during 2^{nd} fortnight of February. The first natural incidence of leaf rust was observed in Wheat Disease Monitoring Nursery on Lal Bahadur variety on 2/2/2014, which increased upto 80S on Feb. 26, 2014. The incidence of stem rust was not seen in the nursery till Feb., 28, 2014. Out of 20 genotypes in TPN, only HD 2329, HD 2160, HW 2021, HD 2204, C 306, HW 2008, DL 784-3, MACS 2496 and HW 971 were free from leaf rust. Incidence of stem rust has not been observed on the surveyed farmers fields in Nasik district. Survey was undertaken for wheat crop health status in Nasik district on 11/3/2014 and 13/3/2014 by Dr. B.C.Game, ARS, Niphad. Stem rust in farmers field was not noticed. Leaf rust was recorded for the first time in two fields on variety LOK-1 at Jopul village (Dindori Tahsil, Dist.Nasik). In Dindori Tehsil, leaf rust severity was recorded upto 80S on Lok-1 and other susceptible off-types. Incidence of stem rust was found in two fields, first field of Lok-1 and in second field on off-types from Mohadi and Korhate villages. During first fortnight of March, leaf rust upto 60S was reported in farmers fields of western Maharashtra and Marathwada region. Stem rust severity upto 40S was observed in wheat fields from Nashik and Dhule districts of Maharashtra during 2^{nd} fortnight of March, 2014. Leaf rust and stem rust incidence was recorded in trap plot nursery planted at IARI Regional station, Indore on 12.3.2014. Leaf rust was observed in range of 5MR to 80S and stem rust (TR-50MS) on the test varieties in trap plot nursery.

Central Zone

Leaf rust in off types in farmers fields of Jabalpur was observed on the way from Kota to Sawai Madhopur. Brown rust was observed on off type plant near village Chhata.

North Eastern Plain Zone

The first incidence of yellow and brown rust was observed in wheat on 24.02.2014 at Kanpur. Initiation of brown rust infection was also observed in Kharchia (TPN) at Araul at Dalipnagar on 24^{th} Feb., 2014.

Other pest & disease survey

On 12-13 March, 2014 in different districts of Punjab and Haryana moderate to severe incidence of wheat aphid was observed while minor incidence of Pink Stem Borer was observed in village Bilaspur (Dabwali). Incidence of foliar aphids was recorded on early and timely sown wheat in Nasik and Dhule districts. Initiation of aphids was recorded in first week of December 2013. Among FLDs, heavy incidence of root aphids was also observed in farmer's field. Flag smut in traces was recorded at Alampur and Jangal areas of Lamba Gaon block. Powdery mildew with high severity was recorded on HPW 184 at Alampur area in Kangra district and low to moderate severity at Sunder Nagar, Nagchala and Mehar areas in Mandi district. In Kanpur, termite infestation was reported ranging from 12-15% in rainfed crop and about 5% infestations in irrigated crop. Wheat crop showed moderately resistant reaction against aphid. In late sown wheat crop, shoot fly infestation ranged from 10-13%. Incidence of root rot, foot rot and blight symptoms were noticed in some fields of Faizabad area.Moderate incidence of foliar blight, shoot fly and aphids were also observed in some fields. In Coochbehar, leaf blight was observed during 1st week of March.

Awareness for stripe rust management: Stripe rust awareness among farmers was created by organizing Farmers' Fair in collaboration with State Department of Agriculture, Yamunanagar at Bilaspur (Yamunanagar) on September 25, 2013 and more than 2500 farmers attended the fair. On September 28, 2013, one Kisan Mela was organized at Kaithal and stripe rust management cards were distributed among the farmers. Farmers Innovator and Seed day was organized at DWR, Karnal on October 15, 2013 in which farmers were apprised of the strategies enhancing wheat production including crop production and protection technologies with emphasis on stripe rust management.

Strategy Planning Meetings: During 2013-14, preventive steps were taken by DWR (ICAR), DAC and State Departments. Strategy meeting was organized by DAC on Oct 5, 2013 in Panchkula (Haryana) for stripe rust management. Strategy meeting were also organized in Dehradoon and Jammu in October, 2013. A meeting was organized by DAC, Ministry of Agriculture, Govt. of India at Una (HP) on January 8, 2014 for stripe rust management in NWPZ and NHZ.

Advisory for stripe rust management: Advisory for stripe rust management was issued by DWR, Karnal on December 17, 2013, January 2, February 3 and March 3, 2014.

Training on wheat health management: A training course on Techniques and Procedures in Crop Health Monitoring and Field Evaluation of Host Resistance in Wheat and Barley was organized by DWR (Karnal and Flowerdale, Shimla) and DRRW project of BGRI for the co-operators of AICW&BIP at DWR, Karnal during January 29-31, 2014. A total 23 scientist working in wheat pathology throughout the country were precipitated in the training. They were familiarize with survey and surveillance techniques, disease rating scales, inoculum multiplication, inoculation, epiphytotic creation, and data recording and reporting. A hands-on understanding has been provided to trainees on these techniques.

Impact of Strategies to combat stripe rust of wheat

Though, stripe rust was occurring in India since long, it was in the year 2001 when a new virulence was detected on PBW 343. With the increase in area under PBW 343, eventually the stripe rust spread to large areas (approx. 3mha) in 6 states (Himachal Pradesh, Jammu region of Jammu and Kashmir, Punjab, Haryana, Uttar Pradesh, Uttarakhand). Due to its high intensity in some years resulting in losses to farmers, led to the formulation of a strategic plan during 2010-11 to limit its occurrence below threshold levels of economic losses. Major emphasis was on bringing in farmer's awareness in replacing susceptible varieties with resistant ones, early detection of the rust, identifying initial foci of infection by regular monitoring of crop after 40 days of planting and immediately spraying the crop with fungicides to limit its spread. Special cards were devised for the awareness to farmers and circulated in large numbers in all the affected areas. Every year strategic planning meetings were held under the chairmanship of Secretary, Department of Agriculture and Cooperation, Government of India, for enhancing wheat production and stripe rust management. Advisories were issued as and when the disease was detected with major emphasis on advising farmers for frequent visits in their fields and making available the recommended fungicide (Propiconazole). Extensive training programmes were organized for the officers' of Department of Agriculture, scientists and farmers of affected areas. In high disease prone areas TRAP nursery/advanced varieties trials were planted for early detection of stripe rust/identifying resistant varieties. To create genetic diversity at farmers' field, several stripe rust resistant varieties viz., HD 2967, WH 1105, HD 3086, DBW 88, HD 3059, WH 1021, WH 1080, HD 3043, DBW 71, DBW 90, HS 507, HPW 349 and HS 542 were released. A gradual decline in stripe rust occurred in disease prone states since 2011 due to awareness to farmers leading to drastic decline in area under susceptible varieties, and replacement with resistant varieties viz., PBW550, DPW 621-50, HD 2967, HD 3059, HS 490, VL 829, VL 892, VL 907, PBW 590 in large areas, feedback from farmers of its early detection and timely spraying with fungicide. In the year 2013-14 though the disease was first detected in 1st week of January coupled with favourable environmental conditions throughout the season the disease did not spread to large areas and furthermore its intensity also remained low avoiding losses to the tune of about 3 mt.

8.2 POST HARVEST SURVEYS

KARNAL BUNT

A total of 8900 grain samples collected from various mandies in different zones, were analyzed by DWR as well as other cooperating centers (Table 1). The number of samples analyzed by various centres were: DWR-1766, Ludhiana-1919, Hisar-960, Pantnagar-2763, Dhaulakuan-381, Vijapur-490 and Durgapura-621. From Central and Peninsular zones, 694 and 222 samples, respectively, were analyzed to know the distribution and disease situation in these zones. The Karnal bunt situation in the country has been depicted in the Table 8.2. The highest incidence (83.98%) was recorded from UP. In Haryana, out of 1769 samples analyzed, 47.99 per cent were found infected with KB. A total of 1919 samples were collected by Ludhiana centre from different grain markets of Punjab. The disease prevalence was higher during the current year and 39.13 per cent samples were found infected. From Rajasthan, out of 720 samples analyzed, 30.13 per cent were found infected with KB with infection range upto 2.15 per cent. In Uttarakhand, out of 2845 samples analyzed, 24.67 % were infected. In MP, out of 294 samples, 6.12 per cent samples were KB infected. Based on the overall KB occurrence, it emerged that the KB incidence this year was less than the previous year. No sample from West Bengal, Gujarat (Vijapur), Maharashtra (Pune) and Karnataka (Dharwad) was found infected with KB (Table 8.2). Karnal bunt situation in Punjab, Haryana, Rajasthan, Uttarakhand and Gujarat is presented in Tables 8.4, 8.5, 8.6, 8.7 and 8.8, respectively.

Table 8.2. Karnal bunt situation in the country during 2013-14 crop season

State	Total samples	Infected samples	% infected samples	Range of infection
Punjab	1919	751	39.13	0.07-2.56
Haryana	1769	849	47.99	0-5.25
Rajasthan	720	217	30.13	0-2.15
Uttarakhand	2845	702	24.67	0-10.00
Himachal Pradesh	381	114	29.90	0.1.8
West Bengal	14	0	0	-
U.P.	256	215	83.98	0-9.3
M.P.	294	18	6.12	0-2.40
Gujarat	490	0	0	-
Maharashtra	112	0	0	-
Karnataka	100	0	0	-
Total	**8900**	**2866**	**32.20**	**0-10.00**

Table 8.3. Grain samples analysis for KB at DWR Karnal during 2013-14 crop season

State	Total samples	Total no. of infected samples	% infected samples	Range of infection
Haryana	809	407	**50.30**	0-5.25
Rajasthan	99	43	**43.43**	0-1.85
Uttarakhand	82	21	**25.60**	0-2.65
U.P.	256	215	**83.98**	0-9.3
M.P.	294	18	**6.12**	0-2.40
Maharashtra	112	0	**0**	--
Karnataka	100	0	0	--
West Bengal	**14**	**0**	**0**	**-**
Total	**1766**	**704**	**39.86**	**0-9.3**

Table 8.4. Spectrum of Karnal bunt in Punjab during 2012-13 crop season (Ludhiana centre)

S. No.	District	Total samples	KB Infection		
			Samples Infected	Infected Samples (%)	Average Infection (%)
1	Amritsar	79	50	63.29	0.5
2	Barnala	54	14	25.93	0.33
3	Bathinda	85	7	8.24	0.009
4	Faridkot	65	8	12.31	0.02
5	Fatehgarh Sahib	61	5	8.20	0.031
6	Fazilka	67	20	29.85	0.054
7	Ferozepur	204	51	25.00	0.033
8	Gurdaspur	99	48	48.48	0.262
9	Hoshiarpur	110	76	69.09	0.546
10	Jallandhar	137	82	59.85	0.304
11	Kapurthala	110	67	60.91	0.156
12	Ludhiana	182	72	35.96	0.102
13	Mansa	47	35	74.47	0.528
14	Moga	65	9	13.85	0.018
15	Mohali	100	38	38.00	0.248
16	Mukatsar	98	5	5.10	0.007
17	Nawanshar	52	9	17.31	0.040
18	Patiala	50	13	26.00	0.338
19	Pathankot	38	35	92.11	2.555
20	Ropar	69	33	47.83	0.765
21	Sangrur	83	39	46.99	0.199
22	Tarantarn	64	35	54.69	0.105
Total		**1919**	**751**	**39.13**	**0.241**

Table 8.5. Spectrum of Karnal bunt in Haryana during 2013-14 crop season (Hisar centre)

District	Total samples	Infected samples	% infected samples	Range of infection (%)	Average infection (%)
S-W Zone					
Hisar	91	14	15.38	0.05-0.45	0.043
Rohtak	26	14	53.84	0.05-0.20	0.050
Bhiwani	80	53	66.25	0.05-0.95	0.168
M.Garh	20	13	65.00	0.05-0.35	0.075
Rewari	58	45	77.58	0.05-1.05	0.276
Jhajjar	39	19	48.71	0.05-0.95	0.244
Gurgaon	45	31	68.88	0.05-1.00	0.144
Mewat	54	41	75.92	0.05-1.25	0.363

District	Total samples	Infected samples	% infected samples	Range of infection (%)	Average infection (%)
Jind	117	51	43.58	0.05-0.50	0.141
Sirsa	62	1	1.61	0.05	0.001
Fatehabad	31	0	0.00	0.0	0.00
Total	**623**	**291**	**46.71**	**0.05-1.25**	**0.136**
N-E Zone					
Karnal	34	14	41.17	0.05-0.45	0.063
Ambala	41	8	19,.51	0.05-0.15	0.046
Kurukshetra	61	32	52.45	0.05-1.00	0.092
Kaithal	23	8	34.78	0.05-0.25	0.041
Sonepat	22	3	13.63	0.05-0.15	0.011
Panipat	40	4	10.00	0.05-0.25	0.020
Palwal	30	22	73.33	0.05-1.00	0.210
Y.Nagar	86	60	69.76	0.05-3.75	0.583
Total	**337**	**151**	**44.80**	**0.05-3.75**	**0.133**

Table 8.6. Spectrum of KB in Rajasthan in wheat cultivars during 2013-14 (Durgapura centre)

Sr. No.	Location	Total samples	Infected Samples	% Infected Samples
1.	Ajmer	57	4	7.0
2.	Bagru	27	0	0
3.	Bansur	55	43	78.20
4.	Bassi	43	12	27.90
5.	Chaksu	23	2	8.70
6.	Chomu	44	13	29.50
7.	Dausa	51	18	35.30
8.	Deoli	37	1	2.70
9.	Jaipur	39	14	35.90
10.	Kishangarh	16	0	0
11.	Kotputli	52	32	61.50
12.	Lalsot	80	18	22.50
13.	Renwal	19	6	31.60
14.	Shahpura	11	7	63.60
15.	Tonk	67	4	5.90
Total		621	174	28.00

Table 8.7. Incidence of KB in different districts of Uttarakhand during 2013-14 crop season (Pantnagar centre)

Districts	Total Samples	No. of infected samples	% infected samples	< 0.25%	0.26-1%	1.1- 5%	>5-10 %
Udham Singh Nagar							
Pantnagar	1500	186	12.40	174	12	0.0	0.0
Kashipur	102	24	23.53	16	08	0.0	0.0
Bajpur	384	47	12.24	45	02	0.0	0.0
Khatima	127	22	17.32	20	02	0.0	0.0
Sitarganj	119	13	10.92	12	01	0.0	0.0
Total	**2232**	**292**	**13.08**	**267**	**25**	**0.0**	**0.0**
Dehradun	227	187	82.38	64	93	28	02
Almora	211	132	62.56	81	45	06	0.0
Pauri Garhwal	93	70	75.27	30	31	06	03
Total	**2763**	**681**	**24.65**	**442**	**194**	**40**	**5**

Table 8.8. Spectrum of KB in Vijapur, Gujarat during 2013-14 (Vijapur centre)

Location	Total samples	Infected samples	% infected samples
Mansa	39	0	0.0
Dehgam	27	0	0.0
Talod	17	0	0.0
Khedbrahma	36	0	0.0
Idar	66	0	0.0
Vadali	49	0	0.0
Bhiloda	32	0	0.0
Himmatnagar	24	0	0.0
Visnagar	34	0	0.0
Mehsana	44	0	0.0
Vijapur	38	0	0.0
Kukurvada	32	0	0.0
Gogria	27	0	0.0
Farmers Fields	25	0	0.0
Total	**490**	**0**	**0.0**

BLACK POINT

Out of 5717 grain samples (Table 8.9) analyzed for black point from different zones in the country, 78.95 per cent samples showed black point. Grain samples analyzed by DWR, Karnal, Ludhiana, Hisar, Durgapura and Vijapur are presented in Tables 8.10, 8.11, 8.12, 8.13 and 8.14, respectively. Black point incidence in AVT lines was recorded by Hisar centre (Table 8.16).

GRAIN DISCOLOURATION

Out of 1611 grain samples (Table 8.15) analyzed from different zones in the country, 77.40 per cent samples showed grain discolouration.

Table 8.9. Spectrum of black point in the country during 2013-14 crop season

State	Total samples	Infected samples	% infected samples	Range of infection
Punjab	1878	1878	100.00	0.63-1.025
Haryana	1769	1241	70.15	0-5.00
Rajasthan	720	579	80.41	0-1.05
Uttarakhand	82	45	54.87	0-1.1
West Bengal	14	12	85.71	0-1.8
UP	256	183	71.48	0-1.1
M.P.	294	223	75.85	0-2.0
Gujarat	490	234	47.75	0-9.5
Maharashtra	112	95	84.82	0-4.2
Karnataka	102	24	23.52	0-0.5
Total	**5717**	**4514**	**78.95**	**0-9.5**

Table 8.10. Analysis of grain samples for black point at DWR Karnal during 2013-14 crop season

State	Total samples	Total no. of infected samples	% infected samples	Range of infection	Location of highest infection
Haryana	809	602	74.41	0-1.7	Ambala
Rajasthan	99	53	53.53	0-1.05	Durgapura
Uttarakhand	82	45	54.87	0-1.1	Pantnagar
U.P.	256	183	71.48	0-1.1	Pilibhit
M.P.	294	223	75.85	0-2.00	Indore
Maharashtra	112	95	84.82	0-4.2	Pune
Karnataka	102	24	23.52	0-0.5	Dharwad
West Bengal	14	12	85.71	0-1.8	Sagardhiri
Total	**1768**	**1237**	**69.96**	**0-4.2**	**West Bengal**

Table 8.11. Analysis of grain samples for black point in Punjab during 2013-14 crop season (Ludhiana centre)

S. No.	District	No of grain markets surveyed	Total samples	Infected Samples (%)	Infected Grains (%)
1	Amritsar	6	78	100	0.732
2	Bathinda	5	85	100	0.991
3	Barnala	3	54	100	0.85
4	Faridkot	4	65	100	0.98
5	Ferozepur	13	188	100	0.974
6	Fatehgarh sahib	4	67	100	0.94
7	Fazilka	5	77	100	0.545
8	Gurdaspur	3	63	100	0.733
9	Hoshiarpur	8	126	100	0.768
10	Jallandhar	9	133	100	0.846
11	Kapurthala	8	110	100	0.934
12	Ludhiana	12	182	100	0.892
13	Moga	6	100	100	1.025
14	Mansa	4	65	100	0.86
15	Mukatsar	6	98	100	0.914
16	Mohali	2	32	100	0.668
17	Nawanshar	2	36	100	0.63
18	Pathankot	3	38	100	0.81
19	Patiala	4	65	100	0.76
20	Ropar	5	69	100	0.833
21	Sangrur	5	83	100	1.007
22	Tarantaran	4	64	100	0.789
Total		121	1878		

Table 8.12. Analysis of grain samples for black point in Haryana during 2013-14 crop season (Hisar centre)

District	Total samples	Infected samples	% infected samples	Range of infection (%)	Average infection (%)
S-W Zone					
Hisar	91	79	86.81	0.05-2.20	0.504
Rohtak	26	6	23.-7	0.05-0.20	0.025
Bhiwani	80	52	65.00	0.05-0.50	0.110
M.Garh	20	11	55.00	0.05-0.25	0.040
Rewari	58	36	62.06	0.05-0,40	0.061
Jhajjar	39	18	46.15	0.05-0.55	0.063
Gurgaon	45	31	68.88	0-.05-0.50	0.070
Mewat	54	33	61.11	0.05-1.10	0.142
Jind	117	81	69,.23	0.05-4.00	0.418
Sirsa	62	39	62.90	0.05-3.50	0.252
Fatehabad	31	20	64.51	0.05-0.80	0.227
Total	**623**	**406**	**65.16**	**0.05.4.00**	**0.173**
N-E Zone					
Karnal	34	30	88.23	0.15-1.80	0.385
Ambala	41	25	60.97	0.20-1.90	0.274
Kurukshetra	61	36	59.01	0.15-5.00	0.331
Kaithal	23	16	69.56	0.15-1.25	0.267
Sonepat	22	22	100.00	0.20-1.80	0.538
Panipat	40	38	95.00	0.10-0.90	0.423
Palwal	30	16	53.33	0.05-0.35	0.100
Y.Nagar	86	50	58.13	0.10-1.00	0.221
Total	**337**	**233**	**69.13**	**0.05-5.00**	**0.317**

Table 8.13. Spectrum of black point in Rajasthan in wheat cultivars during 2013-14 season (Durgapura centre)

Sr. No.	Location	Total samples	Infected Samples	% Infected Samples
1.	Ajmer	57	48	84.20
2.	Bagru	27	16	59.30
3.	Bansur	55	45	81.90
4.	Bassi	43	42	97.70
5.	Chaksu	23	22	95.70
6.	Chomu	44	31	70.50
7.	Dausa	51	46	90.20
8.	Deoli	37	35	94.60
9.	Jaipur	39	34	87.20
10.	Kishangarh	16	10	62.50
11.	Kotputli	52	40	76.90
12.	Lalsot	80	70	87.50
13.	Renwal	19	14	73.70
14.	Shahpura	11	7	63.60
15.	Tonk	67	66	98.50
Total		621	526	84.70

Table 8.14. Spectrum of black point in Vijapur district of Gujarat during 2013-14 season (Vijapur centre)

Location	Total samples	Infected samples	% infected samples	Infection range
Mansa	39	16	41.03	0-8.9
Dehgam	27	17	62.96	0-6.3
Talod	17	8	47.06	0-4.8
Khedbrahma	36	23	63.89	0-5.0
Idar	66	34	51.52	0-9.50
Vadali	49	27	55.10	0-6.8
Bhiloda	32	16	50.00	0-7.3
Himmatnagar	24	7	29.17	0-4.5
Visnagar	34	16	47.06	0-9.3
Mehsana	44	19	43.18	0-7.5
Vijapur	38	14	36.84	0-5.5
Kukurvada	32	12	37.50	0-7.3
Gogria	27	13	48.15	0-6.8
Farmers Fields	25	12	48.00	0-3.6
Total	**490**	234	47.24	0-9.5

Table 8.15. Analysis of grain samples for grain discolouration at DWR Karnal during 2013-14 crop season

State	Total samples	Infected samples	% infected samples	Range of infection	Location of highest infection
Haryana	809	654	80.84	0-2.35	Ambala
Rajasthan	89	77	86.51	0-1.3	Durgapura
Uttarakhand	82	59	71.95	0-1.25	Pantnagar
U.P.	151	82	54.30	0-1.15	Kanpur
M.P.	266	246	92.48	0-2.5	Indore
Maharashtra	112	84	75.0	0-3.5	Pune
Karnataka	102	45	44.11	0-1.1	Dharwad
Total	**1611**	**1247**	**77.40**	**0-3.5**	**Indore(M.P)**

Table. 8.16. Black point incidence in AVT lines during 2013-14 (Hisar centre)

I. NORTHERN HILL ZONE			III. NORTH EASTERN PLAIN ZONE		
Sr. No.	Genotype	Incidence (%)	Sr. No.	Genotype	Incidence (%)
1	HPW 376	1.0	49	K 8027 (C)	1.2
2	VL 967	0.0	50	NW 2036 (C)	0.0
3	HPW 251 (C)	0.0	51	NW 5054 (I) (C)	0.0
4	HPW 349 (C)	0.0	IV. CENTRAL ZONE		
5	HS 277 (C)	0.0			
6	HS 375 (C)	0.0	52	DBW 110	0.0
7	HS 490 (C)	0.0	53	HI 8736 (D)	-
8	HS 507 (C)	0.8	54	HI 8737 (D)	0.6
9	HS 542 (I) (C)	1.5	55	MP 3382	-
10	VL 804 (C)	0.9	56	NIAW 1885	6.2
11	VL 829 (C)	1.9	57	PBW 689	0.0
12	VL 892 (C)	1.9	58	A 9-30-1 (D) (C)	1.2
13	VL 907 (C)	0.0	59	GW 322 (C)	0.0
II. NORTH WESTERN PLAIN ZONE			60	HD 2864 (C)	1.6
14	HUW 666	0.0	61	HD 2932 (C)	2.2
15	PBW 681	-	62	HI 1500 (C)	-
16	WH 1129	1.6	63	HI 1544 (C)	2.6
17	WH 1138	3.2	64	HI 8498 (D) (C)	-
18	WH 1142	0.0	65	HI 8627 (D) (C)	5.5
19	DBW 88 (I) (C)	0.0	66	MP 3288 (C)	0.0
20	DBW 90 (I) (C)	0.1	67	MP 3336 (C)	0.0
21	DPW 621-50 (C)	0.4	68	MP 4010 (C)	8.4
22	HD 2967 (C)	-	69	MPO 1215 (d) (C)	0.0
23	HD 3043 (C)	8.6	V. PENINSULAR ZONE		
24	HD 3059 (C)	3.5			
25	HD 3086 (I) (C)	0.7	70	NIAW 1994	1.4
26	PBW 590 (C)	2.7	71	UAS 347	1.2
27	PBW 644 (C)	0.7	72	UAS 446 (D)	0.0
28	PBW 660 (I) (C)	1.5	73	AKDW 2997-16(d) (C)	0.6
29	PDW 233 (C)	1.4	74	HD 3090 (I) (C)	0.0
30	PDW 291 (C)	0.7	75	MACS 6222 (C)	38.6
31	PDW 314 (C)	0.3	76	MACS 6478 (C)	1.5
32	WH 1021 (C)	0.4	77	NI 5439 (C)	0.0
33	WH 1080 (C)	0.0	78	NIAW 1415 (C)	1.4
34	WH 1105 (C)	0.0	79	NIDW 295 (d) (C)	0.0
35	WH 1124 (I) (C)	0.0	80	Raj 4083 (C)	14.3
III. NORTH EASTERN PLAIN ZONE			81	UAS 428 (d) (C)	0.0
36	BRW 3723	0.0	VI. SOUTHERN HILLS ZONE		
37	DBW 107	3.9	82	CoW(W) 1 (C)	0.0
38	HD 3118	1.8	83	HW 2044 (C)	0.0
39	K 1114	1.0	84	HW 5216 (C)	0.8
40	C 306 (C)	1.6	VII. SPECIAL TRIAL		
41	DBW 14 (C)		85	DDK 1042	1.6
42	DBW 39 (C)	1.9	86	MACS 5022	0.0
43	HD 2733 (C)	0.0	87	DDK 1029 (C)	0.0
44	HD 2888 (C)	0.0	88	HW 1098 (I) (C)	0.0
45	HD 2985 (C)	7.4	89	Kharchia 65 (C)	0.0
46	HI 1563 (C)	7.8	90	KRL 19 (C)	0.7
47	K 0307 (C)	1.5	91	KRL 210 (C)	0.4
48	K 1006 (I) (C)	5.6	92	MACS 2496 (C)	0.0
			93	MACS 2971 (C)	0.0

COOPERATORS

NAME	CENTRE
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SS KARWASARA AND R S BENIWAL	HISAR
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Samples received from Drs. JP Tandon, Deep Shikha (Pantnagar), AN Mishra (Indore), AP Padhye (Niphad), BK Honrao (Pune), Javed Bahar Khan (Kanpur), KK Mishra (Powarkheda) and IK Kalapannavar (Dharwad) were analyzed at DWR, Karnal.

8.3: RUST PATHOTYPE DISTRIBUTION

A. SHIMLA CENTRE

Incidence of wheat rusts in India

This crop year was marked with the sporadic appearance of yellow (stripe) rust in some pockets of Northern India. Though the yellow rust was observed in early January 2014, however, due to the resistance in cultivated varieties as well as pro active steps for the management, it could be managed well. Black (stem) rust of wheat was observed on indigenous wheat material planted at Bhowali, Hawalbagh and Pantnagar (Uttarakhand) and barley material in Karnataka. Brown (leaf) rust was widely distributed in different wheat growing areas of India. In nutshell there was no major incidence of wheat rusts in India during 2013-14.

Sample analysis and pathotype distribution of wheat and barley rusts

So far1209 samples of three rusts of wheat and yellow rust of barley have been analyzed for pathotype distribution.

Yellow rust of wheat & Barley (*Puccinia striiformis*)

During this crop year, 312 samples of yellow rust of wheat and barley were analyzed from six North Indian states and Nepal. Owing to the cool and humid weather, the population of pathotype 46S119, which is virulent to *Yr9* and *YrA* has increased in proportion and was observed in more than 74 % of the samples analyzed (Table 8.17)

Table 8.17. Pathotype distribution of Yellow rust (*Puccinia striiformis*) up to 30-06-2014

S. No.	State/ country	No. of Samples	Pathotypes observed							
			46S119	78S84	47S103T	46S103P	46S102N	NP*	1S0(M)	0S0(57)
1	Himachal Pradesh	171	132	20	5	2	1	7	3	1
2	Jammu & Kashmir	27	17	7	1		-	-	1	1
3	Punjab	55	32	20	-	2	-	1	-	-
4	Haryana	30	25	5	-	-	-	-	-	-
5	Uttarakhand	21	16	3	-	-	-	-	-	2
6	Uttar Pradesh	7	2	2	-	-	-	3	-	-
7	Nepal	1	1	-	-	-	-	-	-	-
	Total	**312**	**225**	**57**	**6**	**4**	**1**	**11**	**4**	**4**

* Probable new pathotype ________ so far. Since 2011, there is a drastic shift of pathotypes in favor of pt.46S119. Partly it is due to the cold climate over the years as well as decrease in the area under PBW343. Many of the wheat lines/varieties which were resistant to yellow rust in farmers' field prior to 2011, became susceptible due to this shift in virulence. The proportion of PBW343 virulent pathotype 78S84 which is virulent to *Yr9* and *Yr27* has reduced to 18.5%. Three other pathotype were found in about 4% of the samples only (Table1). Barley yellow rust prevalence was negligible during the year. In barley yellow rust pathotype M and 57 were observed in four samples each from Himachal Pradesh and Jammu and Kashmir.

New pathotype

In eleven samples, a new pathotype has been identified which is not very virulent but is very competitive. During repeated tests, new pathotype has shown virulence to *Yr1*, *Yr* 6 and *Yr* 7 but is avirulent to *Yr9*. Further studies are under way.

i. Black rust of wheat (*Puccinia graminis tritici*)

Black rust of wheat was observed in 9 states of India, Nepal and Bangladesh in Peninsular India. **Virulence on *Sr*31 (Ug99 type of pathotypes) were not identified anywhere in India, Bangladesh, Bhutan and Nepal.** Pathotype 40A

Table 8.18. Pathotype distribution of black rust (*Puccinia graminis tritici*) up to 30-6-2014

S. No.	State/ country	Samples	Pathotypes observed*									
			79G31 (11)	123G 15 (15-1)	9G5 (21)	24G5 (21-1)	75G5 (21A-2)	62G29-1 (40-1)	58G13-3 (40-2)	127G29 (40-3)	62G29 (40A)	NP**
1	Tamil Nadu	56	-	-	-	-	-	3	-	8	43	2
2	Karnataka	70	69	-	-	-	-	-	1	-	-	
3	Maharashtra	14	8	-	-	-	-	-	-	1	5	
4	Gujarat	8	1	-	-	-	-	1	-	1	5	
5	Madhya Pradesh	15	2	1	-	-	2	1	2	3	4	
6	Uttar Pradesh	2	2	-	-	-	-	-	-	-	-	
7	Uttarakhand	36	8	-	3	21	4	-	-	-	-	
8	Rajasthan	6	-	-	-	5		-	-	-	1	
9	Himachal Pradesh	5	-	-	-	2	2	-	1	-	-	
10	Nepal	6	2	-	1	1	1	-	-	-	1	
11	Bangladesh	4	-	-	-	1	3	-	-	-		
	Total	224	92	1	4	30	12	5	4	13	59	2

** Probable new pathotype was frequent in Tamil Nadu.Among the 224 samples analyzed, pathotype was widely observed in Karnataka, Maharashtra and some areas in Northern India but not in the Nilgiri hills. In Gujarat pathotype 40A was identified in maximum number of samples whereas three other pathotype were observed in one sample each. Diversity of pathotype was maximum in Madhya Pradesh where seven pathotypes were identified in 15 samples with predominance of pathotype 40A. In Uttar Pradesh, pathotype 11 was identified in two samples whereas in Uttarakhand, Rajasthan and Himachal Pradesh pathotype 21-1 which was identified in 1985 was identified in maximum numbers of samples. In north Indian states other pathotypes of 21 group were identified in few samples whereas pathotype 11 was observed in Uttarakhand (Table 8.18).

New pathotype

Preliminary studies have shown the occurrence of two new pathotypes in one sample each from Tamil Nadu .These were designated as 40-4 and 40-5. Both the pathotypes seem to be an off-shoot of pathotype 40A.While 40-4 is virulent to *Sr*21, 40-5 has additional virulence to *Sr*7a. These new pathotypes appear to be virulence selection in 40A on diploid and tetraploid wheat.

ii. Brown rust of wheat (*Puccinia triticina*)

Thirty pathotypes were identified in 673 samples of brown rust of wheat analyzed from 15 states of India, Nepal, Bhutan and Bangladesh. Pathotype 77-5, virulent to *Lr*23 and *Lr*26 was predominant in 14 states and 3 neighboring countries. Pathotype 104-2 , virulent to *Lr*23 and *Lr*26 succeeded 77-5 and was observed in 12 states and two adjoining countries Nepal and Bangladesh. In Nilgiri hills, the proportion of pathotype 77-9 has increased in comparison to the previous years and was identified in 56% of the samples analyzed from that area. Frequency of predominant pathotype 77-5 for the last more than 18 years has reduced considerably. Likewise, in Karnataka, pathotype 77-9, 12 and 77-11 were the three most frequent pathotypes. In addition pathotype 77-5, 12-2 and 104-2 were also frequent. Fifteen other pathotypes were identified in the remaining samples. In Maharashtra pathotype 12 was most frequent followed by pathotype 77-5 whereas other pathotype were identified in few samples only. Contrarily pathotype 104-2 was predominant in Gujarat, Rajasthan and Madhya Pradesh. Based on the analysis of 17 samples from North eastern states of Bihar and West Bengal pt 77-5 was the most predominant. In Uttar Pradesh, pts. 77-5 and 104-2 were identified in 31% of the samples each. Eleven other pathotypes were detected in few samples only. In Uttarakhand, pathotype 104-2 was most frequent whereas in Himachal Pradesh pt 77-5 and 104-2 were more predominant with equal frequency. In Punjab, pt. 77-3 was found in maximum number of samples whereas in Jammu &Kashmir, pt. 12-9 occurred in the only two samples analyzed. In Nepal Bhutan and Bangladesh pt. 77-5 and 104-2 were identified in maximum numbers of samples whereas thirteen other pathotype were identified in few samples only (Table 8.19).

New pathotypes

In few samples from the Nilgiri hills, a new pathotype designated as 77-12 was identified. The new pathotype is close to the pathotype 77-9 but is avirulent to *Lr*26.In a sample from the Maharashtra, a new pathotype, designated as 77-13 was identified. This pathotype appears to be the result of a loss of virulence on *Lr*26 in the pathotype 77-10, which has virulence to *Lr*28. Further studies on rust resistance, avirulence/virulence structure are being undertaken.

Table 8.19. Pathotype distribution of brown rust (*Puccinia triticina*) up to 30-06-2014

S. No	State/ country	No. of Samples	Pathotypes observed*																											
			12(5R5)	12-1 (5R37)	12-2 (1R5)	12-3 (49R37)	12-4 (69R13)	12-5 (29R45)	12-6 (5R45)	12-9 (93R37)	12A (5R13)	77-1 (109R63)	77-2 (109R31-1)	77-3 (125R55)	77-4 (125R23-1)	77-5 (121R63-1)	77-6 (121R55-1)	77-9 (121R60-1)	77-10 (377R60-1)	77-11 (125R28)	77-12 (121R52-1)	77A (109R31)	77A-1 (109R23)	104-2 (21R55)	104-3 (21R63)	104-4 (93R57)	104A (21R31)	104B (29R23)	162 (93R07)	162-1(93R47)	162-2(93R39)	162A (93R15)
1	Tamil Nadu	71										1				12	8	40			9									1		
2	Karnataka	169	36	1	14	2	2				1	1		1	1	18	2	36		28	2	2	2	12	2		1		3		2	
3	Maharashtra	51	27				1				1			1		7	1	3	1	4				3			1				1	
4	Gujarat	19											2			5								10					1		1	
5	Madhya Pradesh	63	1									1				1		1						45	9		1	2	2			
6	Bihar	6							1				1			2								1	1							
7	West Bengal	12														8	3															1
8	Chhattisgarh	3											1			1																
9	Rajasthan	25														6	1	2						9	2					4	1	
10	Uttar Pradesh	70	1	2				1		.		3		1		22	1	8						22	4				1	3	1	
11	Haryana	10												1		2				1				2	1	2						1
12	Uttrakhand	20		2								1				3								8	3		1				2	
13	Punjab	7				1						1		2		1		1						1								
14	Himachal Pradesh	34										1		1		10	5							10	5	1						1
15	Jammu&Kashmir	3								2														1								
16	Nepal	48	1			1								1		34		1						9			1					
17	Bhutan	13		1												11	1															
18	Bangladesh	49		3		1	1					1		2		25								4	5	1	1			3		2
	Total	673	66	9	14	5	4	1	1	2	2	10	4	10	1	168	22	92	1	33	11	3	2	137	32	4	6	2	7	11	8	5

8.4. PREPARENESS TO COMBAT Ug99

Extensive surveys were conducted in the country to monitor the occurrence of stem rust pt. Ug99. Till today, there has not been any report from anywhere in the country. As a part of our preparedness, AICW&BIP/ICAR, in collaboration with CIMMYT, Mexico have continued with the testing programme of wheat at Njoro in Kenya and Ethiopia. During 2013, AVT entries, of 2012-2013, numbering 221 were evaluated at Kenya and Ethiopia for Ug99 resistance (Annex.15)

8.5 46th Wheat Disease Monitoring Nursery (WDMN) 2013-14

Wheat disease monitoring nursery (earlier known as trap plot nursery) is an effective tool for monitoring the occurrence of wheat diseases especially rusts across different wheat growing areas of India. In addition, it helps to know the seasonal progress of the diseases in all the zones. Samples analyzed from WDMN helps to trap new pathotypes in initial stages, gives an overview of area wise distribution and frequency of different rust pathotypes.

The nursery also helps in understanding the area wise performance of different disease resistance genes. Wheat disease monitoring nursery was strengthened and planted at about 66 locations (Table 8.20) as well as some other locations covering all the major wheat growing areas in the country, especially those situated near the bordering areas to the neighboring countries.

There were a total of 20 entries in the WDMN however; one extra entry, Barley was added for northern hill and high altitude zone. Of the total entries first 15 constitute the common set for all zones, rest of the five (six in northern hill and high altitude zone) entries were zone specific varieties. Keeping into account the changed varietal situation there was some change in the constitution of WDMN for NWPZ and NEPZ. The detailed constituent of WDMN for 2013-14 crop season is as given below:

Common set of varieties for all zones

WL 711, HD 2329, Agra Local, HD 2160, Lal Bahadur, WL 1562, HW2021 (*Sr26/Sr24*), HD 2204, C 306, WH 147, HW 2008 (*Sr24/Lr24*), Kharchia mutant, HP 1633, DL 784-3 and *Lr24*.

Zone specific varieties

i) **North Western Plains Zone**
DBW17, WH 542, PBW 343, DPW 621-50 and WH 896

ii) **North Eastern Plains Zone**
K 8804, HD 2402, HP 1102, HUW 468 and NW 1014

iii) **Central Zone**
HI 8381, DL 803-3, Lok -1, GW273, GW322

iv) **Peninsular and Southern Hills Zone**
MACS 2496, Bijaga Yellow, HW 971, HD 2501, HW 2022 (*Sr24/Lr24*)

v) **Northern Hills and High Altitude Zone**
HPW 251, VL892, HS 420, Sonalika, VL 738, Barley Local

Data booklets containing sowing plan, procedures and disease recording methodology and the seed material were sent to co-operators early in the season. As per the decision in wheat workshop 2012-13 and requests from state agriculture department, WDMN was planted at various locations including five locations in Himachal Pradesh, working under state agriculture department and sis location (KVKs) in Uttarakhand.

Table 8.20. List of co-operators and locations:

Northern Hills and High Altitude Zone		
Himachal Pradesh	Dhanbir Singh	Dhaulakuan
Himachal Pradesh	S.K. Rana	Malan (Kangra)
Himachal Pradesh		*Sundernagar*
Himachal Pradesh	R. Devlash	Bajaura
Himachal Pradesh	Associate Director	Sangla (Kinnaur)
Himachal Pradesh	Associate Director	Kukumseri
Himachal Pradesh	Head, WSN	Dalang Maidan
Himachal Pradesh	Head, Flowerdale	Shimla
Himachal Pradesh	Officer in-charge Agriculture Department	Bilaspur Mandi Sirmaur Thana, Kangra Una
Jammu & Kashmir	M.K. Pandey M.K. Pandey & A.K. Singh	Udhaywalla (Jammu) Kathua Rajouri
Jammu & Kashmir	G.M.Parray, Assoc. Director	Leh
Jammu & Kashmir	Guljar Singh	Khudwani (Anantnag)
Uttarakhand	J. Kumar, Deep Shikha & Kanak Srivastava	Pantnagar
Uttarakhand	S.K. Jain	Hawalbagh (Almora)
Uttarakhand	Officer in-charge	KVK, Lohaghat KVK, Dhanauri, Haridwar KVK, Kafligar, Bageshwar KVK, Chilyalisaur Uttarkashi KVK, Jyolikot, Nainital KVK, Dhakrani, Dehradun
North Western Plains Zone		
Haryana	S.S. Karwasra & R. Singh	Hisar
Haryana	M.S Saharan and R.S. Taya	Yamunanagar
Punjab	Madhu Meeta Jindal	Abohar Ludhiana Gurdaspur Dera-Baba-Nanak
North Eastern Plains Zone		
Bihar	S. Sarkhel	Sabour
Bihar	I.S. Solanki and Ashish Kumar	Pusa
Jharkhand	H.C. Lal	Ranchi
Uttar Pradesh	S.P.Singh & J.P.Verma	Faizabad
Uttar Pradesh	J.B. Khan & C. Kanchan	Araul (Kanpur)
West Bengal	S.K.Mukhopadhyay & S.Datta	Kalyani
Central Zone		
Gujarat	R.K. Jaiman	Ladol (Vijapur)
Gujarat	K.H. Dabhi	Mangrol (Junagadh)
Chhatisgarh	A.P. Agarwal	Bilaspur
Madhya Pradesh	A.N. Mishra, K. Kaushal, Prakasha, T. L. & V.G. Dubey	Indore
Madhya Pradesh	K. K. Mishra	Khojanpur (Powarkheda)
Madhya Pradesh	In Charge	Sagar
Peninsular and Southern Hills Zone		
Maharashtra	B.K. Honrao, V.M. Khade & S.C. Misra	A.R.S. Baner, (Pune)
Maharashtra	B.C. Game	ARS, Niphad
Maharashtra	N. R. Potdukhe	Akola
Karnataka	I.K. Kalappanavar	Kalloli (Dharwad)
Tamil Nadu	P. Nallathambi	Wellington

Each entry of the WDMN was planted in two consecutive rows of one meter each with two rows of Agra local as spreader entry covering the periphery of WDMN. Observations on diseases were generally recorded five times during the crop season. The co-operators were advised to plant wheat disease monitoring nursery in time, in isolation and away from the artificially inoculated fields. The disease situation was monitored at regular intervals.

Disease incidence on WDMN

Information on wheat disease situation was received from Dhaulakuan, Malan (Kangra), Bajaura, Sundar Nagar, Thana Kangra, Shimla, Udhaywalla (Jammu), Kathua, Rajauri, Pantnagar, Almora, Kafligare, Lohaghat, Dhanauri (Haridwar), Hisar, Yamunanagar, Sabaur, Ranchi, Faizabad, Araul (Kanpur), Bilaspur, Ladal (Vijapur), Mangrol (Junagarh), Indore, Powarkheda, Pune, Pimpalgaon (Niphad), Dharwad and Wellington. Information from the state dept. of agriculture from Jammu & Kashmir, Haryana and Punjab have not been received so far. The data received from above locations suggest that wheat diseases appeared in their usual pattern in all the locations. Yellow rust was mostly confined to NHZ and NWPZ, however it was also observed at Faizabad and Kanpur in NEPZ. Brown rust appeared at all the locations in NEPZ, CZ, PZ, and SHZ. In addition, brown rust was also observed at Shimla, Dhaulakuan, Pantnagar, Almora, Kathua and Udhaywalla in NHZ and Hisar in NWPZ. Black rust was reported from Almora, Indore, Powarkhera, Vizapur, Mangrol (Junaagarh), Wellington. At Almora centre, it was observed only on one entry i.e. Agra Local and that too in traces. All the entries of WDMN at Dharwad were free from black rust. Under NEPZ, leaf blight was observed at all the locations except at Bilaspur. Leaf blight was also recorded at Hisar in NWPZ, Pune and Dharwad in PZ and Wellington in SHZ. Report on powdery mildew was received only from Kathua, Udhaywalla and Shimla locations in NHZ.

APPEARANCE OF WHEAT RUSTS IN WDMN

High Altitude and Northern Hills zone

First report at yellow rust in NHZ/HAZ was from Kinnaur in the month of Sept., 2013. In rabi season, first record of yellow rust was from Udhaywalla (10.1.14) followed by Dhaulakuan (12.1.14), Kathua (2.2.14) and Pantnagar (5.2.14). At Bajaura it appeared on 10th of March. Brown rust was first observed in Shimla (9.1.14) followed by Pantnagar (5.2.14), Udhaywalla (16.2.14), Kathua (18.2.14) Dhaulakuan (19.3.14) and Almora (24.3.14). Black rust was observed only at Almora on (20.4.14).

North western plains zone

Yellow rust was observed at Hisar (14.2.14) and Yamunanagar. Brown rust appeared only at Hisar on (3.3.14). Black rust was absent in this zone.

North eastern plains zone

Yellow rust appeared only at Kanpur (24.2.14) and Faizabad (6.3.14). First report of brown rust was from Kanpur (24.2.14) followed by Bilaspur (26.2.14), Faizabad (28.2.14), Sabaur (1.3.14) and Ranchi. Black rust did not appear at any of the locations of this zone.

Central zone

Yellow rust did not appear in this zone. Brown rust first appeared at Indore (4.2.14) followed by Powarkheda (12.2.14) followed by Ladol and Vijapur (10.03.14) and Mangrol (12.3.14). Black rust was first reported from Powarkheda (21.2.14) followed by Indore (27.2.14), Vijapur (12.3.14) and Mangrol (Junagarh) on 20.3.14.

Peninsular zone
Yellow rust was not observed in this zone. First report of brown rust was from Dharwad (9.1.14) followed by Pune (22.1.14) and Pimpalgaon {(Nasik) (26.2.14)}.

Southern hill zone
Yellow rust was not reported in WDMN at Wellington. Brown and Black rust were first appeared on 17.12.13 and 23.01.14, respectively.

VARIETAL PERFORMANCE AGAINST WHEAT RUSTS

High altitude and Northern Hills zone
All the entries of WDMN were highly susceptible at location viz Bajaura, Malan (Kangra), Thana (Kangra), Dhaulakuan. Kathua and Udhaywalla. Highest yellow rust severity was at Bajaura, where 18 entries showed severity more than 40S. At Sunder Nagar all entries except C306 were showing more than 80S severity of yellow rust. Brown rust was reported from Shimla, Dhaulakuan, Pantnagar, Almora. Kathua and Udhaywalla. Severity of brown rust was maximum at Shimla, where WL711, HD2329 and Lal Bahadur were showing 100S severity. HW2021 was free from brown rust at all locations. At Dhaulakuan only five entries viz. WL711 (40S), WL562 (5S), HD2204 (TR), C306 (60S) and DL 784-3 (20S) were infected with brown rust. Black rust was observed in traces only at Almora on Agra local.

North western plains zone
Yellow rust infection was observed on all the entries of WDMN except *Lr*24 and VL738 at Yamunanagar. Ten entries were showing more than 40S severity of yellow rust. High severity of yellow rust was observed at Hisar too. Brown rust was observed only at Hisar, where 9 entries were showing severity more than 40S. Black rust was absent at both the locations of NWPZ.

North eastern plains zone
Yellow rust was observed at Faizabad and Kanpur location of NEPZ. At Faizabad 4 entries viz. Agra Local (20S), Lal Bahadfur (5S), Kharchia Mutant (20S) and *Lr*24 (20S) were showing yellow rust infection. At Kanpur, Lala Bahadur (10S), Kharchia Mutant (40S), DL784-3 (20S) and *Lr*24 (20S) were infected with yellow rust. Brown rust was reported from all the locations of NEPZ. Maximum severity of brown rust was reported from Kanpur, where sixteen entries were showing brown rust infection. Severity of brown rust on Agra Local, Lal Bahadur and Kharchia Mutant was 100S at Kanpur. HW2021 was free of brown rust at all the locations of NEPZ. All the entries of WDMN at all the locations of NEPZ were free of black rust.

Central Zone
All the locations in Central zone were yellow rust free. Black rust was observed only at Indore location, where up to 80M severity (Kharchia Mutant) was recorded. Brown rust was reported from all the locations of Central zone. Severity of brown rust at Junagarh was very poor. At Vijapur only two entries viz. Lal Bahadur (10S) and Lok-1 (10S) were infected with brown rust.

Peninsular zone and Southern hill zone
All the locations in PZ and SHZ were free from yellow rust infection. Black rust was observed only at Wellington. Brown rust was observed at all the locations of both the zones. All the entries of WDMN were infected with brown rust at Wellington except C306 and WH1147. Maximum severity of brown rust was at Dharwad, where WL711, HD2329 and Lal Bahadur were showing 100S severity.

OTHER DISEASES

Blights

Information on foliar blights was received from 8 locations. Incidence of blight was low in comparison to the previous years. Earliest record of blight was from Ranchi (8.1.14) followed by Dharwad (9.1.2014), Pune (10.01.14), Faizabad (01.02.14), Sabaur (12.02.14), Rajauri (13.02.14) and Kanpur (18.2.12). It was evident from the data that blight was distributed in all the wheat growing zones except central zone, however, severity was high in NEPZ. At Kanpur only 12 entries were showing the symptoms of leaf blight. All the entries of WDMN at Shimla, Kafligare, Almora, Udhaywalla, Faizabad, Ranchi, Sabaur, Dharwad and Wellington were showing susceptibility to leaf blight disease.

Powdery mildew

Powdery mildew was reported only from 3 locations viz Udhaywalla and Kathua in Jammu and Kashmir and Almora in Uttarakhand. The order of appearance of Powdery mildew in these locations was as Udhaywalla (16.2.14), Kathua (18.2.14) and Almora (22.2.14). All the entries of WDMN were susceptible to powdery mildew at all these locations. Maximum severity of Powdery mildew was observed at Kathua with five entries showing Powdery mildew severity of 8.

Loose smut

There is no report of Loose smut from any of the locations.

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8.6 SAARC WHEAT DISEASE MONITORING NURSERY (2013-14)

Under the umbrella of Regional Station, DWR, Shimla and CIMMYT, Nepal SAARC wheat disease monitoring nursery is being conducted to study the occurrence of wheat diseases especially rusts in wheat growing SAARC nations. The nursery also helps in recording the severity of wheat diseases across the locations and understanding the performance of different area specific disease resistance genes. During 2013-14, SAARC wheat disease monitoring nursery was planted at 27 locations across the six SAARC countries (Table 8.21).

Table 8.21. Details of locations and contact persons are as given below: -

S. No.	Country/ Locations	Contact person
1.	Nepal (3 sets)	CIMMYT, Nepal*
2.	Bangladesh (5 sets)	-do-*
3.	Pakistan (2 sets)	-do-*
4.	**Bhutan (1 set)**	-do-*
5.	**Afghanistan (1set)**	-do-*
6.	India (15 sets)	Head, Flowerdale
Total	27 location	

*Coordinator: Dr. A.K. Joshi, CIMMYT, Nepal.

Information on wheat diseases in SAARC Wheat Disease Monitoring Nursery has been received from all the locations in India; Dinajpur, Joydebpur, Jamalpur, Jessore and Rajshahi in Bangladesh and Khumaltar and Bhirahawa in Nepal. Data from Afghanistan, Bhutan and Pakistan is awaited. In India SAARC wheat disease nursery was planted at 15 locations as detailed below (Table 8.22).

Table 8.22. Locations of SAARC wheat Disease Trap Nursery in India

State	Co-operator	Locations
Delhi	V.K.Singh	New Delhi
Himachal Pradesh	Dhanbir Singh	Dhaulakuan
Jammu & Kashmir	M.K. Pandey, A.K. Singh	Jammu (Chatha) Kathua Rajauri
Punjab	Madhu Meeta Jindal	Dera-Baba-Nanak Abohar Ludhiana Gurdaspur
Bihar	I.S. Solanki and Ashish Kumar	Pusa, Bihar
Rajasthan	R.K. Bansal & P.S. Shekhawat	Durgapura (Jaipur)
Tamil Nadu	P. Nallathambi	Wellington
Uttar Pradesh	S.P. Singh	Faizabad
Uttarakhand	J. Kumar S.K. Jain	Pantnagar Almora

The SAARC wheat disease monitoring nursery comprised 20 lines contributed by four SAARC countries (Table 8.23).

Table 8.23. Composition of SAARC wheat disease monitoring nursery.

S. No.	Variety	S. No.	Variety
1.	Annapurna-1	11.	Punjab 85
2.	WL 1562	12.	Chakwal 86
3.	HD 2204	13.	Faisalabad 85
4.	PBW 343	14.	Inquilab 91
5.	HD 2687	15.	Faisalabad 83
6.	HD 2189	16.	Rawal 87
7.	HP 1633	17.	Kohsar
8.	RAJ 3765	18.	Bakhtawar 94
9.	PBW 373	19.	Gourab
10.	Pak 81	20.	Susceptible Check

Wheat Disease Situation in SAARC countries
Disease situation in India

Powdery mildew

Among the five locations i.e. Pusa, Kathua, Almora, Udhaywalla and Wellington, the earliest report of powdery mildew was from Almora (11.02.14), followed by Udhaywalla (16.02.14), Kathua (18.02.14), Wellington (05.03.14) and Pusa (07.03.14). All the entries were infected with powdery mildew at all the locations except Pusa and Wellington. At Pusa, PBW343 and PBW373 with PM severity of 2 were the only entries showing powdery mildew infection. Maximum severity of powdery mildew was observed at Kathua with severity ranging between 4 and 9 (Table 8.24).

Table 8.24. Incidence of Powdery Mildew in SAARC Wheat Disease Monitoring Nursery during 2013-14 in India

S.No.	Varieties	Powdery Mildew				
		Almora	Kathua	Pusa	Udhaywalla	Wellington
1	Annapurna-1	5	6	-	6	3
2	WL1562	5	6	-	6	4
3	HD 2204	3	8	-	7	8
4	PBW 343	5	8	2	6	9
5	HD 2687	3	4	-	6	4
6	HD 2189	3	5	-	4	2
7	HP 1633	5	8	-	7	0
8	Raj 3765	5	5	-	8	8
9	PBW 373	7	9	2	4	9
10	Pak 81	5	7	-	7	4
11	Punjab 85	3	8	-	6	3
12	Chakwal 86	7	7	-	7	0
13	Faisalabad 85	5	6	-	5	4
14	Inquilab 91	7	7	-	7	5
15	Faisalabad 83	3	8	-	6	5
16	Rawal 87	3	5	-	6	-
17	Kohsar	7	8	-	7	-
18	Bakhtawar 94	5	8	-	4	-
19	Gourab	3	5	-	5	1
20	Susceptible check	7	9	-	7	7
Date of first appearance		**11.02.14**	**18.02.14**	**07.03.14**	**16.02.14**	**05.03.14**

Blight

Leaf Blight of wheat was observed only at seven locations of SAARC nursery. Like previous year, first report of blight was from Faizabad (01.02.14) followed by Pusa (06.02.14), Rajauri (13.02.14), Kathua (01.03.14), Wellington (05.03.14), Almora (15.03.14), and Udhaywalla (30.03.14). All the entries were showing blight infection at Udhaywalla (Jammu), Kathua, Almora, Pusa and Faizabad. Severity of leaf blight was maximum at Pusa, where 19 entries were showing severity of more than 45. At wellington WL1562, PBW 343 and Gaurab were free from blight infection (Table 8.25)

Table 8.25. Incidence of leaf blight in SAARC Wheat Disease Monitoring Nursery during 2013-14 in India

S. No.	Varieties	Leaf blight						
		Almora	Faizabad	Kathua	Pusa	Rajouri	Udhaywa lla	Wellingt on
1	Annapurna-1	23	67	16	46	15	23	02
2	WL1562	13	68	36	67	12	24	-
3	HD 2204	23	78	274	67	10	23	03
4	PBW 343	23	36	16	68	16	13	45
5	HD 2687	13	35	16	78	-	12	12
6	HD 2189	13	46	13	68	-	12	02
7	HP 1633	23	57	27	78	-	23	-
8	Raj 3765	13	36	36	78	24	24	34
9	PBW 373	24	24	16	46	00	12	34
10	Pak 81	23	46	16	78	05	12	54
11	Punjab 85	01	57	26	78	30	05	45
12	Chakwal 86	01	24	12	68	00	11	02
13	Faisalabad 85	11	25	27	78	06	12	34
14	Inquilab 91	02	67	16	78	21	12	56
15	Faisalabad 83	12	68	26	45	-	12	01
16	Rawal 87	01	46	16	36	-	11	23
17	Kohsar	12	57	13	67	20	16	45
18	Bakhtawar 94	12	36	13	67	24	09	23
19	Gourab	13	77	24	68	-	12	00
20	Susceptible check	23	78	12	78	40	12	02
Date of first appearance		**15.03.14**	**01.02.14**	**01.03.14**	**06.02.14**	**13.02.14**	**30.03.14**	**05.03.14**

Loose Smut

There was no report of loose smut from any of the locations of SAARC nursery.

RUSTS

SAARC nursery was planted at 6 locations of NHZ, 5 locations of NWPZ, Faizabad, Pusa, Durgapura and Wellington (Table 8.26). Yellow rust was observed at all the SAARC nursery locations in India except at Wellington and Jaipur. Yellow rust was observed at Udhaywalla {(Jammu) (10.01.14)} followed by Dhaulakuan (12.01.14), Kathua (02.02.14), Pantnagar (05.02.14) and Ludhiana (07.02.14). All the entries of SAARC nursery were infected at 4 locations viz. Gurdaspur, Kathua, Ludhiana and Udhaywalla. At Faizabad only 5 entries viz. Raj3765, PBW373, Faisalabad 85, Gourab and Susceptible check were showing yellow rust infection with 5S severity of the rust in each entry. Entries PBW343 and HD2687 were showing yellow rust infection at all the locations except Faizabad where yellow rust was observed. Similarly, Raj3765 and PBW373 were infected at all the SAARC nursery locations except Delhi. Maximum severity of yellow rust was observed at Dhaulakuan, where 18 of the SAARC entries showed more than 40S severity. Annapurna-1, Raj3765 and Susceptible check were showing 100S severity at Dhaulakuan.

Brown rust was observed at all the locations except at Firozepur, Dera Baba Nanak, Ludhiana, Rajauri and Jaipur. First report of brown rust was from Wellington (17.12.13) followed by Pantnagar (05.02.14), Udhaywalla (16.0.14), Kathua (18.02.14) Faizabad (28.02.14) and Gurdaspur (10.03.14). At Gurdaspur susceptible check with brown rust severity of 60S was the only entry showing brown rust infection. Wellington was the only location where all the SAARC nursery entries were infected with brown rust. The brown rust severity at Pusa ranged between traces to 10S only. Gourab with 20S and HP1633 with 40S severity of brown rust at Wellington were free from brown rust in est of the SAARC nursery locations in India.

Among the 15 SAARC nursery locations in India, black rust was observed at Wellington and Almora only. Black rust was first observed at Wellington on 23.01.14 and on 20.0414 at Almora. It was observed on HD2204 (Traces) only at Almora. All the entries except WL1562 were black rust infected at Wellington. However, score of black rust on some of the entries doesn't appear to be realistic.

Disease situation in Bangladesh

SAARC wheat disease monitoring nursery was planted at five locations i.e. Dinajpur, Joydebpur, Jamalpur, Jessore and Ishurdi by P.K. Malaker and group. Both brown rust and leaf blight diseases of wheat were observed at all six locations (Table 8.27). Earliest report of brown rust was from Dinajpur (23.02.14) followed by Rajshahi (28.02.14). At Dinajpur, all entries except Gourab were infected with brown rust. All other entries were showing brown rust infection at one or more locations. Except at Dinajpur, Raj 3765 was free from brown rust at all other locations. Leaf blight was very severe at all six locations and appeared when plants were at seedling stage.

Incidence of wheat rusts in Nepal

SAARC nursery was planted at three locations in Nepal but the data on the same have been received from two locations (Khumaltar and Bhirahawa) only, while the data from other location is awaited. At Khumaltar only yellow rust was observed on all the SAARC nursery entries. Yellow rust severity of 60S was reported on WL1563, HP1633, Faisalabad 85 and susceptible check (Morocco). Brown rust was observed at Bhirahawa on all the entries except WL1563, Punjab 81 and Gourab (Table 8.28).

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Table 8.26. Incidence of rusts in SAARC Wheat Disease Monitoring Nursery in India during 2013-14.

S. No.	VARIETIES	BROWN										YELLOW												BLACK	
		ALM*	NDL	DKN	FAZ	GUR	KAT	PAN	PUS	UDH	WEL	ALM	NDL	DKN	FAZ	FIR	GUR	DBN	KAT	LUD	PAN	RAJ	UDH	ALM	WEL
1	Annapurana-1	-	TS	-	-	-	40S	-	T	20S	40S	60S	5S	100S	-	5S	40S	5S	40S	60S	80S	40S	60S	-	10S
2	WL1562	-	10S	5S	-	-	-	TR	-	-	60S	5MR	-	60S	-	-	20S	-	10S	10S	80S	20S	20S	-	-
3	HD2204	TR	TS	-	-	-	-	TR	-	-	40S	-	-	40S	-	5S	10S	5S	10MS	10S	5S	-	10MS	TS	10S
4	PBW343	10S	10S	-	-	-	10S	TR	T	10S	20S	30s	20S	80S	-	80S	60S	20S	60S	60S	5S	60S	60S	-	10S
5	HD2687	-	-	-	-	-	10S	-	-	-	20S	80S	10S	80S	-	5S	40S	5S	40S	60S	50S	40S	60S	-	10S
6	HD2189	10MS	-	-	-	-	5S	-	-	5S	20S	5MS	-	60S	-	-S	10S	-	5MS	10S	70S	20S	20MS	-	20S
7	HP1633	-	-	-	-	-	-	-	-	-	40S	20S	TR	20S	-	20S	40S	-	20S	5S	60S	5S	60MS	-	20S
8	RAJ3765	-	-	-	-	-	-	TR	-	-	40S	40MS	-	100S	5S	80S	60S	5S	10S	60S	TR	20S	20S	-	20S
9	PBW373	-TR	-	-	-	-	10S	TR	10S	TS	20S	40S	-	80S	5S	80S	60S	5S	60S	60S	TR	40S	80S	-	10S
10	PAK81	-	-	-	5S	-	30S	-	-	5S	60S	80S	-	80S	-	5S	40S	5S	40S	60S	80S	40S	80S	-	10S
11	Punjab-85	-	-	60S	-	-	20S	10S	-	-	20S	TS	-	40S	-	-	5S	-	TR	40MS	5S	10S	10MR	-	10S
12	Chakwal-86	-	-	-	-	-	5S	TR	-	-	20S	TR	-	10S	-	-	5S	-	10MR	20MS	TR	10S	10MR	-	5S
13	Faisalabad-85	-	30S	60S	5S	-	40S	TR	T	20S	20S	80S	-	60S	5S	10S	60S	-	20S	60S	90S	20S	40S	-	10S
14	Inquilab-91	-	5S	-	-	-	10S	-	-	TR	40S	40S	-	60S	-	-	40S	-	40S	60S	TR	40S	40S	-	5S
15	Faisalbad-83	-	-	-	-	-	-	-	-	-	40S	10S	-	40S	-	10S	10S	-	5MR	40S	-	20MS	10MR	-	5S
16	Rawal87	-	-	40S	5S	-	20S	5S	10S	TS	40S	-	-	40S	-	40S	5S	-	5MS	40S	-	40S	20MS	-	10S

S. No.	VARIETIES	BROWN										YELLOW												BLACK	
		ALM*	NDL	DKN	FAZ	GUR	KAT	PAN	PUS	UDH	WEL	ALM	NDL	DKN	FAZ	FIR	GUR	DBN	KAT	LUD	PAN	RAJ	UDH	ALM	WEL
17	Kohsar	-	-	40S	-	-	10S	TR	-	TS	20S	20S	30S	60S	-	10S	10S	-	40S	40S	TR	5S	40S	-	20S
18	Bakhtawar 94	-	-	40S	-	-	20S	20S	-	20S	20S	5MS	5S	80S	-	-	10S	-	5MS	60S	TR	60S	10MS	-	10S
19	Gourab	-	-	-	-	-	-	-	-	-	20S	40S	-	80S	5MS	20S	40S	-	5MS	40S	90S	-	20MS	-	20S
20	Susceptible Check	10S	40S	-	50S	60S	40S	20S	10S	20S	60S	80S	60S	100S	5S	40S	60S	-	60S	60S	100S	60S	60S	-	60S
Date of first Appearance		07.04.14	28.03.14	19.03.14	28.02.14	10.03.14	18.02.14	05.02.14	20.02.14	16.02.14	17.12.13	3WK Feb 14	16.03.14	12.01.14	06.03.14	15.03.14	10.02.14	18.03.14	02.02.14	07.02.14	05.02.14	02.03.14	10.01.14	20.04.14	23.01.14

*ALM= Almora, NDL=New Delhi, DBN=Dera-Baba-Nanak, DKN=Dhaulakuan, FAZ= Faizabad, FIR=Firozpur, GUR=Gurdaspur, KAT=Kathua, LUD=Ludhiana, PAN=Pantnagar, PUS=Pusa, RAJ=Rajauri, UDH= Udhaywalla, WEL=Wellington

Table 8.27. SAARC wheat disease monitoring nursery 2013-14, Bangladesh

S.No.	Variety	Brown rust						Leaf Blight					
		Dinajpur	Joydebpur	Jamalpur	Jessore	Ishurdi	Rajshahi	Dinajpur	Joydebpur	Jamalpur	Jessore	Ishurdi	Rajshahi
1	Annapurna-1	20MSS	40S	40S	MS	30MSS	50S	75	54	52	42	75	65
2	WL 1567	TMSS	20R	0	MS	0	0	75	77	42	52	77	64
3	HD 2204	5MSS	20MSS	TMR	M	20MS	40MSS	85	77	52	52	75	65
4	PBW 343	TMSS	0	5MS	0	TMR	10MS	74	55	53	32	74	53
5	HD 2687	5MSS	10R	TMR	0	TMR	5R	74	75	53	32	75	53
6	HD 2189	TMSS	TR	0	0	0	0	73	76	53	32	76	55
7	HP1633	TMSS	20MR	TMR	0	TMR	0	85	78	52	53	78	66
8	Raj 3765	TMR	0	0	0	0	0	73	74	42	42	75	44
9	PBW 373	TMS	10R	TMR	0	TMR	0	73	76	42	32	75	53
10	Pak 81	20MSS	20MR	5MS	0	5MSS	10MR	75	75	52	42	76	66
11	Punjab 85	TMSS	0	0	0	0	0	75	74	42	32	74	44
12	Chakwal 86	TMR	TR	0	0	0	10MS	63	54	43	32	64	45
13	Faisalabad 85	40S	20MR	10MS	MS	10MS	40S	74	54	42	32	65	63
14	Inquilab 91	TMR	0	0	0	0	10MR	73	55	42	32	75	64
15	Faisalabad 83	TMSS	0	0	M	0	0	75	76	42	43	77	65
16	Rawal 87	TMSS	20R	0	M	0	20MS	74	75	43	32	76	44
17	Koshar	TMSS	20MR	TMS	M	TMS	5MR	73	76	52	32	75	44
18	Bakhtwar 94	TMSS	0	0	M	0	5MR	73	75	52	32	74	64
19	Gourab	0	0	0	M	0	TR	74	77	42	32	74	55
20	Susceptible check	20MSS	40S	20MSS	MS	40MSS	20MS	75	54	42	43	77	55
Date of first appearance		23/02/2014	09/03/2014	02/03/2014	02/03/2014	10/03/2014	28/02/2014	At seedling stage	At seedling stage	At seedling stage	At seedling stage	At seedling stage	At seedling stage

Table 8.28. SAARC wheat disease monitoring nursery 2013-14, Nepal

S. No.	Genotypes	Yellow Rust (Khumaltar)	Leaf Rust (Bhirahawa)
1	Annapurna-1	TR	20MS
2	WL 1563	60S	0
3	HD 2204	40MR	10MR
4	PBW 343	TR	20MS
5	HD 2687	TR	20MS
6	HD 2189	20MS	5MR
7	HP 163	60MS	TR
8	Raj 3765	20MS	20MS
9	PBW 373	40s	20S
10	Pak 81	TR	10MS
11	Punjab 85	TR	0
12	Chakwal 86	TR	5MR
13	Faisalabad 85	TR	20S
14	Inquilab 85	20MR	TR
15	Faislabad 83	60S	TR
16	Rawal 87	TR	5MR
17	Kohsar	TR	10MS
18	Bakhtwar	TR	5MR
19	Gaurab	TR	0
20	Morocco	60S	80S

PROGRAMME 9. INTEGRATED PEST MANGEMENT IN WHEAT

9.1 HOST RESISTANCE AGAINST DISEASES AND INSECT PESTS

I. Elite Plant Pathological Screening Nursery (EPPSN), 2013-14

Breeding for disease and insect pests resistance in wheat is an important component of crop improvement. The use of resistant cultivars has been the most effective and easy way to minimize losses due to biotic stresses in wheat in India. The breeders are, however, in need of new sources of resistance to incorporate these in the future cultivars to tackle the threat of evolving new virulences of pathogens as well as new biotypes in insects. The present chapter deals with identification and utilization of multiple disease and insect pests resistant genotypes.

Size: Total 66 entries.

Diseases: Stripe, Leaf and Stem rusts

Centres: North: Karnal, Ludhiana, New Delhi, Ranichauri, Pantnagar, Hisar, Durgapura, Almora (8)

South: Wellington, Mahabaleshwar, Dharwad, Indore (4)

The nursery was inoculated with most virulent and prevalent pathotypes of stripe, leaf and stem rusts as in case of PPSN (given earlier under Chapter 1). The record on rusts was taken at dough stage. The stripe or yellow rust records was taken from five centres situated in the north. These were Durgapura, Karnal, Ludhiana, Almora and Pantnagar. The stem rust and leaf rust records of Indore, Mahabaleshwar, Wellington and Dharwad were taken for calculating ACI in South. In north, the leaf rust was recorded New Delhi, Pantnagar, Hisar, Ludhiana, Durgapura and Karnal centres. The highest score and ACI were calculated. Entries with ACI up to 10.0, were categorized as resistant (Table 9.1).

COOPERATORS:

NAME	CENTRE	RUSTS
MADHU MEETA JINDAL	LUDHIANA	STRIPE
S. S. KARWASRA, R.S. BENIWAL	HISAR	LEAF
J. KUMAR, DEEPSHIKHA, K.SRIVASTAVA	PANTNAGAR	STRIPE AND LEAF
R.K. BANSAL	DURGAPURA	STRIPE AND LEAF
I. K. KALAPPANAVAR	DHARWAD	STEM AND LEAF
T.L. PRAKASHA, A. N. MISHRA AND K. KAUSHAL	INDORE	STEM AND LEAF
S.G. SAWASHE	MAHABALESHWAR	STEM AND LEAF
U.D. SINGH AND V.K. SINGH	NEW DELHI	LEAF
S.K.JAIN	ALMORA	STRIPE
P. NALLATHAMBI, C. UMA MAHESHWARI	WELLINGTON	LEAF, STRIPE STEM,
M.S. SAHARAN, R. SELVAKUMAR	KARNAL (CO-ORDINATING UNIT)	STRIPE AND LEAF

Table 9.1. Entries tested in Elite Plant Pathological Screening Nursery, 2013-14

S.No.	Entry	SR South		LR South		LR North		YR North	
		H.S.	ACI	H.S.	ACI	HS	ACI	HS	ACI
A. Resistant to all three rusts									
Source: AVT IInd Year 2012-13									
1	HI 8724 (d)	20S	11.0	10MS	3.0	TR	0.0	10S	3.0
2	HI 8728 (d)	20S	8.0	20MS	8.0	TR	0.0	20S	7.0
3	HI 8731 (d)	20S	6.5	5S	3.2	5MR	0.4	20S	12.4
4	PBW 660	10S	3.5	10S	2.5	20MS	2.8	20S	5.0
Source: AVT Ist Year 2012-13									
5	DDW 23	20MS	7.7	20S	9.5	5MR	0.4	0	0.0
6	HI 8739 (d)	10MS	2.0	20MR	4.2	0	0.0	20S	4.0
7	HI 8742 (d)	10S	4.0	20MS	7.8	0	0.0	20S	5.0
8	HPW 388	40S	13.5	5S	2.3	TS	0.2	80S	33.6
9	UAS 447 (d)	40S	20.0	10S	4.4	TS	0.2	60S	16.0
10	UPD 94 (d)	30S	12.5	10MS	2.1	TS	0.2	20S	7.0
11	VL 1002	20S	10.0	40S	10.1	5S	1.0	80S	19.4
12	VL 3001	5S	3.5	TS	0.3	5MR	0.4	5S	1.8
B. Resistant to Stem & Leaf rusts									
Source: AVT IInd Year 2012-13									
13	GW 432	10S	3.0	5S	1.6	TR	0.0	100S	61.6
14	HD 3095	30S	10.0	5S	1.4	0	0.0	100S	36.8
15	MPO 1255 (d)	60S	12.6	10MS	2.1	10S	2.0	70S	20.4
16	RAJ 4250	20S	5.5	10S	2.6	5MR	0.6	100S	32.0
Source: AVT Ist Year 2012-13									
17	DDK 1044	20S	5.0	5S	1.3	TR	0.0	90S	30.0
18	DDK 1045	20S	5.5	5S	1.2	5MR	0.4	40S	15.4
19	HD 3116	40S	21.0	40S	10.1	TR	0.0	100S	26.6
20	HI 1588 Q	20S	6.3	5S	1.2	10MR	0.8	100S	41.2
20A	INFECTOR	100S	57.5	100S	70.0	80S	44.0	100S	78.0
21	HI 8735	20S	6.0	5MS	1.5	TR	0.0	15S	3.8
22	HPW 381	20S	5.1	TMR	0.1	0	0.0	10S	5.2
23	HS 574	20S	11.5	20S	5.4	80S	18.0	100S	30.6
24	HS 578	20S	7.5	10S	3.5	20S	9.0	5S	2.0
25	HUW 662	40S	13.2	40S	12.5	TS	0.2	100S	30.0
26	HUW 668	20S	5.5	10S	2.5	5MR	0.4	100S	34.0
27	HW 1099	20S	5.0	0	0.0	5MR	0.6	40MS	17.2
28	HW 1900	20S	7.7	TR	0.0	0	0.0	80S	35.0
29	HW 4013	20S	5.0	TMR	0.1	0	0.0	100S	24.8
30	HW 4042	20S	7.5	TMR	0.1	TR	0.0	100S	37.8
31	HW 5235	10S	2.5	0	0.0	0	0.0	80S	33.0
32	HW 5237	5S	1.3	0	0.0	0	0.0	80S	32.8
33	JAUW 598	5S	1.8	TS	0.2	10MS	1.4	100S	27.4
34	KRL 330	20S	10.1	60S	21.0	5MS	1.6	100S	33.0
35	KRL 348	20S	8.5	20S	5.0	TR	0.0	40S	9.6
36	MACS 3929	50MS	15.1	20S	10.2	5S	1.0	30S	13.2
37	MACS 5031	20S	5.5	5MS	1.0	0	0.0	60S	30.4
38	MACS 6583	20S	11.0	5R	0.6	0	0.0	80S	25.4
39	MP 3379	20S	10.5	TMR	0.1	TS	0.2	60S	32.4
40	NIAW 1951	40S	21.0	20S	7.2	30S	7.0	100S	31.4
40A	INFECTOR	100S	60.0	100S	65.0	80S	52.0	100S	78.0

S.No.	Entry	SR South		LR South		LR North		YR North	
		H.S.	ACI	H.S.	ACI	HS	ACI	HS	ACI
41	NIDW 699 (d)	40S	21.2	10MS	2.0	5MR	0.4	10MS	9.8
42	PBW 683	40S	14.2	20MS	4.0	10MS	1.6	80S	18.8
43	RAJ 4324	20S	7.0	5S	2.2	0	0.0	80S	24.2
44	UP 2843	20S	5.2	5S	1.3	0	0.0	100S	22.6
45	UP 2847	10S	4.0	5S	2.8	40S	8.0	80S	26.0
46	UP 2848	20S	10.2	20S	6.1	80S	16.0	100S	27.6
47	UP 2871	20S	7.5	20S	5.0	0	0.0	60S	14.0
48	UP 2872	TR	0.0	TR	0.0	5MR	0.4	80S	19.8
C. Resistant to Leaf & Stripe rusts									
Source: AVT IInd Year 2012-13									
49	HI 8725 (d)	20S	6.0	20MR	4.0	20S	4.2	20S	5.4
50	HW 5224	60MS	26.5	10S	2.6	30S	6.0	20S	8.0
51	WH 1098	40S	21.5	10S	2.3	0	0.0	10S	2.0
Source: AVT Ist Year 2012-13									
52	HD 3111	40S	17.7	5S	1.4	0	0.0	40S	12.6
53	HD 3119	60S	32.5	10S	2.5	0	0.0	40S	14.0
54	HD 3121	20S	12.5	40S	10.0	0	0.0	20S	7.0
55	HI 8738	40S	16.4	20MS	4.1	TR	0.0	5MS	1.0
56	HPW 398	20S	15.0	60S	15.0	50S	10.0	20S	5.0
57	HPW 399	40S	19.0	5S	2.5	70S	14.0	10MS	1.6
58	NIDW 706 (d)	70MS	21.5	5S	2.3	0	0.0	5MS	0.8
59	VL 1001	40S	11.5	20S	4.0	5S	1.4	80S	19.2
60	WH 1129	40S	12.7	TR	0.0	TR	0.0	10S	2.0
60 A	INFECTOR	100S	52.5	100S	60.0	80S	40.0	100S	74.0
61	WH 1137	40S	14.5	5R	0.3	0	0.0	0.0	0.0
62	WH 1138	60S	29.0	20S	5.1	5S	1.0	60MS	14.4
B. Resistant to Stem & Stripe rusts									
Source: AVT Ist Year 2012-13									
63	HD 3123	20S	11.2	40S	10.1	0	0.0	10S	3.6
64	HS 576	40S	16.4	TMS	0.2	TR	0.0	60S	12.0
65	HS 577	40S	16.5	10S	2.5	5MR	0.4	80S	20.2
66	VL 3002	30S	12.6	40S	10.5	TR	0.0	40S	8.0

d=durum, T=Triticale

II. Multiple Disease Screening Nursery, 2013-14

It includes, 47 numbers of resistant sources identified in EPPSN against rusts and aimed to be cross checked for resistance to other diseases at hot spot multi locations under artificially created conditions to reconfirm their resistance. These were tested at Karnal, Ludhiana, Dhaulakuan, Pantnagar, New Delhi, Almora, Kaul, Jammu, Faizabad, Coochbehar, Varanasi, Hisar, Durgapura and Sabour centres in north and Wellington, Mahabaleshwar, Indore, Dharwad centres in south. Each centre screened the entries for particular diseases and planted one susceptible check entry for each disease after every 20 test entries for specific disease. The records were taken at dough stage for rust incidence, leaf blight as well as powdery mildew as per standard raring scales, whereas Karnal bunt and flag smut were counted as per cent infected grains and tillers, respectively. Based on the ACI up to 10.0, Karnal bunt up to 5.0%, Flag smut up to 5% and powdery mildew up to 3 and leaf blight up to 35 (R) and 36-57 (MR) entries were categorized resistant (Table 9.2). Following entries were found to possess multiple disease resistance:

Resistant to all three rusts + KB+ FS
PDW 329 (d)

Resistant to all three rusts + LB+ FS +PM
TL 2978 (T)

Resistant to all three rusts
GW 1276 (d),HD 3098, PBW 670, Raj 4270, and VL 971

Resistant to Stem and Leaf rusts
GW 433, GW 1280 (d), HD 3076, HI 1584, HW 5216, KLP 402, KRL 327, MP1259, MP 3353, Raj 4238, Raj 4240, Raj 4245, UAS 336, UP 2824, UP 2825, UP 2828, UP 2852 and VL 971.

Resistant to Leaf and Stripe rusts
AKDW 4749, HD 3065, HD 3075, HD 3077, HD 3081Q, HD 4725, HI 1579, HI 8626(d), HPW 368, HS 557, MACS 3828, PBW 658, RW 3705, VL 972 and WH 1105

Resistant to Stem and Leaf rusts + R to LB + KB +FS+PM
HW 1098

Resistant to Leaf and Stripe rusts + R to LB
HS 526, NIAW 1846

COOPERATORS

CENTRES	DISEASES	COOPERATORS
LUDHIANA	STRIPE AND LEAF RUSTS, FS	MADHU MEETA JINDAL
ALMORA	POWDERY MILDEW(PM)	S. K. JAIN
HISAR	FLAG SMUT (FS), LS	S. S. KARWASRA, R.S. BENIWAL
DHAULAKUAN	STRIPE RUST, PM, KB	DHANBIR SINGH
PANTNAGAR	STRIPE RUST, PM	J. KUMAR, DEEPSHIKHA, K. SRIVASTAVA
SABOUR	LEAF BLIGHT (LB), LEAF RUST	C.S. AZAD
INDORE	LEAF AND STEM RUSTS	PRAKASHA, A.N. MISHRA, K. KAUSHAL
MAHABALESHWAR	LEAF AND STEM RUSTS	S.G. SAWASHE
COOCHBEHAR	LB	A.K. CHOWDHURY, S. MAHAPATRA
WELLINGTON	STEM AND LEAF RUSTS, LB	P. NALLATHAMBI, C. UMA MAHESHWARI
KAUL	LB	D. S. DODAN
FAIZABAD	LB	S.P. SINGH
DURGAPURA	FS	R,K. BANSAL
JAMMU	PM	M. K. PANDEY
DHARWAD	STEM AND LEAF RUSTS, LB	I.K.KALAPPANAVAR
NEW DELHI	LEAF RUST	U.D. SINGH, V.K. SINGH
VARANASI	LB	S.S. VAISH
KARNAL	HEAD SCAB	M.S. SAHARAN
DURGAPURA	CCN	INDIRA RAJAVANSHI
HISAR	CCN	R.S.KANWAR
KARNAL	LEAF & STRIPE RUSTS	M.S.SAHARAN AND R. SELVAKUMAR (COORDINATING UNIT)

Table 9.2 Reactions of different entries of Multiple Disease Screening Nursery, 2013-14 against diseases and CCN

S.No.	Entry	SR		LR		LR	YR		LB		KB		PM		FS	HS	CCN
		South		South		North	North		dd 0-9		%		(0-9		%	0-5	
		HS	ACI	HS	ACI	HS	HS	AV.	HS	AV.	HS	AV.	HS	AV.	HS	HS	HS
A. Resistant to all three rusts																	
Source: AVT IInd Year 2011-12																	
1	HW 1098	TMR	0.2	TR	0.0	0	60MS	40.0	46	35	0	0	5	2	0.0	3	HS
2	HW 5216	5S	2.3	TR	0.0	0	80S	35.0	67	57	46.4	26.6	5	2	66.7	3	HS
Source: AVT Ist Year 2011-12																	
3	GW 433	5S	2.0	20S	9.5	TR	100S	38.7	68	57	37.9	15.8	6	3	50.0	4	HS
4	GW 1276 (d)	5MS	1.4	20S	8.0	TMR	20S	10.0	69	68	52.9	33.1	9	5	0.0	5	HS
5	HD 3076	10S	7.6	20S	9.4	0	100S	36.2	68	57	44.8	20.4	6	3	28.6	5	HS
6	HD 3098	TR	0.1	5S	1.8	0	10S	4.5	78	57	31.9	12.6	7	3	58.3	4	HS
7	HPW 385	40S	21.3	20S	8.3	0	20MS	7.2	79	46	47.6	22.2	6	3	0.0	4	HS
8	KRL 327	10S	3.6	20S	10.0	5MR	100S	33.7	79	57	13	9.93	7	4	0.0	4	HS
9	PBW 670	10S	5.0	10S	3.4	0	40MS	9.0	68	36	31.7	11.8	7	3	35.7	4	HS
10	PDW 329 (d)	15MS	7.3	20MR	4.0	5MR	TR	0.0	69	57	5.6	2.97	6	3	0.0	4	HS
11	TL 2978 (T)	TR	0.1	TR	0.0	0	TMS	0.2	47	35	9.3	3.1	1	0	0.0	4	HS
12	VL 971	TR	0.1	TR	0.0	0	80S	23.7	57	25	21.8	9.5	7	2	0.0	5	HS
13	MP1259	TS	0.3	5S	1.7	TR	60S	16.2	69	35	47.2	20.9	9	5	20.0	3	HS
14	Raj 4240	TR	0.0	5S	1.7	0	100S	41.2	67	46	12.2	4.58	9	5	22.2	4	HS
15	Raj 4270	20S	6.7	20S	6.7	10MR	10S	4.0	69	57	22.7	10.6	7	2	50.0	5	HS
16	UP 2825	20S	7.6	10MS	2.7	0	100S	38.7	79	57	46.8	19.6	9	5	83.3	4	HS
17	UP 2852	10S	4.0	20S	13.3	10MR	100S	41.2	68	46	34.8	22	9	5	10.0	4	HS
B. Resistant to Stem & Leaf rusts																	
Source: AVT II Year 2011-12																	
18	Raj 4238	5S	2.6	5MR	0.7	TR	100S	57.5	79	68	26.3	11	9	4	0.0	4	HS
Source: AVT Ist Year 2011-12																	
19	GW 1280 (d)	5S	3.0	20MS	5.5	0	100S	75.0	78	57	2.2	0.73	2	1	0.0	3	S
20	HI 1584	TR	0.0	TR	0.0	0	60S	35.0	69	47	28.3	18.5	7	2	2.5	4	HS
20A	Infector for Rust	100S	66.6	100S	66.6	80S	80S	75.0	89	57	5.9	5.9	6	3	25.0	2	-
20B	WL 711 for K.B.	-	-	40S	20.0	40S	40S	27.5	89	57	31.7	26.8	3	1	100.0	3	-
20C	PBW 343 for P.M.	-	-	60S	23.3	0	100S	52.5	89	57	8.8	8.8	9	3	50.0	4	S
20D	RAJ 4015 for L.B.	-	-	20S	10.0	0	5S	2.5	99	78	6	6	9	4	100.0	4	-
21	KLP 402	20S	10.0	60S	38.3	0	100S	42.5	57	46	79.1	29.5	7	2	100.0	4	HS
22	MP 3353	20S	8.3	40S	15.0	0	100S	40.0	69	68	58.3	25.2	5	2	14.1	4	HS

S.No.	Entry	SR		LR		LR	YR		LB		KB		PM		FS	HS	CCN
		South		South		North	North		dd 0-9		%		(0-9		%	0-5	
		HS	ACI	HS	ACI	HS	HS	AV.	HS	AV.	HS	AV.	HS	AV.	HS	HS	HS
23	Raj 4245	5S	2.0	TR	0.0	0	100S	57.5	79	68	70.2	27.1	7	3	75.0	4	HS
24	UP 2824	20S	7.3	5S	2.6	0	100S	32.5	69	47	14.8	10.9	7	3	14.1	4	HS
25	UP 2828	20S	7.0	40S	13.4	0	80S	30.0	69	46	44.7	21.3	7	2	33.3	4	HS
26	UAS 336	5S	1.7	40S	13.4	0	100S	28.7	46	25	92.2	34.9	3	1	50.0	4	HS
C. Resistant to Leaf & Stripe rusts																	
Source: AVT II Year 2011-12																	
27	HS 526	30MS	14.6	20S	8.3	TR	5S	2.2	47	35	44.7	17	7	2	100.0	4	HS
28	HD 3065	40S	27.3	20S	10.0	TR	10S	9.3	78	46	24.6	14.1	6	3	0.0	5	HS
29	HI 1579	30S	12.3	TR	0.0	0	10S	4.6	79	36	52.2	25.7	7	3	55.6	4	HS
30	WH 1105	40S	20.3	TR	0.0	5S	0	0.0	78	46	8.6	3.67	3	1	0.0	4	HS
31	MACS 3828	5MS	1.3	5MS	1.4	TS	0	0.0	68	46	9.7	6.43	5	2	0.0	4	HS
32	PBW 658	5MS	3.0	TR	0.0	TS	TMR	0.2	57	36	47.2	19.9	5	3	25.0	4	HS
Source: AVT I Year 2011-12																	
33	AKDW 4749	20S	12.0	5S	2.3	0	TR	0.0	69	47	32.5	17.9	9	7	0.0	4	HS
34	HD 3075	40MS	24.0	20S	9.6	0	5S	3.7	69	47	30.9	12.5	6	2	0.0	4	HS
35	HD 3081Q	20S	18.6	60S	20.0	5MR	20S	6.2	57	36	50	20.2	6	3	0.0	3	HS
36	HPW 368	30S	20.0	40S	13.4	TR	15S	3.7	68	46	4.2	1.4	7	2	0.0	4	HS
37	HS 557	30S	21.6	20S	6.7	0	0	0.0	46	35	28.8	16.9	8	3	22.2	4	HS
38	NIAW 1846	30S	10.0	40S	13.4	0	40MS	10.5	57	35	23.9	16.7	8	5	100.0	4	HS
39	RW 3705	20S	13.3	5S	1.7	0	50S	20.0	79	67	34.9	21.6	3	1	0.0	4	HS
40	VL 972	20S	10.0	20S	6.7	TR	60S	18.7	79	45	23.1	13.3	9	5	6.7	3	HS
40A	Infector for Rust	100S	53.3	100S	46.6	80S	80S	66.6	69	57	12.5	12.5	7	4	60.0	4	S
40B	WL 711 for K.B.	60S	33.3	40S	20.0	40S	60S	33.3	89	67	36.5	18.4	5	2	73.3	4	-
40C	PBW 343 for P.M.	40S	33.3	60S	23.3	0	100S	66.6	89	67	2	2	9	7	87.5	3	-
40D	RAJ 4015 for L.B.	40S	16.6	60S	23.3	0	0	0.0	89	79	14.2	14.2	9	4	87.5	4	S
41	PBW 661	40S	20.0	20S	6.7	TR	80S	36.0	67	46	54.6	30.4	5	3	4.2	3	HS
42	HD 3077	40S	16.6	20S	10.0	5MR	5MS	1.0	67	57	58	22.7	6	2	3.4	5	HS
43	HD 4725	40S*	13.3	20S	13.3	0	20S	13.7	69	46	20.3	6.77	5	1	0.0	4	HS
44	HI 8626 (d)	40S*	13.3	10S	4.6	TR	0	0.0	58	57	22.8	8.04	9	4	0.0	4	HS
45	HUW 652	20S	10.0	TR	0.0	0	60S	21.2	78	67	26.8	13.6	6	2	100.0	5	HS
46	K 1016	20S	13.3	20S	6.7	0	80S	34.5	69	57	17.8	6	5	2	10.0	4	HS
47	Raj 4246Q	10S	3.4	40S	13.4	5MR	100S	41.2	78	67	12	7.32	9	5	100.0	4	HS

d=durum, T=Triticale

III. Screening of MDSN 2012-13 entries against loose smut during 2013-14

Eighty eight entries of MDSN 2012-13 were inoculated with loose smut during 2012-13 crop season and expression of loose smut was observed during 2013-14 season at Hisar, Durgapura and Ludhiana centres. The smutted and healthy tillers were counted and per cent infected tillers were calculated. The entries showing 0-5% infection were resistant to loose smut (Table 9.3).

Table 9.3. Performance of Multiple Disease Screening Nursery, 2012-13, against loose smut during 2013-14 crop season

S.No.	Entry	LS %			
		Hisar	Ludhiana	HS	AV.
A. Resistant to all three rusts					
Source: AVT IInd Year 2009-10					
1	HI 1563	30.1	54.7	54.7	42.4
2	MACS 3742 (d)	25.1	0.0	25.1	12.6
3	MP 3288	60.3	22.5	60.3	41.4
4	RSP 561	50.7	12.7	50.7	31.7
Source: AVT Ist Year 2009-10					
5	DBW 58	55.1	13.6	55.1	34.4
6	GW 1255	60.0	0.0	60.0	30.0
7	HS 534	40.2	25.3	40.2	32.8
8	HUW 636	70.2	3.5	70.2	36.9
9	SKW 441	20.3	5.9	20.3	13.1
10	TL 2968 (T)	10.5	4.7	10.5	7.6
11	UP 2763	30.0	33.7	33.7	31.9
12	UP 2798	65.7	8.0	65.7	36.9
13	WH 1095	50.3	8.3	50.3	29.3
Source: AVT IInd Year 2010-11					
14	TL 2969 (T)	13.3	16.4	16.4	14.9
15	HI 1571	41.2	28.6	41.2	34.9
16	HI 8703 (d)	35.5	1.1	35.5	18.3
17	HI 8704 (d)	27.3	0.0	27.3	13.7
18	LOK 62	60.3	44.6	60.3	52.5
19	UAS 320	30.2	35.3	35.3	32.8
20	UAS 428 (d)	21.5	0.0	21.5	10.8
20A	Sonalika	80.7	33.8	80.7	57.3
Source: AVT Ist Year 2010-11					
21	DBW 71	30.2		30.2	30.2
22	DBW 74	40.2	21.1	40.2	30.7
23	HD 3058	70.1	1.0	70.1	35.6
24	HD 3066	65.3	0.0	65.3	32.7
25	HD 3068	68.2	40.5	68.2	54.4
26	HD 3071	50.3	39.0	50.3	44.7
27	HI 1579	65.3	11.8	65.3	38.6
28	HI 8722 (d)	41.2	31.7	41.2	36.5
29	HPW 347	51.1	0.0	51.1	25.6
30	HPW 348	37.7	9.4	37.7	23.6
31	HPW 349	42.1	0.0	42.1	21.1
32	HPW 360	51.3	28.7	51.3	40.0
33	HPW 361	35.3	25.0	35.3	30.2
34	HPW 371	41.7	0.0	41.7	20.9
35	HS 526	60.1	44.4	60.1	52.3

S.No.	Entry	LS %			
		Hisar	Ludhiana	HS	AV.
36	HS 541	80.3	56.5	80.3	68.4
37	HS 542	21.1	23.1	23.1	22.1
38	HS 544	45.6	30.5	45.6	38.1
39	HS 545	37.3	26.1	37.3	31.7
40	HUW 640	25.4	35.0	35.0	30.2
40A	Sonalika	88.3	18.8	88.3	53.6
41	HW 1098 (dic.)	10.2	0.9	10.2	5.6
42	MACS 3815	27.3	1.4	27.3	14.4
43	MACS 3828	30.1	0.0	30.1	15.1
44	MPO 1243 (d)	35.2	0.0	35.2	17.6
45	NW 5013	40.2	34.9	40.2	37.6
46	PBW 648	60.3	33.7	60.3	47.0
47	PBW 651	55.2	20.9	55.2	38.1
48	PBW 658	70.2	15.6	70.2	42.9
49	PBW 659	68.2	20.6	68.2	44.4
50	RAJ 4211	51.4	21.3	51.4	36.4
51	RAJ 4228	60.2	12.9	60.2	36.6
52	RAJ 4229	62.3	10.9	62.3	36.6
53	RAJ 4235	45.7	0.0	45.7	22.9
54	RAJ 4237	41.3	5.5	41.3	23.4
55	SKW 441	30.6	13.9	34.3	22.3
56	TL 2975 (T)	20.1	0.0	20.1	10.1
57	UP 2832	80.2	28.4	80.2	54.3
58	UP 2997	80.0	20.0	80.0	50.0
59	VL 941	27.2	0.0	27.2	13.6
60	VL 946	20.1	18.8	20.1	19.5
60A	Sonalika	80.8	15.8	80.8	48.3
61	VL 955	15.2	14.0	15.2	14.6
62	VL 956	23.2	14.6	23.2	18.9
63	WHD 948	30.1	0.0	30.1	15.1
Source: AVT II Year 2010-11					
64	AKAW 4210-6	15.7	27.9	27.9	21.8
65	HD 3040	60.3	17.0	60.3	38.7
66	HI 1572	37.6	52.1	52.1	44.9
67	MP 3304	60.3	30.7	60.3	45.5
Source: AVT Ist Year 2010-11					
68	RAJ 4238	-	23.3	23.3	23.3
69	DDK 1041 (dic.)	13.2	6.3	13.2	9.8
70	HW 5216	-	13.1	13.1	13.1
71	HW 5224	-	34.4	34.4	34.4
72	JWS 134	-	28.4	28.4	28.4
73	MACS 2997(dic.)	18.3	0.0	18.3	9.2
74	MACS 5012 (dic.)	15.7	0.0	15.7	7.9
75	MP 1242	57.3	30.8	57.3	44.1
Source: AVT II Year 2009-10					
76	PDW 322 (d)	21.1	0.0	21.1	10.6
77	WHD 946 (d)	19.2	4.8	19.2	12.0
Source: AVT Ist Year 2010-11					
78	DDW 19 (d)	-	3.3	3.3	3.3
79	HI 8713 (d)	-	0.0	0.0	0.0
80	HI 8715 (d)	-	0.0	0.0	0.0
80A	Sonalika	90.2	14.3	90.2	52.3

S.No.	Entry	LS %			
		Hisar	Ludhiana	HS	AV.
81	JAUW 584	31.3	26.3	31.3	28.8
82	KRL 304	57.2	22.7	57.2	40.0
83	PDW 324 (d)	31.2	0.0	31.2	15.6
84	PDW 325 (d)	28.7	0.0	28.7	14.4
85	RKD 216 (d)	30.7	0.0	30.7	15.4
86	WH 1083	60.4	19.4	60.4	39.9
87	WH 1098	57.3	22.3	57.3	39.8
88	WH 1105	37.2	27.2	37.2	32.2

* Due to low loose smut incidence, Durgapura data was not considered.

COOPERATORS

NAME	CENTRE
S. S. KARWASRA AND R.S. BENIWAL	HISAR
RITU BALA	LUDHIANA
R.K. BANSAL	DURGAPURA

IV. Multiple Pest Screening Nursery for 2013-14

Evaluation for insect pest resistance

Shoot fly: Forty nine MPSN lines were screened against shoot fly at four locations viz. Dharwad, Durgapura, Ludhiana and Kanpur, out of which average maximum score was 36.02 for Raj 4240 entry and minimum score was 12.34% for HD 3065 entry (Table 9.4a).

Brown wheat mite: Forty nine entries were screened against brown mite at two locations viz. Durgapura and Ludhiana, out of which maximum score was 80/10 cm sq area for HW 1098 and minimum score was 13.66/10 cm sq area for MP 3353 entry (Table 9.4a).

Foliar aphid: Forty nine entries were screened against wheat aphid at Niphad Ludhiana, Shillongani and Karnal. All the entries were either susceptible (grade 4) or highly susceptible (grade 5) to wheat aphid (Table 9.4b).

Root aphid: The screening consists of Forty nine entries. The data was collected from Enthkedi, Ludhiana and Karnal locations form each entry by uprooting the seedling when the crop was 3-4 weeks old. The entries GW 433, HD 3098, VL 971, MP 1259, MACS 3828, HD 3081Q, HPW 376, VL 972 and PBW 661 were found to be moderately resistant and rest of them were susceptible (grade 4) or highly susceptible (grade 5) to wheat root aphid (Table 9.4b).

Table 9.4a. Screening of MPSN nursery against shootfly and brown wheat mite 2013-14

S.No.	Entry	Shoot fly incidence (%)						Brown Wheat mite		
		Dharwad	Durgapura	Ludhiana	Kanpur	HS.	AV.	Ludhiana	Durgapura	HS
A. Resistant to all three rusts										
Source: AVT IInd Year 2011-12										
1	HW 1098	37.50	18.00	15.20	10.00	37.50	20.18	80.00	20.33	80.00
2	HW 5216	46.00	14.00	12.50	11.11	46.00	20.90	25.00	21.66	25.00
Source: AVT Ist Year 2011-12										
3	GW 433	43.64	18.50	4.20	1.33	43.64	16.92	30.00	18.66	30.00
4	GW 1276 (d)	32.31	16.00	6.20	6.66	32.31	15.29	40.00	20.00	40.00
5	HD 3076	46.67	14.00	4.90	18.18	46.67	20.94	62.00	20.33	62.00
6	HD 3098	66.00	14.00	3.60	18.75	66.00	25.59	42.00	20.00	42.00
7	HPW 385	29.23	16.00	4.80	13.33	29.23	15.84	20.00	18.66	20.00
8	KRL 327	22.00	20.00	5.10	11.11	22.00	14.55	36.00	20.00	36.00
9	PBW 670	31.43	20.00	3.10	12.50	31.43	16.76	32.00	20.33	32.00
10	PDW 329 (d)	21.82	20.00	10.50	1.33	21.82	13.41	55.00	20.00	55.00
11	TL 2978 (T)	30.00	22.00	14.60	1.33	30.00	16.98	28.00	18.00	28.00
12	VL 971	31.43	21.00	9.50	11.11	31.43	18.26	55.00	20.33	55.00
13	MP 1259	70.91	14.50	15.40	14.28	70.91	28.77	44.00	18.00	44.00
14	Raj 4240	100.00	11.00	16.40	16.66	100.00	36.02	32.00	18.00	32.00
15	Raj 4270	48.39	16.00	5.70	13.66	48.39	20.94	20.00	20.00	20.00
16	UP 2825	39.13	14.00	8.20	12.00	39.13	18.33	20.00	22.66	22.66
17	UP 2852	39.13	15.00	11.40	8.00	39.13	18.38	35.00	22.00	35.00
B. Resistant to Stem & Leaf rusts										
Source: AVT II Year 2011-12										
18	Raj 4238	37.97	13.00	8.40	15.38	37.97	18.69	23.00	18.00	23.00
19	DDK 1042	88.00	18.00	10.50	6.66	88.00	30.79	25.00	18.33	25.00
Source: AVT Ist Year 2011-12										
20	GW 1280 (d)	45.76	14.00	2.60	12.50	45.76	18.72	25.00	20.00	25.00
20A	SONALIKA(C) for SF	35.48	22.00	18.60	13.33	35.48	22.35	-	-	-
20B	IWP 72 (C) for BWM	-	-	-	-	-	-	101.00	22.00	101.00
21	HI 1584	41.54	12.00	11.80	12.50	41.54	19.46	25.00	16.00	25.00
22	KLP 402	33.85	14.00	7.50	19.35	33.85	18.67	30.00	14.00	30.00
23	MP 3353	48.33	12.00	8.40	16.66	48.33	21.35	10.00	13.66	13.66
24	Raj 4245	56.36	12.00	3.60	15.40	56.36	21.84	28.00	15.00	28.00

S.No.	Entry	Shoot fly incidence (%)						Brown Wheat mite		
		Dharwad	Durgapura	Ludhiana	Kanpur	HS.	AV.	Ludhiana	Durgapura	HS
25	UP 2824	45.45	15.00	7.90	18.18	45.45	21.63	35.00	18.66	35.00
26	UP 2828	67.50	16.00	9.40	7.69	67.50	25.15	20.00	18.00	20.00
27	UAS 336	36.76	15.50	6.40	13.33	36.76	18.00	38.00	16.33	38.00
C. Resistant to Leaf & Stripe rusts										
Source: AVT II Year 2011-12										
28	HS 526	32.05	14.00	7.80	10.71	32.05	16.14	22.00	14.66	22.00
29	HD 3065	17.44	12.00	8.40	11.53	17.44	12.34	12.00	14.00	14.00
30	HI 1579	65.79	16.00	10.50	13.33	65.79	26.40	30.00	13.66	30.00
31	WH 1105	21.25	15.50	5.60	12.50	21.25	13.71	25.00	12.33	25.00
32	MACS 3828	27.66	12.00	9.40	9.09	27.66	14.54	16.00	14.00	16.00
33	PBW 658	54.55	13.00	10.50	7.69	54.55	21.43	15.00	13.00	15.00
Source: AVT Ist Year 2011-12										
34	AKDW 4749	53.13	18.00	8.60	16.66	53.13	24.10	18.00	18.00	18.00
35	HD 3075	46.67	16.00	7.60	9.09	46.67	19.84	35.00	20.00	35.00
36	HD 3081Q	40.38	14.00	12.60	14.28	40.38	20.32	35.00	22.00	35.00
37	HPW 368	42.03	14.50	9.40	13.79	42.03	19.93	40.00	20.00	40.00
38	HPW 376	67.35	12.00	10.50	12.00	67.35	25.46	36.00	18.00	36.00
39	HS 557	58.46	13.00	6.20	10.71	58.46	22.09	20.00	20.00	20.00
40	NIAW 1846	46.84	10.00	10.40	16.66	46.84	20.97	20.00	20.66	20.66
40A	SONALIKA(C) for SF	39.13	16.50	16.50	13.33	39.13	21.37	-	-	-
40B	IWP 72 (C) for BWM	-	-	-	-	-	-	30.00	22.00	30.00
41	RW 3705	39.24	-	7.40	13.33	39.24	19.99	28.00	16.00	28.00
42	VL 972	33.71	16.00	15.40	16.33	33.71	20.36	40.00	-	40.00
43	PBW 661	34.09	14.00	9.40	15.00	34.09	18.12	18.00	20.00	20.00
44	HD 3077	32.35	12.50	8.20	6.66	32.35	14.93	40.00	16.66	40.00
45	HD 4725	46.15	15.00	13.40	13.63	46.15	22.05	45.00	18.00	45.00
46	HI 8626 (d)	35.71	12.00	7.40	18.75	35.71	18.47	15.00	18.66	18.66
47	HUW 652	35.90	14.50	10.60	12.49	35.90	18.37	22.00	20.33	22.00
48	K 1016	30.26	14.00	3.80	13.33	30.26	15.35	25.00	18.00	25.00
49	Raj 4246Q	40.28	12.00	10.50	7.69	40.28	17.62	28.00	16.00	28.00

Table 9.4b. Screening of MPSN nursery against foliar aphid and root aphid 2013-14

S.No.	Entry	Foliar aphids (1-5 scale)						Root aphid(1-5 scale)				
		Niphad	Ludhiana	Shillongani	Karnal	HS	AV.	Entkhedi	Ludhiana	Karnal	HS	AV.
A. Resistant to all three rusts												
Source: AVT IInd Year 2011-12												
1	HW 1098	4	4	3	5	5	4.0	2	4	3	4	3.0
2	HW 5216	5	5	3	5	5	4.5	2	4	3	4	3.0
Source: AVT Ist Year 2011-12												
3	GW 433	5	5	3	5	5	4.5	2	3	3	3	2.7
4	GW 1276 (d)	5	4	3	5	5	4.3	2	4	3	4	3.0
5	HD 3076	5	4	3	5	5	4.3	2	4	3	4	3.0
6	HD 3098	5	5	3	5	5	4.5	2	3	3	3	2.7
7	HPW 385	5	5	4	4	5	4.5	2	4	3	4	3.0
8	KRL 327	5	3	4	5	5	4.3	3	4	3	4	3.3
9	PBW 670	5	5	4	5	5	4.8	2	5	3	5	3.3
10	PDW 329 (d)	5	4	4	5	5	4.5	3	4	3	4	3.3
11	TL 2978 (T)	5	4	3	3	5	3.8	2	4	3	4	3.0
12	VL 971	5	5	3	5	5	4.5	2	2	3	3	2.3
13	MP 1259	5	5	3	5	5	4.5	3	3	3	3	3.0
14	Raj 4240	5	5	3	4	5	4.3	2	4	3	4	3.0
15	Raj 4270	5	5	3	5	5	4.5	2	4	3	4	3.0
16	UP 2825	5	5	4	5	5	4.8	3	4	3	4	3.3
17	UP 2852	5	4	4	5	5	4.5	2	4	3	4	3.0
B. Resistant to Stem & Leaf rusts												
Source: AVT II Year 2011-12												
18	Raj 4238	5	4	3	5	5	4.3	4	4	3	4	3.7
19	DDK 1042	5	5	4	5	5	4.8	3	5	3	5	3.7
Source: AVT Ist Year 2011-12												
20	GW 1280 (d)	5	5	4	5	5	4.8	3	4	3	4	3.3
20A	A 9-30-1 (C) for FA	5	5	4	5	5	4.8	-	-	-	-	-
20B	GW 173 (C) for RA	-	-	-	-	-	-	2	4	3	4	3.0
21	HI 1584	5	4	3	5	5	4.3	2	4	3	4	3.0
22	KLP 402	5	5	3	5	5	4.5	2	4	3	4	3.0
23	MP 3353	5	5	4	4	5	4.5	2	5	3	5	3.3
24	Raj 4245	5	4	2	4	5	3.8	3	4	3	4	3.3
25	UP 2824	5	5	3	4	5	4.3	3	4	3	4	3.3
26	UP 2828	5	5	4	5	5	4.8	2	4	3	4	3.0
27	UAS 336	4	5	4	5	4	4.5	2	4	3	4	3.0
C. Resistant to Leaf & Stripe rusts												
Source: AVT II Year 2011-12												
28	HS 526	5	5	3	4	5	4.3	2	4	3	4	3.0
29	HD 3065	5	5	3	4	5	4.3	3	4	3	4	3.3
30	HI 1579	5	5	3	5	5	4.5	2	5	3	5	3.3

S.No.	Entry	Foliar aphids (1-5 scale)						Root aphid(1-5 scale)				
		Niphad	Ludhiana	Shillongani	Karnal	HS	AV.	Entkhedi	Ludhiana	Karnal	HS	AV.
31	WH 1105	5	4		5	5	4.3	2	4	3	4	3.0
32	MACS 3828	5	5	4	4	5	4.5	2	3	3	3	2.7
33	PBW 658	4	4	4	5	4	4.3	2	4	3	4	3.0
Source: AVT Ist Year 2011-12												
34	AKDW 4749	5	5	4	4	5	4.5	-	4	3	4	3.5
35	HD 3075	5	5	4	3	5	4.3	2	4	3	4	3.0
36	HD 3081Q	5	4	3	4	5	4.0	2	3	3	3	2.7
37	HPW 368	5	4	4	4	5	4.3	2	4	3	4	3.0
38	HPW 376	5	5	4	4	5	4.5	2	3	3	3	2.7
39	HS 557	4	4	3	4	4	3.8	3	4	3	4	3.3
40	NIAW 1846	4	4	3	4	4	3.8	2	4	3	4	3.0
40A	A 9-30-1 (C) for FA	5	5	4	5	5	4.8	-	-	-	-	-
40B	GW 173 (C) for RA	-	-	-	-	-	-	2	4	3	4	3.0
41	RW 3705	5	5	4	4	5	4.5	2	4	3	4	3.0
42	VL 972	5	5	4	5	5	4.8	2	3	3	3	2.7
43	PBW 661	5	4	2	4	5	3.8	2	3	3	3	2.7
44	HD 3077	5	4	2	4	5	3.8	2	4	3	4	3.0
45	HD 4725	5	4	4	4	5	4.3	2	4	3	4	3.0
46	HI 8626 (d)	5	5	4	4	5	4.5	2	4	3	4	3.0
47	HUW 652	5	5	4	3	5	4.3	2	4	3	4	3.0
48	K 1016	5	5	4	3	5	4.3	2	4	3	4	3.0
49	Raj 4246Q	5	5	4	4	5	4.5	2	4	3	4	3.0

COOPERATORS

NAME	**CENTRE**
BEANT SINGH	LUDHIANA
S.D. PATIL	NIPHAD
J.K. SINGH	KANPUR
K.K. BHARGAVA	DURGAPURA
RAJESH VERMA	ENTKHEDI
K.K. SHARMA	DHARWAD
RUCHIRA TIWARI	PANTNAGAR
SUBHASH KATARE	DWR, KARNAL

V. National Genetic Stock Nursery (NGSN), 2013-14

The confirmed sources of multiple disease and insect pests resistance were contributed in the NGSN and were planted at 22 breeding centers across different agro climatic zones of country for their utilization in breeding for resistance to biotic stresses. All 41 numbers of entries were utilized in the range of 4.1-37.5% by most of the breeding centres. The most utilized entries at many centres were DBW 58, HD 3058, HI 1572, HPW 360, HS 534, HS 545, HUW 640, KRL 304, MACS 3828, MP 3288, MP 3304, NW 5013, PBW 648, PBW 658, RSP 561, UAS 320, VL 941 and WH 1095. The Sagar centre, utilized 24 entries in their breeding programme followed by Kanpur and Vijapur.

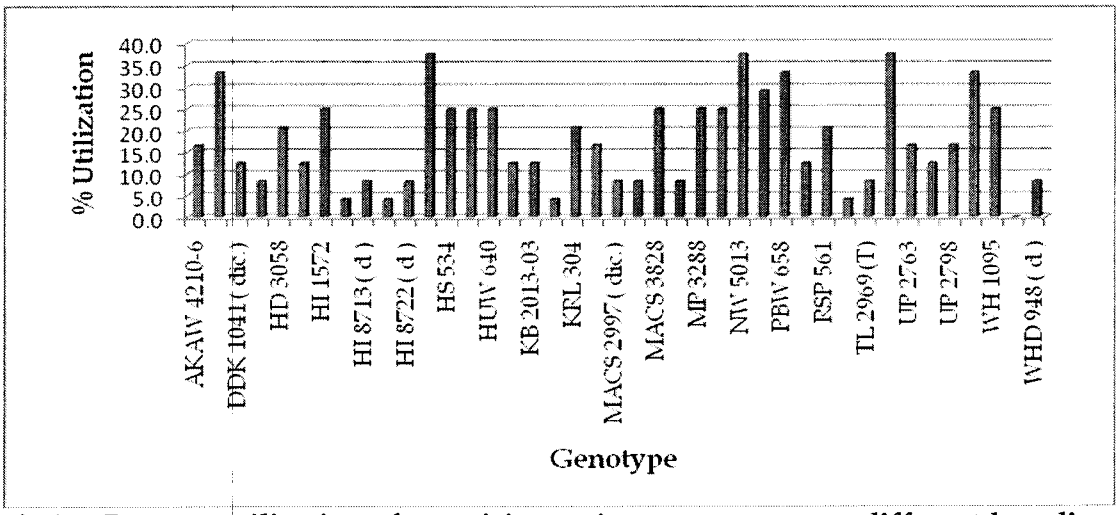

Fig.9.1. Per cent utilization of promising resistant genotypes at different breeding centres in NGSN, 2013-14

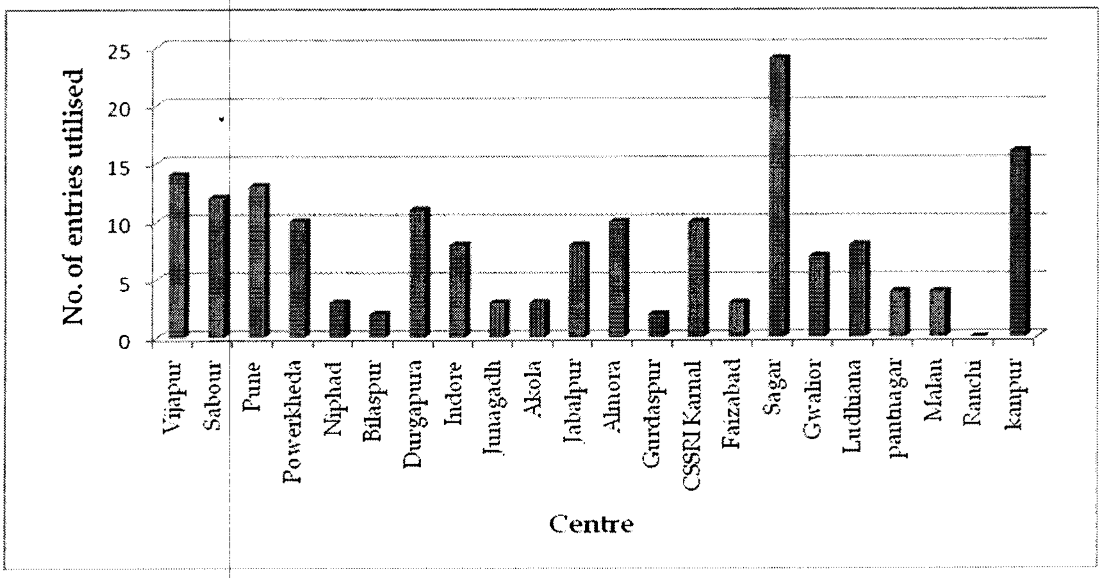

Fig.9.2. Centre wise utilization of promising resistant genotypes from NGSN, 2013-14

Table 9.5. National genetic stock nursery (NGSN), 2013-14

No.	Entry	Vijapur	Sabour	Pune	Powerkheda	Niphad	Bilaspur	Durgapura	Indore	Junagadh	Akola	Jabalpur	Almora	Gurdaspur	CSSRI Karnal	Faizabad	Sagar	Gwalior	Ludhiana	Pantnagar	Malan	Ranchi	Kanpur	Total
1	UP 2763	1													1		1						1	4
2	HI 8703 (d)																						1	1
3	UAS 320	1	1	1				1					1		1		1	1					1	9
4	PBW 658			1					1				1		1	1	1		1				1	8
5	TL 2968 (T)																		1					1
6	DBW 58			1	1			1					1		1				1	1	1			8
7	HS 534			1	1			1				1			1						1			6
8	TL 2969 (T)																		1				1	2
9	HI 8722 (d)																	1					1	2
10	HPW 360	1	1			1	1	1							1	1	1				1			9
11	HUW 640			1							1		1		1		1						1	6
12	VL 941	1						1					1	1	1		1			1	.		1	8
13	HS 545	1			1				1			1					1						1	6
14	PBW 648		1	1					1				1		1		1	1						7
15	RSP 561			1									1		1	1	1							5
16	MACS 3742 (d)				1														1					2
17	MACS 3828		1	1						1				1					1		1			6
18	MP 3288	1		1				1	1		1						1							6
19	HD 3066	1										1					1							3
20	LOK 62	1	1									1					1							4
21	JWS 134				1												1						1	3
22	MP 3304	1			1	1						1					1						1	6
23	HI 1572	1						1	1			1	1					1						6

No.	Entry	Vijapur	Sabour	Pune	Powerkheda	Niphad	Bilaspur	Durgapura	Indore	Junagadh	Akola	Jabalpur	Almora	Gurdaspur	CSSRI Karnal	Faizabad	Sagar	Gwalior	Ludhiana	Pantnagar	Malan	Ranchi	Kanpur	Total
24	WH 1095	1	1						1			1					1	1						6
25	NW 5013		1		1	1		1		1		1	1				1						1	9
26	RAJ 4238							1	1								1							3
27	UP 2798	1						1									1			1				4
28	AKAW 4210-6	1		1													1						1	4
29	HD 3040	1			1																			2
30	MACS 2997 (dic.)		1															1						2
31	MACS 5012 (dic.)																1						1	2
32	DDK 1041 (dic.)		1	1																			1	3
33	KRL 304			1									1					1	1				1	5
34	HD 3058				1			1	1								1		1					5
35	UP 2797		1								1						1							3
36	HI 8713 (d)				1															1				2
37	WHD 948 (d)		1							1														2
38	HI 8715 (d)			1																				1
39	WHD 946 (d)																							0
40	KB 2013-03		1				1										1							3
41	KB 2013-06																1							1

COOPERATORS: M.S. SAHARAN AND R. SELVAKUMAR, DWR, KARNAL (COORDINATING UNIT)

9.2 MANAGEMENT OF DISEASES: CHEMICAL CONTROL

Chemical control has gained importance under the present scenario due to the wide spread occurrence of yellow rust in most of the varieties in the NWPZ. A strategy to combat the threat of rusts, the chemical control has to be an important component in the contingent plan.

Stripe rust

Experiment on chemical control of stripe rust was conducted at four locations viz., Bajaura, Jammu, Pantnagar, Ludhiana and Karnal during 2013-14 crop season.

At Bajaura, yellow rust susceptible variety, Sonalika was sown in field in $4m^2$ plots with nine treatments including untreated control with three replications following RBD. The sprays were given as per spray schedule given in Table 9.6. The best results were obtained with two sprays of Tilt 25 EC @ 0.1% (41.6 Q/Ha) followed by two sprays of Bayleton @ 0.1% (34.2 Q/Ha) yield wise. The stripe rust severity was controlled to 6.7% in treatment with Tilt two sprays @0.1% (6.7%) compared to untreated control (83.3%). All other fungicides treatments also gave statistically superior results than untreated control.

Table 9.6. Management of yellow rust of wheat (var. Sonalika) through fungicides at Bajaura centre

Treatments	Rust Severity (%)	Yield (q/ha)
Tilt (0.1%) one spray	11. 7 (19.8)	31.5
Tilt (0.1%) two sprays	6. 7 (14.7)	41.6
Mancozeb (0.25%) two sprays	56. 7 (48.8)	19.3
Mancozeb (0.25%) three sprays	53.3 (46.9)	23.5
Folicur (0.1%) one spray	16. 7 (24.0)	30.7
Folicur (0.1%) two sprays	13.3 (21.3)	33.9
Bayleton (0.1%) one spray	18.3 (25.3)	29.9
Bayleton (0.1%) two sprays	13.3 (21.3)	34.2
Untreated	83.3 (66.1)	16.5
CD (0.05)	5.3	3.7

* Values in the parentheses are arcsine Transformation

An experiment on chemical management of stripe rust of wheat was conducted at Chatha farm, Jammu during 2013-14 crop season. Stripe rust susceptible variety, PBW 343 was sown in field in 3 x 3 m^2 plots with 9 treatments including control with four replications. Stripe rust was created by artificial inoculation of mixed pathotypes spores. Fungicidal sprays were given at 15 days interval. The result revealed that all the treatments records significant reduction of disease incidence. Two sprays of Tilt (0.1%) and Folicur at 15 days interval gave complete control of yellow rust. The highest yield (44.77q/ha) was found in the plot treated with two sprays of Tilt @0.1% followed by two spray of Folicur @0.1% (44.25q/ha) and Bayleton @0.1% (43.88q/ha) respectively (Table 9.7).

Table 9.7. Management of yellow rust of wheat (var. PBW 343) through fungicides at Chatha farm, Jammu Centre

Treatment	Concentration (%)	Severity	Grain Yield (q/ha)
One spray of Tilt	0.01 %	11.25	41.67
Two sprays of Tilt	0.01 %	0	44.77
Two sprays of Mancozeb	0.25 %	35.75	30.50
Three sprays of Mancozeb	0.25 %	56.25	35.44
One spray of Folicur	0.01 %	13.75	40.77
Two sprays of Folicur	0.01 %	0	44.25
One spray of Bayleton	0.01 %	13.75	40.25
Two sprays of Bayleton	0.01 %	7.5	43.88
Control (No spray)		90	25.50

At Pantnagar, susceptible variety PBW 343 was sown on November 26, 2013 in 1.5x3 m plots with 9 treatments and three replications in RBD. The data on the severity of the rust was recorded before first spray and final data was observed after the last spray. Disease severity was recorded as percent severity according to the modified Cobb's scale.

The results (Table 9.8) revealed that all the treatments recorded significant reduction in disease incidence. One and two spray of Tilt @ 0.1 %, Folicur @ 0.1% and Bayleton @ 0.1% gave complete control of Yellow rust whereas two and three sprays of Mancozeb @ 0.25 %, gave 90.42% and 93.76% disease control, respectively. All treatments were significantly different as compared to untreated check.

The yield was found to be highest in the plot treated with two sprays of Tilt @ 0.1% i.e. 71.11 Q/ha followed by one spray of Tilt @ 0.1 % i.e. 70.44 q/ha. One and two sprays of Bayleton @ 0.1% gave 68.67 Quintal per Hactare each whereas, Folicur@ 0.1% also recorded better yield as compared to control i.e. 67.78 q/ha.

Highest thousand grain weight i.e. 48.13 gms was recorded in three sprays of Mancozeb @ 0.25% followed by one and two sprays of Folicur @0.1% and one spray of Bayletoni.e. 47.94, 47.62, 47.62 and 47.62gms respectively. Two sprays of Bayleton also gave good result i.e. 46.46 gms. One and two sprays of Tilt@0.1% gave 47.05 and 47.03gms, respectively which were significantly superior over control (44.36 gms). In all the treatments, the thousand grain weight was found to be statistically at par with each other.

Table 9.8. Management of yellow rust of wheat (var. PBW 343) through fungicides at Pantnagar centre

No.	Treatments	Dose	Disease Severity	% Disease control	1000 grain wt.(gm)	Yield (q/ha)
T1	One Spray of Tilt	0.1%	0	100	47.05	70.44
T2	Two Sprays of Tilt	0.1%	0	100	47.03	71.11
T3	Two Sprays of Mancozeb	0.25%	5.43	90.42	46.75	67.33
T4	Three Sprays of Mancozeb	0.25%	3.33	93.76	48.13	67.56
T5	One Spray of Folicur	0.1%	0	100	47.94	67.78
T6	Two Sprays of Folicur	0.1%	0	100	47.62	67.78
T7	One Spray of Bayleton	0.1%	0	100	47.62	68.67
T8	Two Sprays of Bayleton	0.1%	0	100	46.46	68.67
T9	Control		56.66	-	44.36	45.11
	CD at 5%				2.28	
	CV				2.81	

At Ludhiana centre, the chemical management of wheat stripe rust was conducted on susceptible variety PBW 343 in field with ten treatments and three replications in RBD (Table 9.9). Stripe rust appeared on 5. 1. 2014. Fungicides sprays were given on 15.1.2014, 5.2.14, and 24.2.2014. Bayleton spray resulted in maximum reduction in disease severity and highest yield was obtained in spraying with Nativo followed by Built and Kontrol in comparison to all treatments including control.

Table 9.9. Management of yellow rust of wheat (var. PBW 343) through fungicides at Ludhiana centre

No.	Fungicide	Conc.(%)	YR severity	Yield (q/ha)	1000 grains weight (g)
1	Nativo	0.1	10S	54.95	36.1
2	Tilt	0.1	20S	48.95	29.7
3	Folicur	0.1	10S	47.70	31.7
4	Bayleton	0.1	10S	48.33	31.8
5	Bavistin	0.1	80S	4.38	16.8
6	Built	0.1	10S	50.00	32.9
7	Kontrol	0.1	10S	43.13	32.9
8	Stilt	0.1	20S	45.43	31.8
9	Amistar Extra	0.1	10S	50.83	32.1
10	Control	-	80S	4.58	14.3

At DWR, Karnal, the chemical management of stripe rust was carried out on susceptible variety PBW343 in RBD with three replications per treatment. The tested chemical (Azoxystrobin 11%+Tebuconazole 18.3%) at various concentrations reduced disease severity at significant level. The highest stripe rust severity was observed in un treated control plot (80S) . The stripe rust in traces (TR) was observed in Foliar spray of Azoxystrobin 11%+Tebuconazole 18.3% @0.15% (750ml /500l) and Azoxystrobin 23SC @ 0.1% (500ml/ 500l). At 0.2% (100ml/500l) Azoxystrobin 11%+Tebuconazole 18.3% spary controlled the rust disease very effectively and there was no presence of rust pustule in the plot.
The yield increase was observed in all fungicide treatments than the control (10.45 q/ha). ranging from 53.68 to 61.66 q/ha. Though the treatment with Azoxystrobin 11%+Tebuconazole 18.3% (0.2%) recorded higher yield (61.66) the other treatments with Azoxystrobin 11%+Tebuconazole 18.3% (0.1% & 0.15%) aloes recorded higher yield at par with treatment @ 0.2% (Table 9.10).

Table 9.10. Management of yellow rust of wheat (var. PBW 343) through fungicides at Karnal centre

No.	Treatments	YR severity	Yield (q/ha)
1	Azoxystrobin 11%+Tebuconazole 18.3%	10S	57.73
2	Azoxystrobin 11%+Tebuconazole 18.3%	TR	60.56
3	Azoxystrobin 11%+Tebuconazole 18.3%	0	61.66
4	Azoxystrobin 23SC	TR	58.35
5	Tebuconazole 25.9 SC	0	56.88
6	Propiconazole 25% EC	0	53.68
7	Control	80S	10.45

Stem rust and leaf rust:

To evolve suitable spraying schedule for the control of rust diseases of wheat the trial was conducted at Niphad, Mahabaleshwar and Dharwad centres during 2013-14 crop season.

At Niphad, the trial was conducted with variety NI 5439, planted in plots of 4.5 m^2 size. The experiment was planted in RBD with four replications. The trial was planted on 4.12.13. The trial was conducted under artificial epiphytic conditions by spraying of mass inoculum of stem and leaf rust. The data is presented in Table 9.11. The disease severity of stem rust ranged from 5 to 50% as per modified Cobb's scale. The stem rust disease severity was significantly lower with the treatment two sprays of tilt @0.1% (6.25%) and two sprays of Folicur @0.1% (6.25%). The highest disease severity of 40.00% was recorded in the control (no spray). The disease intensity of leaf rust was also significantly lower with the treatment of two sprays of tilt @0.1% (15.00%) as against 72.5% in the treatment control. Statistically significant differences were also noticed in 1000 grain weight. The highest 1000 grain weight (36.88 g) was recorded in the treatment of two sprays of tilt @0.1%. Though the differences in yield in yield were statistically non-significant, numerically highest yield was recorded with the treatment of two sprays of tilt @0.1% (31.09 q/ha).

Table 9.11. Effect of spraying schedule on disease severity of stem rust & leaf rust at Niphad centre

No	Treatment	Mean stem rust severity	Mean leaf rust severity	1000 grain weight (gm)	Grain yield of wheat (q/ha.)
1	One spray of Tilt @0.1%	15 (22.65)	40 (39.17)	36.48	26.78
2	Two sprays of Tilt @0.1%	6.25 (14.30)	15 (22.65)	36.88	31.09
3	Two sprays of Mancozeb @0.25%	25 (29.89)	35 (36.22)	35.33	27.68
4	Three sprays of Mancozeb @0.25%	13.75 (21.70)	27.5 (31.55)	36.82	30.00
5	One spray of Folicur @0.1%	22.5 (28.23)	27.5 (31.55)	36.20	27.76
6	Two sprays of Folicur @0.1%	6.25 (14.30)	17.5 (24.68)	37.07	29.20
7	One spray of Bayleton @0.1%	20 (26.34)	30 (33.06)	35.97	25.22
8	Two sprays of Bayleton @0.1%	12.5 (20.18)	20 (26.34)	36.40	26.38
9	Control	40 (39.17)	72.5 (58.61)	30.23	23.08
	S.E. ±	1.588	1.729	**0.534**	NS
	C.D. at 5 %	4.625	5.037	**1.555**	

* Figures in parenthesis are arcsin transformed values

At Mahabaleshwar centre, experiment was conducted on wheat variety NI 5439. There were six rows in each treatment of three meter length, sown at 22.5 cm apart. The experiment was sown in randomized block design with three replications. Fungicidal sprays were commenced before appearance of the disease after sowing. Observations in respect of stem rust were recorded a day earlier to each spray. Final observation was recorded at 10 days after last spray of fungicides. Grain yield at harvest was recorded per treatment per replication.
It is observed from Table 9.12, that, in general there was significantly less intensity of stem rust in all the treatments except control. The fungicidal treatments two sprays of Tilt 25 EC @ 0.1%, three sprays of Mancozeb @ 0.25% and two sprays of Folicur

250EC @ 0.1% were at par with each other with lowest disease intensity and were significantly superior over rest of the treatments. Results regarding grain yield/ha in the fungicidal treatments three sprays of Mancozeb @ 0.25% and two sprays of Tilt 25 EC @ 0.1% were found to be significantly higher over the control. Whereas, grain yield/ha in the fungicidal treatments one spray of Folicur 250EC @ 0.1% , one spray of Tilt 25 EC@ 0.1%, two sprays of Folicur 250EC @ 0.1%, two sprays of Mancozeb @ 0.25%, two sprays of Bayleton 25 WP @ 0.1% and One spray of Bayleton 25 WP @ 0.1% were on par with three sprays of Mancozeb @ 0.25% and two sprays of Tilt 25 EC @ 0.1%.

Table 9.12.Chemical management of stem rust of wheat at Mahabaleshwar centre

No.	Treatment details	ACI	Grain yield (q/ha)
T_1	One spray of Tilt 25 EC@ 0.1%	3.40	24.41
T_2	Two sprays of Tilt 25 EC @ 0.1%	1.27	25.69
T_3	Two sprays of Mancozeb @ 0.25%	4.93	23.88
T_4	Three sprays of Mancozeb @ 0.25%	1.27	25.86
T_5	One spray of Folicur 250 EC @ 0.1%	4.53	24.57
T_6	Two sprays of Folicur 250 EC @ 0.1%	1.87	24.19
T_7	One spray of Bayleton 25 WP @ 0.1%	10.00	22.63
T_8	Two sprays of Bayleton 25 WP @ 0.1%	8.00	23.00
T_9	Control (No spray)	21.33	21.07
	S.E$\pm$	0.48	1.29
	C.D. at 0.05	1.36	3.64
	C.V.	13.30	9.35

At Dharwad, trial on management of rusts was conducted to evaluate the fungicides against stem and leaf rusts. The data is presented in Table 9.13. Two spray of Tilt (Propiconazole) @ 0.1% significantly superior over all other treatments except one spray of Propiconazole and Folicur @ 0.1% which are on par with two spray of Propiconazole @ 0.1% followed by two spray of Bavistin @ 0.1% with respect to grain yield (q/ha). All the treatments were significantly superior over control except both the treatments, of Bavistin with respect to thousand grain weight (g). Stem rust was very less on all other, treatments except Bavistin and control (40S). Leaf rust was not recorded on Propiconazole @ 0.1% and three spray of Mancozeb @0.25%. It was very severe on control plot (20S).

Table 9.13.Chemical management of stem rust of wheat at Dharwad centre

Treatment	Con. (%)	Disease Reaction			Biomass (t/ha)	TGW (g)	Yield (q/ha)
		Stem Rust	Leaf Rust	Spot blotch			
Ti - One spray of Tilt	0.1	TS	0	34	13.47	48.90	16.61
T_2 - Two spray of Tilt	0.1	TMR	0	23	13.89	49.28	17.08
T_3 - Three spray of Mancozeb	0.25	TS	0	33	13.20	47.88	14.39
T_4 - One spray of Folicur	0.1	TMR	TMR	23	13.47	48.68	16.72
T_5 - One spray of Bayleton	0.1	5S	5MS	44	13.33	48.75	15.28
T_6 - One spray of Bavistin	0.1	10S	TMR	45	13.06	44.10	13.17
T_7 - Two spray of Bavistin	0.1	5S	20MS	45	13.47	44.70	16.00
T_8 - Control (No spray)	-	40S	20S	65	10.97	44.13	9.42
S.Em ±					2.90	1.02	1.07
CD at 5%					8.79	3.09	3.24

Validation and promotion of IPM

Niphad Centre:

To verify the results of IPM modules on farmers field, the module was validated at farmers' fields in Nasik district of Mahrashtra . The IPM module was evaluated with two varieties Trimbak (NIAW - 301) and NIAW-34 in five locations at farmers fields (Table 9.14). The module consisted of seed treatment with Azotobactor, PSB and Cruiser spray for the management of aphids.

Table 9.14. Grain yield of wheat q/ha under IPM and non-IPM at farmers fields in District Nasik, Maharashtra

Sr. No.	Name of farmers	Variety	Yield (q/ha)		Yield Difference (q/ha)
			IPM	Farmer practice	
1.	Shri. Ramdas Namdeo Patil At. Dahyana, Tal.Niphad Dist. Nasik.	NIAW-301	47.5	38.0	9.5
2.	Shri. Sanjay Nimbaj Deore At. Bhagurdi, TalKalvan Dist. Nasik.	NIAW-301	37.5	30.0	7.5
3.	Shri. Ramchandra Punjaram Gaikwad, At. Golakhal, Tal. Kalvan, Dist. Nasik.	NIAW-301	42.5	32.5	10.0
4.	ShriHarishchandra Eknath Desai, At. Bhagurdi, Tal. Kalvan, Dist. Nasik.	NIAW-301	42.5	35.5	7.0
5.	Agril. Research Station, Niphad.	NIAW 34	45.0	38.5	6.5
Mean difference					8.1

The yield from farmers practice was in the range of 30.0 to 38.5 q/ha whereas yield of IPM modules in ranged from 37.5 to 47.5q/ha and average difference in yield was 8.1 q/ha. The population of aphids was observed to be above threshold level during the tillering stage in farmers practice plots, while in IPM plot it was below economic threshold level. Rust incidence was not observed throughout the season.

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RESULTS OF THE COORDINATED EXPERIMENTS
2013-14

CROP PROTECTION PRGORAMME (VOL.III, PART - B)
(ENTOMOLOGY)

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PROGRAMME 10. ENTOMOLOGY

RESULTS OF COORDINATED ENTOMOLOGICAL EXPERIMENTS

Wheat entomology programme covers four aspects viz. host plant resistance, chemical control, integrated pest management (IPM) and stored grain pests. During 2013-14 crop season, the experiments were conducted on all above mentioned aspects of entomology. The host plant resistance included studies on pest screening nurseries against foliar and root aphids, shoot fly and brown wheat mite, preliminary screening of elite lines for different pests and multiple pest screening nursery. The chemical control experiments were conducted against foliar aphids including an experiment on bio rational products also. Insect pest management trials were also conducted on termites and brown wheat mite with additional trials on need based sporadic pests at specific locations. New trial on incidence and population build of major insect pest in different dates of sowing was conducted for the first time. IPM studies included basic work on pest management issues and regular surveys in the jurisdiction of each centre. The summary containing highlights of this report is given here:

SUMMARY

Host Plant Resistance

Screening against Shoot fly

Among AVT II year genotypes, none of entry was resistant to shoot fly while 2 genotypes [NIAW 1415 (C) and A 9-30-1 (D) (C)] showed moderate level of resistance (>10%) based on the average incidence. In AVT I year, 2 entries (VL 3002 and TL 2999) have shown good level of resistance (>10 %).

Screening against brown wheat mite

NW 3069, MACS 6221, VL 924, PDW 315, PDW 317, DBW 46, HPW 308, HPW 309, HI 8692 and WH 1076 from previous promising material have shown moderate level of resistance reaction. Among 93, AVT II year and 107, AVT I year entries screened against brown wheat mite, all were susceptible to BWM.

Screening against foliar aphid:

93 AVT II year and 107 AVT I year entries were screened against wheat aphid at Niphad, Ludhiana, Shillongani and Karnal. All the entries were having large number of aphids and were categorized as highly susceptible (grade 5).

Screening against Root aphid:

93 AVT II year and 107 AVT I year entries were screened against root aphid. The data was collected from Enthkedi, Ludhiana and Karnal locations for each entry by uprooting the seedling when the crop was 3-4 weeks old. Of the 93 AVT II year entries NIAW 1994, NIAW 1885, K 1006 (I) (C), DBW 107 and WH 1138 were found moderately resistant. Among 107 AVT I year, eight entries viz. HD 2932-Lr19/Sr25, KB 2012-03, PBW 723, UAS 451 (D), PBW 692, HD 3128, VL 1004 and VL 3002 were moderately resistant and rest of them were susceptible (grade 4) or highly susceptible (grade 5) to wheat root aphid.

Screening against multiple pests

Shoot fly: Forty nine MPSN lines were screened against shoot fly at four locations viz. Dharwad, Durgapura, Ludhiana and Kanpur, out of which average maximum score was 36.02 for Raj 4240 entry and minimum score was 12.34% for HD 3065 entry.

Brown wheat mite: Forty nine genotypes were screened against brown mite at two locations viz. Durgapura and Ludhiana, out of which maximum score was 101 mite per 10 cm sq area for IWP-72(c) and minimum score was 13.66 mite/10 cm sq area for MP-3353 entry

Foliar aphid: Forty nine genotypes were screened against wheat aphid at Niphad, Ludhiana, Shillongani and Karnal. All the entries were either susceptible (grade 4) or highly susceptible (grade 5) to wheat aphid

Root aphid: Forty nine genotypes were screened for root aphid at Enthkedi, Ludhiana and Karnal locations and aphid population was recorded by uprooting the seedling when the crop was 3-4 weeks old. The genotypes GW 433, HD 3098, VL 971, MP 1259, MACS 3828, HD 3081Q, HPW 376, PBW 661 and VL 972 were found moderately resistant and rest of them were susceptible (grade 4) or highly susceptible (grade 5) to wheat root aphid.

II. Chemical Control

- Imidacloprid 600 FS (Gaucho) @ 0.72 g a.i. /kg seed was identified quite effective for the control of termite damage and improving yields.
- Propargite 57 SC (Omite) @ 1.5 ml/l of water was very effective for brown wheat mite management.
- The foliar application of Pride (Acetamiprid 20SP) @ 20 g.a.i./ha was found to be quite effective for the management of foliar aphids in wheat.
- The results of initial studies on stored grain pest indicate that emamectin benzoate (Proclaim @40.0 mg/kg) and spinosad (Tracer 4.4 mg/kg) as seed protectant were quite effective for the management of wheat stored grain pests.

III. Integrated Pest Management

- The Survey in Rajasthan indicates that the termite damage in wheat fields remained moderate throughout the crop season. Population of brown wheat mite was medium and noticed later on at ear head stage of the crop. The attack of pink stem borer in wheat was also observed during survey of wheat crop. The incidence of *Spodoptera litura* and *Helicoverpa armigera* was very low but widespread.
- In Maharashtra, aphid population in Nasik district was heavy. The severity of damage was recorded up to 5 to 35 per cent. The infestation of root aphid was observed in medium intensity in Dhule district.
- In Punjab, sporadic incidence of termites was observed in District Faridkot. Moderate to severe incidence of wheat aphid was observed in some village of Mukatsar (Chakdiwala), Ferozepur (Sarenaga & Sekha Kalan) and Moga district. Minor incidence of Pink stem borer was observed in some parts of Nawanshahr district. Low level of root aphid incidence was also observed in few fields in KVK, Bahowal and adjoining areas.
- In Haryana, moderate to severe incidence of wheat aphid was observed in some village of district Karnal (Bastli), Kaithal, Jind (Danola), Hisar (DWR research Farm). Minor incidence of Pink stem borer was observed in village Bilaspur, district Dabwali. Moderate termite damage was recorded in some parts of Karnal (Basthali) and Kaithal (Batta).
- In Shillongni, sporadic infestation of Cutworm was observed.

  The detailed report is given here under.

10.1. HOST PLANT RESISTANCE

Breeding plants for resistance to insects is really just another form of biological pest control, rather than finding insects to attack the pests, scientists are looking for genetic traits that reduce an organism's susceptibility to its insect pests. This idea was first tested in the 1870's by C. V. Riley, an entomologist who successfully fought a French outbreak of phylloxera (an aphid-like pest of grapes) with resistant North American rootstocks. Present days cultivated cereal crops originated from genetically diverse plant types and these are now grown in large, genetically homogeneous stands, a practice that decreases genetic and species diversity and increase the likelihood of economically significant insect pests. Defense mechanisms of plants can be re-created in resistant plants. These defense mechanisms include escape in space and time, incompatible biological associations, physically and chemically derived barriers and accommodation by replacement or repair of damaged plant parts. Keeping these things in mind the wheat entomological work formulates pest specific hot spot screening of advanced wheat lines in the pursuit of identifying resistant sources. The summary of the result are described here in the following paragraphs.

1: Entomological Screening Nurseries

(1a) Shoot fly screening nursery

A total of 93 AVT II year and 107 AVT I year wheat genotypes were screened against shoot fly, at four hotspot locations *viz.* Dharwad, Durgapura, Ludhiana and Kanpur. The average infestation levels in AVT II year genotypes ranged from 9.18 % (A 9-30-1 (D) (C)) to 29.48 % (BRW 3723) (Table 10.1a). Among AVT II year genotypes, based on the average incidence of all locations, none of entry was resistant to Shoot fly while two genotypes [NIAW 1415 (C) and A 9-30-1 (D) (C)] were moderately resistant (>10%). The average infestation levels among AVT I year lines ranged from 9.33% (VL 3002) to 29.15% (HS 594) (Table 10.1b). In AVT I year, two entries (VL 3002 and TL 2999) have shown good level of resistance (>10 %).

Table 10.1a. Screening against Shoot fly: AVT II year genotypes. (Year-2013-14)

S. No.	Entry	Shootfly Incidence (%)				Average
		Dharwad	Durgapura	Ludhiana	Kanpur	
1	HPW 376	25.00	11.00	13.30	19.09	19.13
2	VL 967	54.10	12.50	5.50	15.83	25.13
3	HPW 251 (C)	43.50	16.00	6.40	23.66	22.38
4	HPW 349 (C)	25.20	17.00	5.80	18.66	16.56
5	HS 277 (C)	42.90	10.00	7.10	8.33	19.43
6	HS 375 (C)	39.70	10.50	7.50	22.72	23.31
7	HS 490 (C)	50.00	10.00	6.40	9.37	21.92
8	HS 507 (C)	32.30	13.00	8.00	21.42	18.67
9	HS 542 (I) (C)	28.20	10.00	5.60	17.70	17.16
10	VL 804 (C)	24.50	12.00	8.00	15.00	15.83
11	VL 829 (C)	36.20	15.00	4.40	13.63	18.08
12	VL 892 (C)	24.60	20.00	6.60	15.38	15.54
13	VL 907 (C)	22.40	17.00	8.20	9.09	13.23
14	HUW 666	51.11	12.00	7.30	7.04	21.82
15	PBW 681	26.40	14.00	2.20	13.63	14.08
16	WH 1129	32.22	12.50	6.50	9.09	15.94
17	WH 1138	45.45	10.00	5.60	18.18	23.08
18	WH 1142	50.77	14.00	1.80	8.69	20.42
19	DBW 88 (I) (C)	38.75	10.50	3.60	3.33	15.23
20	DBW 90 (I) (C)	26.67	12.00	7.90	9.09	14.55

S. No.	Entry	Shootfly Incidence (%)				Average
		Dharwad	Durgapura	Ludhiana	Kanpur	
20A	SONALIKA(C) for SF	60.00	10.00	15.50	18.33	31.28
21	DPW 621-50 (C)	34.69	15.00	11.10	13.33	19.71
22	HD 2967 (C)	39.13	14.00	8.20	18.18	21.84
23	HD 3043 (C)	28.74	10.00	2.20	21.87	17.60
24	HD 3059 (C)	35.65	11.00	4.30	17.85	19.27
25	HD 3086 (I) (C)	24.24	14.00	6.50	18.99	16.58
26	PBW 590 (C)	32.41	10.50	6.20	8.69	14.45
27	PBW 644 (C)	20.95	14.50	5.20	14.99	13.71
28	PBW 660 (I) (C)	29.17	20.00	9.10	11.53	16.60
29	PDW 233 (C)	13.13	14.00	10.40	14.28	12.60
30	PDW 291 (C)	20.77	16.00	9.70	13.33	14.60
31	PDW 314 (C)	21.43	16.00	2.20	15.00	12.88
32	WH 1021 (C)	16.28	10.00	10.40	12.50	13.06
33	WH 1080 (C)	54.55	12.00	6.40	11.76	24.24
34	WH 1105 (C)	32.50	15.00	9.80	14.99	19.10
35	WH 1124 (I) (C)	30.68	10.00	6.20	14.35	17.08
36	BRW 3723	56.67	15.00	8.70	23.07	29.48
37	DBW 107	56.36	18.00	7.90	9.37	24.54
38	HD 3118	24.00	16.00	9.40	6.66	13.35
39	K 1114	13.38	15.00	10.80	10.34	12.38
40	C 306 (C)	35.00	16.00	6.50	11.53	17.68
40A	SONALIKA(C) for SF	54.29	20.00	12.20	21.66	29.38
41	DBW 14 (C)	29.23	15.00	8.80	14.81	17.61
42	DBW 39 (C)	29.41	14.00	12.20	10.52	17.38
43	HD 2733 (C)	27.06	10.50	9.40	10.00	15.49
44	HD 2888 (C)	22.86	14.00	12.40	8.00	14.42
45	HD 2985 (C)	18.00	16.50	8.70	15.62	14.11
46	HI 1563 (C)	37.93	18.00	4.40	11.53	17.95
47	K 0307 (C)	34.85	18.00	6.50	9.37	16.91
48	K 1006 (I) (C)	25.33	20.00	5.40	10.71	13.81
49	K 8027 (C)	31.11	18.50	8.40	8.00	15.84
50	NW 2036 (C)	19.29	14.00	6.20	12.00	12.50
51	NW 5054 (I) (C)	26.67	11.00	7.20	13.33	15.73
52	DBW 110	30.49	15.00	4.60	11.11	15.40
53	HI 8736 (D)	17.14	16.00	6.90	12.50	12.18
54	HI 8737 (D)	20.91	18.00	3.40	10.77	11.69
55	MP 3382	19.13	16.00	4.40	8.00	10.51
56	NIAW 1885	28.00	18.40	6.40	10.00	14.80
57	PBW 689	27.27	19.00	10.80	9.37	15.81
58	A 9-30-1 (D) (C)	13.39	14.00	7.90	6.25	9.18
59	GW 322 (C)	29.49	13.50	5.60	7.14	14.08
60	HD 2864 (C)	41.18	14.50	8.80	8.50	19.49
60A	SONALIKA(C) for SF	38.78	18.00	18.70	20.00	25.83
61	HD 2932 (C)	45.95	16.50	9.70	9.67	21.77
62	HI 1500 (C)	24.14	13.00	8.60	13.79	15.51
63	HI 1544 (C)	52.00	18.00	7.70	11.42	23.71
64	HI 8498 (D) (C)	42.11	20.00	5.60	9.09	18.93
65	HI 8627 (D) (C)	25.58	18.00	4.60	6.66	12.28
66	MP 3288 (C)	64.00	12.00	4.50	6.25	24.92
67	MP 3336 (C)	23.73	12.00	7.40	7.14	12.76
68	MP 4010 (C)	29.41	10.00	7.90	6.66	14.66

S. No.	Entry	Shootfly Incidence (%)				Average
		Dharwad	Durgapura	Ludhiana	Kanpur	
69	MPO 1215 (d) (C)	50.00	16.00	10.50	5.38	21.96
70	NIAW 1994	41.67	16.00	9.40	18.83	23.30
71	UAS 347	15.38	14.00	6.50	12.00	11.29
72	UAS 446 (D)	50.00	14.00	6.10	6.85	20.98
73	AKDW 2997-16(d) (C)	50.00	15.00	8.40	6.66	21.69
74	HD 3090 (I) (C)	60.00	16.00	8.80	8.57	25.79
75	MACS 6222 (C)	27.12	10.00	5.60	8.57	13.76
76	MACS 6478 (C)	33.75	14.00	5.90	11.42	17.02
77	NI 5439 (C)	30.00	16.00	3.30	10.71	14.67
78	NIAW 1415 (C)	14.10	18.00	7.40	7.14	9.55
79	NIDW 295 (d) (C)	21.43	20.00	9.40	11.11	13.98
80	Raj 4083 (C)	23.33	16.00	3.60	9.84	12.26
80A	SONALIKA(C) for SF	46.67	22.00	17.80	18.57	27.68
81	UAS 428 (d) (C)	45.45	16.00	14.40	9.33	23.06
82	CoW(W) 1 (C)	40.91	14.00	12.20	10.47	21.19
83	HW 2044 (C)	59.09	17.50	11.00	16.66	28.92
84	HW 5216 (C)	48.78	19.00	10.40	11.42	23.53
85	DDK 1042	29.17	16.00	14.80	19.23	19.80
86	MACS 5022	21.82	18.00	12.40	7.14	13.79
87	DDK 1029 (C)	51.72	14.00	10.50	15.62	25.95
88	HW 1098 (I) (C)	33.90	16.50	16.40	18.18	21.25
89	Kharchia 65 (C)	30.69	20.00	8.90	9.37	16.32
90	KRL 19 (C)	28.00	12.00	2.60	6.66	12.42
91	KRL 210 (C)	24.39	20.00	5.40	5.25	11.68
92	MACS 2496 (C)	21.88	16.00	6.40	5.55	11.28
93	MACS 2971 (C)	52.73	14.00	8.70	7.74	23.06

Table 10.1b. Screening against Shoot fly: AVT I year genotypes. (Year-2013-14)

S. No.	Entry	Shootfly Incidence (%)				Average
		Dharwad	Durgapura	Ludhiana	Kanpur	
1	HPW 373	27.27	15.50	4.40	22.50	18.06
2	HPW 400	44.44	11.00	2.30	16.66	21.13
3	HPW 401	26.87	10.00	3.40	23.33	17.87
4	HPW 410	42.22	15.00	13.20	16.66	24.03
5	HPW 411	34.09	12.00	6.60	15.00	18.56
6	HPW 412	59.57	15.00	17.20	9.09	28.62
7	HS 547	36.11	11.00	12.10	18.33	22.18
8	HS 558	35.53	14.00	7.60	13.33	18.82
9	HS 562	33.33	-	8.80	4.54	15.56
10	HS 577	40.68	-	2.90	11.66	18.41
11	HS 590	40.91	12.00	9.10	18.33	22.78
12	HS 591	78.95	16.00	8.50	12.00	33.15
13	HS 592	26.47	13.00	5.50	13.50	15.16
14	HS 593	56.86	16.00	5.90	7.87	23.54
15	HS 594	62.96	12.00	6.50	18.00	29.15
16	HS 595	29.79	14.50	5.40	16.33	17.17
17	UP 2890	30.85	14.50	8.40	13.33	17.53
18	UP 2891	30.71	14.00	11.60	6.66	16.32
19	VL 976	38.75	16.00	7.50	9.09	18.45
20	VL 977	61.54	13.00	5.90	8.00	25.15
20A	SONALIKA(C) for SF	40.43	21.00	15.90	17.50	23.71

S. No.	Entry	Shootfly Incidence (%)				Average
		Dharwad	Durgapura	Ludhiana	Kanpur	
21	VL 1003	30.16	12.00	13.40	5.00	16.19
22	VL 1004	24.71	10.00	9.40	10.00	14.70
23	VL 3002	17.04	14.00	4.30	6.66	9.33
24	VL 3004	34.33	13.50	8.40	23.33	22.02
25	VL 3005	30.70	14.00	3.50	7.50	13.90
26	VL 3006	37.91	18.00	5.90	13.33	19.05
27	DBW 95	31.46	12.00	12.80	17.50	18.44
28	DBW 128	33.02	16.50	4.80	9.09	15.64
29	DBW 129	48.10	16.00	7.40	15.41	23.64
30	HD 3128	27.97	11.00	11.90	16.66	18.84
31	HD 3132	40.70	18.00	9.50	13.33	21.18
32	HD 3133	46.75	17.00	6.40	13.63	20.95
33	HD 3139	41.41	18.00	8.70	11.11	19.81
34	HD 4730	51.16	12.00	7.40	13.63	24.06
35	HUW 675	44.32	10.00	6.20	9.09	19.87
36	K 1204	37.10	18.00	5.80	6.66	16.52
37	MP 1277	28.44	13.00	2.40	13.33	14.72
38	PBW 677	34.65	14.00	9.10	9.09	17.61
39	PBW 692	39.05	16.00	2.40	9.09	16.85
40	PBW 695	34.91	18.00	2.80	11.06	16.26
40A	SONALIKA(C) for SF	40.00	20.00	22.30	16.66	24.74
41	PBW 697	37.97	16.50	6.40	14.54	19.64
42	PBW 698	26.97	16.00	3.30	13.33	14.53
43	PBW 702	23.81	13.00	2.40	26.66	17.62
44	PBW 703	34.78	16.00	1.50	9.37	15.22
45	PBW 706	56.60	13.00	4.40	7.14	22.71
46	TL 2995	50.79	12.50	3.20	18.75	24.25
47	UAS 356	53.03	16.00	5.80	24.24	27.69
48	WH 1154	37.50	14.00	7.70	9.09	17.07
49	WH 1156	28.70	18.00	6.30	11.11	15.37
50	WH 1157	30.00	11.00	3.50	13.63	15.71
51	WH 1164	29.57	16.00	5.90	7.69	14.39
52	DBW 126	37.76	15.00	8.50	8.00	17.31
53	DBW 98	26.19	16.00	3.40	11.53	14.28
54	HD 3127	44.00	18.00	5.60	3.84	17.86
55	HUW 661	33.33	15.50	3.50	6.25	14.65
56	HUW 677	40.00	12.50	9.70	3.84	16.51
57	HUW 679	44.16	15.50	7.40	8.33	18.85
58	PBW 693	62.22	10.50	5.60	13.33	22.91
59	PBW 701	28.57	14.50	6.60	16.66	16.58
60	PBW 704	31.63	13.00	7.40	16.66	17.17
60A	SONALIKA(C) for SF	57.14	20.00	18.50	9.09	26.18
61	UP 2855	27.69	12.50	6.40	18.75	17.61
62	WH 1132	22.86	11.00	7.50	10.00	13.45
63	CG 1010	13.64	13.00	5.40	13.33	11.34
64	DDW 30 (D)	25.88	8.00	16.40	6.66	16.31
65	GW 451	36.73	8.00	5.60	9.09	17.14
66	GW 455	31.51	9.00	9.40	19.23	20.05
67	HD 3146	19.57	14.00	4.40	25.00	16.32
68	HD 4728 (D)	25.64	16.00	6.40	23.07	18.37
69	HI 8750 (D)	20.78	12.50	7.80	22.07	16.88
70	HI 8755 (D)	22.06	11.00	10.30	12.20	14.85

S. No.	Entry	Shootfly Incidence (%)				Average
		Dharwad	Durgapura	Ludhiana	Kanpur	
71	K 1215	22.39	12.00	13.40	16.00	17.26
72	K 1217	29.09	12.00	5.40	9.09	14.53
73	MACS 3916 (D)	24.49	18.00	3.20	22.72	16.80
74	MACS 3927 (D)	38.67	16.00	5.40	5.55	16.54
75	MACS 6604	21.33	20.00	6.40	11.11	12.95
76	MP 1279	50.00	16.50	11.40	11.53	22.36
77	NIAW 2030	64.71	14.00	8.20	13.33	28.75
78	UAS 451 (D)	17.89	16.00	7.60	5.55	10.35
79	DDW 27 (D)	34.55	15.00	12.30	25.00	23.95
80	HI 8751 (D)	39.53	14.00	8.40	9.09	19.01
80A	SONALIKA(C) for SF	56.25	16.00	14.80	18.75	29.93
81	HI 8754 (D)	23.08	10.00	10.20	17.61	15.22
82	K 1213	24.44	12.00	5.00	13.33	13.69
83	UP 2864	17.27	14.00	5.90	7.69	11.22
84	MACS 6507	25.71	10.00	1.80	16.00	13.38
85	UAS 358	56.00	12.00	3.30	9.09	20.10
86	DBW 154	18.10	10.50	2.60	13.33	11.13
87	DBW 155	27.00	12.00	4.80	18.00	15.45
88	MACS 5040	36.36	14.50	12.90	16.00	19.94
89	MACS 5031	34.55	12.50	10.40	20.00	19.36
90	DDK 1046	17.33	15.00	15.40	20.71	17.11
91	DDK 1044	30.91	15.00	19.40	23.07	22.09
92	HW 1099	28.57	18.00	12.20	22.72	20.37
93	TL 2996	33.33	12.00	10.40	15.38	17.78
94	TL 2997	55.93	14.00	6.10	22.22	24.56
95	TL 2998	13.33	16.00	8.20	15.00	13.13
96	TL 2999	20.00	14.50	3.40	2.00	9.98
97	TL 3000	15.74	16.50	5.60	11.11	12.24
98	TL 2942 (C)	21.15	14.50	3.10	5.55	11.08
99	TL 2969 (C)	22.35	18.50	7.10	11.00	14.74
100	PBW 722	32.50	12.00	10.20	11.11	16.45
100A	SONALIKA(C) for SF	53.33	20.00	20.20	20.45	28.50
101	PBW 723	29.11	14.50	8.20	22.22	18.51
102	KB 2012-03	30.77	13.00	5.60	19.23	17.15
103	HD 2932+Sr26	33.90	12.00	9.40	12.50	16.95
104	HD 2932-Lr19/Sr25	28.21	11.00	7.20	22.72	17.28
105	MMBL 283	37.74	14.00	8.60	15.86	19.05
106	HUW 234 (C)	32.43	14.00	4.50	23.07	18.50
107	PBW 343 (C)	31.82	12.00	7.80	12.50	16.03

(1b) Brown wheat mite screening nursery

A total of 200 lines, consisting of 93 AVT II year and 107 AVT I year lines were screened against brown wheat mite at Ludhiana and Durgapura centre (Table 10.3a & Table 10.3b). However, 50 previously identified promising entries were tested at Ludhiana centre only. Of the 50 entries screened at Ludhiana centre, NW 3069, MACS 6221, VL 924, PDW 315, PDW 317, DBW 46, HPW 308, HPW 309, HI 8692 and WH 1076 were found to be very promising showing good level of resistance against brown wheat mite (<10.0 mites/10 sq. cm) (Table 10.2). Of 93 AVT II year and 107 AVT I year entries screened against brown wheat mite, all were susceptible to BWM.

Centre: Durgapura

Two hundred and four wheat lines were planted in two rows replicated thrice were screened during 2013-14 against brown wheat mite under irrigated condition. Two observations for mite population were recorded at 20 days intervals during peak infestation period. The infested plants were tapped over 4 glycerine-smeared slides held in a thermocol sampler at ground level for recording the mite population. The observations were recorded from 3 spots per plot. The average of the data was computed to number of mites/10 cm^2 area. The rankings were given for different entries in the last. The data presented in the Table 10.3a and 10.3b.

Centre: Ludhiana

In this trial, a total of 254 genotypes were sown under rainfed conditions for screening against brown mite at Plant Breeding Research Farm, PAU, Ludhiana in the year 2013-14. The varieties were sown in one-meter row length, with three replications of each line. The observations on mite population were recorded at 20 days interval during March-April. For recording mite population, infested plants were tapped over 4 glycerine-smeared slides held in thermocole sampler at ground level. The maximum mite population was observed in VL 888 (48/10 cm^2 area) while minimum in VL 924, HPW 308 and PDW 315 (4/10cm^2 area) in brown wheat mite screening nursery (Table 10.2). Among AVT II year screening nursery, average maximum mite infestation was recorded in PBW 681 (65.17/10m^2 area) and average minimum in NW 5054 (I) (C) and C 306 (C) (16.83/10 m^2 area). (Table 10.3a). Among AVT I year screening nursery, average maximum mite infestation was recorded in HD 4728 (D) (64.33/10m^2 area) and average minimum in HI 8750 (D) (13.67/10 m^2 area). (10.3b).

Table 10.2. Entomological screening nursery for brown wheat mite (Old material) Centre: Ludhiana 2013-14

Sr. No.	Variety	No. of mites/10cmsq area	Sr. No.	Variety	No. of mites/10cmsq area
1	HD 507	21	24	UAS 419	22
2	HD 2888	11	25	HI 1522	34
3	HI 1500	19	26	HD 1911	38
4	HI 1544	22	27	HI 8682	15
5	HS 513	14	28	K 0615	16
6	HS 461	33	29	MACS 3660	16
7	HUW 598	24	30	UAS 305	17
8	Lok 54	11	31	HW 5211	15
9	MACS 3313	24	32	HD 2997	14
10	NW 3069	9	33	VL 616	13
11	VL 888	48	34	VL 738	13
12	VL 892	11	35	VL 925	13
13	IWP 72	20	36	PBW 629	40
14	HS 295	24	37	PDW 315	4
15	PBW 581	26	38	PDW 317	8
16	DBW 31	11	39	UAS 315	16
17	HD 2733	14	40	MP 1203	19
18	MACS 6221	9	41	DBW 46	9
19	RJ 4037	16	42	HPW 308	4
20	DDK 1009	23	43	HPW 309	7
21	VL 924	4	44	HI 8692	9
22	HI 8681	11	45	PBW 620	16
23	PDW 314	16	46	PBW 624	30

Sr. No.	Variety	No. of mites/10cmsq area
47	PBW 628	39
48	WH 1076	5

Sr. No.	Variety	No. of mites/10cmsq area
49	DDK 1037	23
50	DDK 1038	26

Table 10.3a. Brown wheat mite screening nursery: AVT II year lines. (Year-2013-14)

S. No.	Entry	No. of mites/10cmsq area		Average
		Ludhiana	Durgapura	
1	HPW 376	40.00	20.66	30.33
2	VL 967	25.00	22.00	23.50
3	HPW 251 (C)	60.00	20.33	40.17
4	HPW 349 (C)	50.00	21.00	35.50
5	HS 277 (C)	45.00	20.66	32.83
6	HS 375 (C)	80.00	22.00	51.00
7	HS 490 (C)	65.00	20.66	42.83
8	HS 507 (C)	100.00	20.33	60.17
9	HS 542 (I) (C)	90.00	18.66	54.33
10	VL 804 (C)	60.00	20.66	40.33
11	VL 829 (C)	30.00	17.66	23.83
12	VL 892 (C)	25.00	20.33	22.67
13	VL 907 (C)	40.00	20.66	30.33
14	HUW 666	35.00	22.66	28.83
15	PBW 681	110.00	20.33	65.17
16	WH 1129	100.00	14.66	57.33
17	WH 1138	45.00	20.66	32.83
18	WH 1142	28.00	17.66	22.83
19	DBW 88 (I) (C)	20.00	20.66	20.33
20	DBW 90 (I) (C)	50.00	20.00	35.00
20A	IWP 72 (C) for BWM	129.00	20.66	74.83
21	DPW 621-50 (C)	35.00	20.00	27.50
22	HD 2967 (C)	55.00	18.66	36.83
23	HD 3043 (C)	45.00	20.33	32.67
24	HD 3059 (C)	28.00	21.33	24.67
25	HD 3086 (I) (C)	20.00	20.00	20.00
26	PBW 590 (C)	50.00	19.33	34.67
27	PBW 644 (C)	25.00	20.66	22.83
28	PBW 660 (I) (C)	20.00	22.66	21.33
29	PDW 233 (C)	35.00	20.00	27.50
30	PDW 291 (C)	50.00	20.33	35.17
31	PDW 314 (C)	65.00	18.66	41.83
32	WH 1021 (C)	25.00	20.66	22.83
33	WH 1080 (C)	50.00	18.33	34.17
34	WH 1105 (C)	15.00	20.66	17.83
35	WH 1124 (I) (C)	40.00	20.00	30.00
36	BRW 3723	50.00	18.66	34.33
37	DBW 107	40.00	17.33	28.67
38	HD 3118	60.00	20.66	40.33
39	K 1114	45.00	20.00	32.50
40	C 306 (C)	15.00	18.66	16.83
40A	IWP 72 (C) for BWM	135.00	22.33	78.67
41	DBW 14 (C)	50.00	18.66	34.33
42	DBW 39 (C)	40.00	20.66	30.33
43	HD 2733 (C)	20.00	20.00	20.00
44	HD 2888 (C)	50.00	20.66	35.33

S. No.	Entry	No. of mites/10cmsq area		Average
		Ludhiana	Durgapura	
45	HD 2985 (C)	30.00	18.66	24.33
46	HI 1563 (C)	44.00	20.66	32.33
47	K 0307 (C)	61.00	20.33	40.67
48	K 1006 (I) (C)	16.00	22.00	19.00
49	K 8027 (C)	33.00	20.00	26.50
50	NW 2036 (C)	22.00	18.00	20.00
51	NW 5054 (I) (C)	15.00	18.66	16.83
52	DBW 110	26.00	22.00	24.00
53	HI 8736 (D)	22.00	18.00	20.00
54	HI 8737 (D)	18.00	18.33	18.17
55	MP 3382	39.00	20.33	29.67
56	NIAW 1885	44.00	18.66	31.33
57	PBW 689	28.00	20.66	24.33
58	A 9-30-1 (D) (C)	-	20.33	20.33
59	GW 322 (C)	-	20.66	20.66
60	HD 2864 (C)	44.00	20.66	32.33
60A	IWP 72 (C) for BWM	105.00	22.66	63.83
61	HD 2932 (C)	33.00	18.66	25.83
62	HI 1500 (C)	52.00	20.00	36.00
63	HI 1544 (C)	26.00	18.66	22.33
64	HI 8498 (D) (C)	24.00	20.66	22.33
65	HI 8627 (D) (C)	44.00	20.33	32.17
66	MP 3288 (C)	34.00	21.66	27.83
67	MP 3336 (C)	36.00	20.00	28.00
68	MP 4010 (C)	45.00	20.00	32.50
69	MPO 1215 (d) (C)	22.00	20.33	21.17
70	NIAW 1994	30.00	18.33	24.17
71	UAS 347	22.00	16.33	19.17
72	UAS 446 (D)	18.00	18.00	18.00
73	AKDW 2997-16(d) (C)	25.00	20.00	22.50
74	HD 3090 (I) (C)	44.00	18.66	31.33
75	MACS 6222 (C)	31.00	21.33	26.17
76	MACS 6478 (C)	65.00	18.66	41.83
77	NI 5439 (C)	25.00	18.33	21.67
78	NIAW 1415 (C)	22.00	15.33	18.67
79	NIDW 295 (d) (C)	40.00	19.66	29.83
80	Raj 4083 (C)	56.00	14.66	35.33
80A	IWP 72 (C) for BWM	98.00	23.66	60.83
81	UAS 428 (d) (C)	40.00	18.66	29.33
82	CoW(W) 1 (C)	28.00	20.66	24.33
83	HW 2044 (C)	20.00	18.33	19.17
84	HW 5216 (C)	35.00	20.00	27.50
85	DDK 1042	65.00	18.66	41.83
86	MACS 5022	45.00	14.33	29.67
87	DDK 1029 (C)	31.00	17.66	24.33
88	HW 1098 (I) (C)	61.00	18.33	39.67
89	Kharchia 65 (C)	15.00	19.00	17.00
90	KRL 19 (C)	26.00	20.66	23.33
91	KRL 210 (C)	40.00	18.00	29.00
92	MACS 2496 (C)	51.00	20.66	35.83
93	MACS 2971 (C)	65.00	20.33	42.67

Table 10.3b. Brown wheat mite screening nursery: AVT I year lines. (Year-2013-14)

S. No.	Entry	No. of mites/10cmsq area		Average
		Ludhiana	Durgapura	
1	HPW 373	20.00	17.66	18.83
2	HPW 400	12.00	18.33	15.17
3	HPW 401	15.00	16.33	15.67
4	HPW 410	25.00	18.00	21.50
5	HPW 411	45.00	20.66	32.83
6	HPW 412	31.00	20.00	25.50
7	HS 547	25.00	18.00	21.50
8	HS 558	28.00	-	28.00
9	HS 562	51.00	-	51.00
10	HS 577	25.00	20.66	22.83
11	HS 590	20.00	18..66	20.00
12	HS 591	40.00	18.33	29.17
13	HS 592	20.00	20.00	20.00
14	HS 593	30.00	18.00	24.00
15	HS 594	17.00	16.00	16.50
16	HS 595	25.00	20.00	22.50
17	UP 2890	51.00	12.66	31.83
18	UP 2891	41.00	20.66	30.83
19	VL 976	60.00	18.33	39.17
20	VL 977	66.00	20.00	43.00
20A	IWP 72 (C) for BWM	89.00	23.33	56.17
21	VL 1003	45.00	20.00	32.50
22	VL 1004	28.00	16.66	22.33
23	VL 3002	12.00	16.00	14.00
24	VL 3004	45.00	18.33	31.67
25	VL 3005	25.00	18.00	21.50
26	VL 3006	18.00	20.00	19.00
27	DBW 95	33.00	18.33	25.67
28	DBW 128	28.00	19.66	23.83
29	DBW 129	15.00	18.33	16.67
30	HD 3128	30.00	15.00	22.50
31	HD 3132	32.00	20.66	26.33
32	HD 3133	22.00	-	22.00
33	HD 3139	40.00	-	40.00
34	HD 4730	28.00	14.66	21.33
35	HUW 675	50.00	15.33	32.67
36	K 1204	18.00	20.00	19.00
37	MP 1277	20.00	15.00	17.50
38	PBW 677	25.00	13.66	19.33
39	PBW 692	25.00	14.66	19.83
40	PBW 695	15.00	16.00	15.50
40A	IWP 72 (C) for BWM	78.00	20.33	49.17
41	PBW 697	80.00	19.66	49.83
42	PBW 698	40.00	18.00	29.00
43	PBW 702	25.00	15.66	20.33
44	PBW 703	33.00	16.00	24.50
45	PBW 706	71.00	15.33	43.17
46	TL 2995	18.00	15.66	16.83
47	UAS 356	21.00	18.00	19.50
48	WH 1154	20.00	20.66	20.33

S. No.	Entry	No. of mites/10cmsq area		Average
		Ludhiana	Durgapura	
49	WH 1156	25.00	19.66	22.33
50	WH 1157	41.00	18.00	29.50
51	WH 1164	32.00	18.66	25.33
52	DBW 126	70.00	17.66	43.83
53	DBW 98	28.00	20.00	24.00
54	HD 3127	50.00	21.33	35.67
55	HUW 661	35.00	20.00	27.50
56	HUW 677	61.00	18.33	39.67
57	HUW 679	25.00	17.66	21.33
58	PBW 693	45.00	19.66	32.33
59	PBW 701	36.00	16.66	26.33
60	PBW 704	55.00	15.66	35.33
60A	IWP 72 (C) for BWM	88.00	22.66	55.33
61	UP 2855	60.00	16.33	38.17
62	WH 1132	70.00	18.66	44.33
63	CG 1010	40.00	20.00	30.00
64	DDW 30 (D)	28.00	15.66	21.83
65	GW 451	35.00	17.66	26.33
66	GW 455	61.00	18.33	39.67
67	HD 3146	91.00	18.00	54.50
68	HD 4728 (D)	110.00	18.66	64.33
69	HI 8750 (D)	9.00	18.33	13.67
70	HI 8755 (D)	41.00	18.00	29.50
71	K 1215	44.00	18.66	31.33
72	K 1217	36.00	18.00	27.00
73	MACS 3916 (D)	20.00	20.00	20.00
74	MACS 3927 (D)	10.00	18.33	14.17
75	MACS 6604	22.00	21.66	21.83
76	MP 1279	30.00	22.00	26.00
77	NIAW 2030	25.00	20.66	22.83
78	UAS 451 (D)	45.00	18.00	31.50
79	DDW 27 (D)	61.00	17.66	39.33
80	HI 8751 (D)	35.00	16.33	25.67
80A	IWP 72 (C) for BWM	121.00	19.33	70.17
81	HI 8754 (D)	56.00	18.00	37.00
82	K 1213	52.00	16.33	34.17
83	UP 2864	77.00	14.66	45.83
84	MACS 6507	91.00	20.00	55.50
85	UAS 358	29.00	16.66	22.83
86	DBW 154	40.00	18.33	29.17
87	DBW 155	65.00	20.00	42.50
88	MACS 5040	46.00	18.00	32.00
89	MACS 5031	36.00	20.00	28.00
90	DDK 1046	70.00	18.00	44.00
91	DDK 1044	91.00	20.00	55.50
92	HW 1099	40.00	20.00	30.00
93	TL 2996	51.00	18.00	34.50
94	TL 2997	29.00	17.66	23.33
95	TL 2998	60.00	18.00	39.00
96	TL 2999	82.00	17.33	49.67
97	TL 3000	91.00	17.00	54.00
98	TL 2942 (C)	44.00	18.66	31.33

S. No.	Entry	No. of mites/10cmsq area		Average
		Ludhiana	Durgapura	
99	TL 2969 (C)	71.00	20.00	45.50
100	PBW 722	64.00	20.00	42.00
100A	IWP 72 (C) for BWM	88.00	22.66	55.33
101	PBW 723	53.00	20.66	36.83
102	KB 2012-03	52.00	20.33	36.17
103	HD 2932+Sr26	46.00	28.66	37.33
104	HD 2932-Lr19/Sr25	89.00	17.00	53.00
105	MMBL 283	66.00	20.33	43.17
106	HUW 234 (C)	101.00	20.66	60.83
107	PBW 343 (C)	110.00	18.00	64.00

(1c) Screening nursery for foliar wheat aphid

The foliar wheat aphid screenings nursery consisting of 93 AVT II and 107 AVT I year genotypes were screened at four locations *viz.,* Niphad, Ludhiana, Shillongani and Karnal. At Kanpur, the pest did not appeared so the data were not considered. Aphid count/shoot were recorded at weekly interval from all these genotypes and grades were given according to 5 point system as described below:

Grade	Approx. numbers of aphids/shoot	Rating
1	0	Immune
2	1-5	Resistant
3	6-10	Moderately resistant
4	11-20	Susceptible
5	21 and above	Highly susceptible

The data suggest that the aphid incidence was good at all the locations *viz.* Niphad, Ludhiana, Shillongani and Karnal. Of 93 AVT II and 107 AVT I year genotypes, all were susceptible to highly susceptible against foliar wheat aphids (Table 10.4a and 10.4b).

Table 10.4a: Screening against foliar wheat aphids: AVT II year lines. (Year-2013-14)

S.No.	Entry	Aphid score (1-5)				AV	HS
		Niphad	Ludhiana	Shillongani	Karnal		
1	HPW 376	4	5	4	5	4.5	5
2	VL 967	4	4	4	5	4.3	5
3	HPW 251 (C)	4	4	4	5	4.3	5
4	HPW 349 (C)	5	4	4	5	4.5	5
5	HS 277 (C)	4	4	4	5	4.3	5
6	HS 375 (C)	4	4	4	5	4.3	5
7	HS 490 (C)	4	4	4	5	4.3	5
8	HS 507 (C)	3	4	4	5	4.0	5
9	HS 542 (I) (C)	3	4	4	5	4.0	5
10	VL 804 (C)	4	4	3	5	4.0	5
11	VL 829 (C)	3	4	4	5	4.0	5
12	VL 892 (C)	4	4	4	5	4.3	5
13	VL 907 (C)	5	5	4	5	4.8	5
14	HUW 666	5	4	4	5	4.5	5
15	PBW 681	5	4	4	5	4.5	5
16	WH 1129	5	4	4	5	4.5	5

S.No.	Entry	Aphid score (1-5)				AV	HS
		Niphad	Ludhiana	Shillongani	Karnal		
17	WH 1138	4	4	4	5	4.3	5
18	WH 1142	4	5	4	5	4.5	5
19	DBW 88 (I) (C)	4	5	4	5	4.5	5
20	DBW 90 (I) (C)	4	5	4	5	4.5	5
20A	A 9-30-1 (C) for FA	5	5	4	5	4.8	5
21	DPW 621-50 (C)	5	4	5	5	4.8	5
22	HD 2967 (C)	5	4	5	5	4.8	5
23	HD 3043 (C)	5	4	4	5	4.5	5
24	HD 3059 (C)	4	4	4	5	4.3	5
25	HD 3086 (I) (C)	4	5	4	5	4.5	5
26	PBW 590 (C)	5	5	4	5	4.8	5
27	PBW 644 (C)	4	5	4	5	4.5	5
28	PBW 660 (I) (C)	4	5	3	5	4.3	5
29	PDW 233 (C)	4	5	3	5	4.3	5
30	PDW 291 (C)	4	5	4	5	4.5	5
31	PDW 314 (C)	4	5	4	5	4.5	5
32	WH 1021 (C)	4	4	4	5	4.3	5
33	WH 1080 (C)	4	5	4	5	4.5	5
34	WH 1105 (C)	4	5	4	5	4.5	5
35	WH 1124 (I) (C)	4	4	4	5	4.3	5
36	BRW 3723	3	4	5	5	4.3	5
37	DBW 107	4	4	4	5	4.3	5
38	HD 3118	5	5	4	5	4.8	5
39	K 1114	5	4	4	5	4.5	5
40	C 306 (C)	4	5	4	5	4.5	5
40A	A 9-30-1 (C) for FA	5	5	3	5	4.5	5
41	DBW 14 (C)	4	4	4	5	4.3	5
42	DBW 39 (C)	5	4	4	5	4.5	5
43	HD 2733 (C)	5	4	5	5	4.8	5
44	HD 2888 (C)	5	4	4	5	4.5	5
45	HD 2985 (C)	5	5	4	5	4.8	5
46	HI 1563 (C)	5	5	4	5	4.8	5
47	K 0307 (C)	4	5	4	5	4.5	5
48	K 1006 (I) (C)	4	5	3	5	4.3	5
49	K 8027 (C)	4	5	4	5	4.5	5
50	NW 2036 (C)	4	5	4	5	4.5	5
51	NW 5054 (I) (C)	3	5	4	5	4.3	5
52	DBW 110	4	4	4	5	4.3	5
53	HI 8736 (D)	5	5	4	5	4.8	5
54	HI 8737 (D)	4	5	5	5	4.8	5
55	MP 3382	4	5	4	5	4.5	5
56	NIAW 1885	4	5	4	5	4.5	5
57	PBW 689	4	5	4	5	4.5	5
58	A 9-30-1 (D) (C)	4	5	4	5	4.5	5
59	GW 322 (C)	4	5	4	5	4.5	5
60	HD 2864 (C)	4	5	4	5	4.5	5
60A	A 9-30-1 (C) for FA	5	5	4	5	4.8	5
61	HD 2932 (C)	3	4	4	5	4.0	5
62	HI 1500 (C)	3	5	5	5	4.5	5
63	HI 1544 (C)	3	5	4	5	4.3	5
64	HI 8498 (D) (C)	3	5	4	5	4.3	5
65	HI 8627 (D) (C)	3	4	4	5	4.0	5

S.No.	Entry	Aphid score (1-5)				AV	HS
		Niphad	Ludhiana	Shillongani	Karnal		
66	MP 3288 (C)	3	4	4	5	4.0	5
67	MP 3336 (C)	3	4	4	5	4.0	5
68	MP 4010 (C)	3	5	4	5	4.3	5
69	MPO 1215 (d) (C)	3	5	3	5	4.0	5
70	NIAW 1994	3	5	4	5	4.3	5
71	UAS 347	3	4	4	5	4.0	5
72	UAS 446 (D)	3	4	4	5	4.0	5
73	AKDW 2997-16(d) (C)	4	4	4	5	4.3	5
74	HD 3090 (I) (C)	4	5	4	5	4.5	5
75	MACS 6222 (C)	4	5	4	5	4.5	5
76	MACS 6478 (C)	4	5	4	5	4.5	5
77	NI 5439 (C)	4	5	4	5	4.5	5
78	NIAW 1415 (C)	4	5	4	5	4.5	5
79	NIDW 295 (d) (C)	4	5	4	5	4.5	5
80	Raj 4083 (C)	3	4	4	5	4.0	5
80A	A 9-30-1 (C) for FA	5	5	4	5	4.8	5
81	UAS 428 (d) (C)	3	5	4	5	4.3	5
82	CoW(W) 1 (C)	3	5	4	5	4.3	5
83	HW 2044 (C)	3	4	4	5	4.0	5
84	HW 5216 (C)	3	4	4	5	4.0	5
85	DDK 1042	5	5	4	5	4.8	5
86	MACS 5022	3	5	4	5	4.3	5
87	DDK 1029 (C)	4	5	4	5	4.5	5
88	HW 1098 (I) (C)	5	5	3	5	4.5	5
89	Kharchia 65 (C)	4	4	4	5	4.3	5
90	KRL 19 (C)	3	4	3	5	3.8	5
91	KRL 210 (C)	4	5	4	5	4.5	5
92	MACS 2496 (C)	3	4	4	5	4.0	5
93	MACS 2971 (C)	3	4	4	5	4.0	5

Table 10.4b: Screening against foliar wheat aphid: AVT I year lines. Year-2013-14)

S.No.	Variety	Aphid score (1-5)				AV	HS
		Niphad	Ludhiana	Shillongani	Karnal		
1	HPW 373	4	5	4	5	4.5	5
2	HPW 400	4	5	4	5	4.5	5
3	HPW 401	4	5	4	5	4.5	5
4	HPW 410	4	4	4	5	4.3	5
5	HPW 411	5	4	4	5	4.5	5
6	HPW 412	4	4	3	5	4.0	5
7	HS 547	4	5	4	5	4.5	5
8	HS 558	4	5	4	5	4.5	5
9	HS 562	4	4	5	5	4.5	5
10	HS 577	5	4	5	5	4.8	5
11	HS 590	4	4	4	5	4.3	5
12	HS 591	4	5	4	5	4.5	5
13	HS 592	3	5	4	5	4.3	5
14	HS 593	3	5	4	5	4.3	5
15	HS 594	3	3	4	5	3.8	5
16	HS 595	5	4	4	5	4.5	5
17	UP 2890	3	4	4	5	4.0	5
18	UP 2891	3	4	4	5	4.0	5

S.No.	Variety	Aphid score (1-5)				AV	HS
		Niphad	Ludhiana	Shillongani	Karnal		
19	VL 976	4	5	3	5	4.3	5
20	VL 977	3	5	4	5	4.3	5
20A	A 9-30-1 (C) for FA	5	5	4	5	4.8	5
21	VL 1003	4	5	5	5	4.8	5
22	VL 1004	5	5	5	5	5.0	5
23	VL 3002	4	5	4	5	4.5	5
24	VL 3004	5	4	4	5	4.5	5
25	VL 3005	4	4	4	5	4.3	5
26	VL 3006	5	4	4	5	4.5	5
27	DBW 95	4	5	4	5	4.5	5
28	DBW 128	5	5	4	5	4.8	5
29	DBW 129	4	4	4	5	4.3	5
30	HD 3128	4	5	4	5	4.5	5
31	HD 3132	5	5	4	5	4.8	5
32	HD 3133	4	5	4	5	4.5	5
33	HD 3139	5	4	4	5	4.5	5
34	HD 4730	3	4	4	5	4.0	5
35	HUW 675	4	4	5	5	4.5	5
36	K 1204	4	5	5	5	4.8	5
37	MP 1277	4	5	5	5	4.8	5
38	PBW 677	3	5	5	5	4.5	5
39	PBW 692	5	4	4	5	4.5	5
40	PBW 695	5	4	4	5	4.5	5
40A	A 9-30-1 (C) for FA	5	5	4	5	4.8	5
41	PBW 697	5	4	4	5	4.5	5
42	PBW 698	5	4	4	5	4.5	5
43	PBW 702	5	4	4	5	4.5	5
44	PBW 703	5	5	4	5	4.8	5
45	PBW 706	5	5	4	5	4.8	5
46	TL 2995	5	4	3	5	4.3	5
47	UAS 356	5	4	4	5	4.5	5
48	WH 1154	5	4	4	5	4.5	5
49	WH 1156	5	5	4	5	4.8	5
50	WH 1157	4	5	5	5	4.8	5
51	WH 1164	5	5	4	5	4.8	5
52	DBW 126	5	5	4	5	4.8	5
53	DBW 98	5	5	4	5	4.8	5
54	HD 3127	5	4	4	5	4.5	5
55	HUW 661	5	4	5	5	4.8	5
56	HUW 677	4	5	5	5	4.8	5
57	HUW 679	5	5	4	5	4.8	5
58	PBW 693	4	5	4	5	4.5	5
59	PBW 701	5	5	3	5	4.5	5
60	PBW 704	5	4	4	5	4.5	5
60A	A 9-30-1 (C) for FA	5	5	4	5	4.8	5
61	UP 2855	5	5	4	5	4.8	5
62	WH 1132	5	5	3	5	4.5	5
63	CG 1010	4	4	4	5	4.3	5
64	DDW 30 (D)	4	5	4	5	4.5	5
65	GW 451	5	5	4	5	4.8	5
66	GW 455	5	5	4	5	4.8	5

S.No.	Variety	Aphid score (1-5)				AV	HS
		Niphad	Ludhiana	Shillongani	Karnal		
67	HD 3146	5	5	4	5	4.8	5
68	HD 4728 (D)	5	4	4	5	4.5	5
69	HI 8750 (D)	5	5	4	5	4.8	5
70	HI 8755 (D)	4	5	4	5	4.5	5
71	K 1215	5	4	3	5	4.3	5
72	K 1217	5	5	3	5	4.5	5
73	MACS 3916 (D)	5	5	4	5	4.8	5
74	MACS 3927 (D)	5	4	4	5	4.5	5
75	MACS 6604	5	5	4	5	4.8	5
76	MP 1279	5	5	4	5	4.8	5
77	NIAW 2030	4	5	4	5	4.5	5
78	UAS 451 (D)	4	4	4	5	4.3	5
79	DDW 27 (D)	4	5	4	5	4.5	5
80	HI 8751 (D)	4	5	4	5	4.5	5
80A	A 9-30-1 (C) for FA	5	5	3	5	4.5	5
81	HI 8754 (D)	4	4	4	5	4.3	5
82	K 1213	5	4	4	5	4.5	5
83	UP 2864	5	4	5	5	4.8	5
84	MACS 6507	4	5	4	5	4.5	5
85	UAS 358	5	5	4	5	4.8	5
86	DBW 154	5	4	4	5	4.5	5
87	DBW 155	4	4	4	5	4.3	5
88	MACS 5040	3	5	3	5	4.0	5
89	MACS 5031	4	5	3	5	4.3	5
90	DDK 1046	5	4	4	5	4.5	5
91	DDK 1044	5	5	4	5	4.8	5
92	HW 1099	5	5	3	5	4.5	5
93	TL 2996	5	5	4	5	4.8	5
94	TL 2997	4	4	4	5	4.3	5
95	TL 2998	4	5	5	5	4.8	5
96	TL 2999	4	5	5	5	4.8	5
97	TL 3000	4	4	4	5	4.3	5
98	TL 2942 (C)	4	5	4	5	4.5	5
99	TL 2969 (C)	5	5	3	5	4.5	5
100	PBW 722	3	5	4	5	4.3	5
100A	A 9-30-1 (C) for FA	5	5	4	5	4.8	5
101	PBW 723	4	5	4	5	4.5	5
102	KB 2012-03	4	4	4	5	4.3	5
103	HD 2932+Sr26	4	5	4	5	4.5	5
104	HD 2932-Lr19/Sr25	5	5	4	5	4.8	5
105	MMBL 283	5	5	4	5	4.8	5
106	HUW 234 (C)	5	4	4	5	4.5	5
107	PBW 343 (C)	5	5	4	5	4.8	5

*** Kanpur cooperative centre Aphid were not observed**

(1d): Screening nursery for root aphid of wheat.

The screening nursery for root aphid was consisted of 93 AVT II year and 107 AVT I year entries. The data was collected from Ludhiana, Entkhedi and Karnal centre for each entry by uprooting the seedling when the crop was 3-4 weeks old. Though the material was screened at Kanpur and Niphad, the pest did not appear and the data was not considered. Of the 93 AVT II year genotypes, none of the line was resistant, while four genotypes VL 892 (C), DBW 107, NIAW 1885 and NIAW 1994 were moderately resistant and rest of them were susceptible (grade 4) or highly susceptible (grade 5) against wheat root aphids (Table 10.5a). Among 107 AVT I year genotypes, none of the line was resistant, while eight genotypes, HD 2932-Lr19/Sr25, KB 2012-03, PBW 723, UAS 451 (D), PBW 692, HD 3128, VL 3002 and VL 1004 were moderately resistant while all other were susceptible (grade 4) or highly susceptible (grade 5) against wheat root aphids (10.5b).

Table 10.5a: Screening of AVT II material against root aphid of wheat.(Year-2013-14)

S. No.	Entry	Root Aphid Score (1-5)			Average	HS
		Ludhiana	Entkhedi	Karnal		
1	HPW 376	4	3	3	3.3	4
2	VL 967	4	2	3	3.0	4
3	HPW 251 (C)	4	3	3	3.3	4
4	HPW 349 (C)	4	2	3	3.0	4
5	HS 277 (C)	4	2	3	3.0	4
6	HS 375 (C)	4	3	4	3.7	4
7	HS 490 (C)	4	3	3	3.3	4
8	HS 507 (C)	5	2	3	3.3	5
9	HS 542 (I) (C)	5	2	4	3.7	5
10	VL 804 (C)	4	3	3	3.3	4
11	VL 829 (C)	4	2	3	3.0	4
12	VL 892 (C)	3	2	3	2.7	3
13	VL 907 (C)	4	2	3	3.0	4
14	HUW 666	4	3	3	3.3	4
15	PBW 681	4	2	3	3.0	4
16	WH 1129	4	3	3	3.3	4
17	WH 1138	3	2	3	2.7	3
18	WH 1142	4	3	3	3.3	4
19	DBW 88 (I) (C)	4	2	3	3.0	4
20	DBW 90 (I) (C)	4	3	3	3.3	4
20A	GW 173 (C) for RA	5	4	3	4.0	5
21	DPW 621-50 (C)	4	3	3	3.3	4
22	HD 2967 (C)	4	3	3	3.3	4
23	HD 3043 (C)	4	2	3	3.0	4
24	HD 3059 (C)	3	3	4	3.3	4
25	HD 3086 (I) (C)	4	2	3	3.0	4
26	PBW 590 (C)	4	2	4	3.3	4
27	PBW 644 (C)	4	2	3	3.0	4
28	PBW 660 (I) (C)	2	3	4	3.0	4
29	PDW 233 (C)	4	2	4	3.3	4
30	PDW 291 (C)	4	2	3	3.0	4
31	PDW 314 (C)	4	2	3	3.0	4
32	WH 1021 (C)	5	3	3	3.7	5
33	WH 1080 (C)	5	2	3	3.3	5
34	WH 1105 (C)	4	3	3	3.3	4
35	WH 1124 (I) (C)	4	3	3	3.3	4
36	BRW 3723	4	2	3	3.0	4
37	DBW 107	3	3	3	3.0	3
38	HD 3118	4	3	3	3.3	4
39	K 1114	4	3	3	3.3	4
40	C 306 (C)	4	3	3	3.3	4
40A	GW 173 (C) for RA	4	3	4	3.7	4

S. No.	Entry	Root Aphid Score (1-5)			Average	HS
		Ludhiana	Entkhedi	Karnal		
41	DBW 14 (C)	4	2	3	3.0	4
42	DBW 39 (C)	4	4	3	3.7	4
43	HD 2733 (C)	4	5	3	4.0	4
44	HD 2888 (C)	5	3	3	3.7	5
45	HD 2985 (C)	4	4	4	4.0	4
46	HI 1563 (C)	4	3	3	3.3	4
47	K 0307 (C)	4	2	3	3.0	4
48	K 1006 (I) (C)	3	3	3	3.0	3
49	K 8027 (C)	4	2	3	3.0	4
50	NW 2036 (C)	4	3	3	3.3	4
51	NW 5054 (I) (C)	4	2	3	3.0	4
52	DBW 110	4	2	4	3.3	4
53	HI 8736 (D)	4	3	3	3.3	4
54	HI 8737 (D)	4	4	3	3.7	4
55	MP 3382	4	4	3	3.7	4
56	NIAW 1885	3	3	3	3.0	3
57	PBW 689	4	2	3	3.0	4
58	A 9-30-1 (D) (C)	4	2	3	3.0	4
59	GW 322 (C)	4	3	4	3.7	4
60	HD 2864 (C)	4	3	4	3.7	4
60A	GW 173 (C) for RA	4	3	4	3.7	4
61	HD 2932 (C)	5	3	3	3.7	5
62	HI 1500 (C)	4	2	4	3.3	4
63	HI 1544 (C)	4	2	3	3.0	4
64	HI 8498 (D) (C)	4	3	3	3.3	4
65	HI 8627 (D) (C)	4	2	3	3.0	4
66	MP 3288 (C)	4	3	4	3.7	4
67	MP 3336 (C)	4	3	3	3.3	4
68	MP 4010 (C)	4	4	4	4.0	4
69	MPO 1215 (d) (C)	4	4	3	3.7	4
70	NIAW 1994	3	3	3	3.0	3
71	UAS 347	4	2	4	3.3	4
72	UAS 446 (D)	4	3	4	3.7	4
73	AKDW 2997-16(d) (C)	4	3	3	3.3	4
74	HD 3090 (I) (C)	4	2	3	3.0	4
75	MACS 6222 (C)	4	2	3	3.0	4
76	MACS 6478 (C)	4	3	3	3.3	4
77	NI 5439 (C)	5	3	4	4.0	5
78	NIAW 1415 (C)	4	2	3	3.0	4
79	NIDW 295 (d) (C)	4	2	3	3.0	4
80	Raj 4083 (C)	4	2	3	3.0	4
80A	GW 173 (C) for RA	5	3	3	3.7	5
81	UAS 428 (d) (C)	4	2	4	3.3	4
82	CoW(W) 1 (C)	4	2	3	3.0	4
83	HW 2044 (C)	4	2	4	3.3	4
84	HW 5216 (C)	4	3	3	3.3	4
85	DDK 1042	4	2	3	3.0	4
86	MACS 5022	5	3	4	4.0	5
87	DDK 1029 (C)	4	3	4	3.7	4
88	HW 1098 (I) (C)	4	3	4	3.7	4
89	Kharchia 65 (C)	4	3	4	3.7	4
90	KRL 19 (C)	5	3	4	4.0	5

S. No.	Entry	Root Aphid Score (1-5)			Average	HS
		Ludhiana	Entkhedi	Karnal		
91	KRL 210 (C)	4	2	4	3.3	4
92	MACS 2496 (C)	4	2	4	3.3	4
93	MACS 2971 (C)	4	2	3	3.0	4

Table 10.5b. Screening of AVT I material against root aphid of wheat.(Year-2013-14)

S. No.	Entry	Root Aphid Score (1-5)			Average	HS
		Ludhiana	Entkhedi	Karnal		
1	HPW 373	5	2	3	3.3	5
2	HPW 400	4	2	3	3.0	4
3	HPW 401	4	3	3	3.3	4
4	HPW 410	4	2	3	3.0	4
5	HPW 411	5	2	3	3.3	5
6	HPW 412	4	2	4	3.3	4
7	HS 547	4	2	4	3.3	4
8	HS 558	4	2	4	3.3	4
9	HS 562	4	2	4	3.3	4
10	HS 577	4	2	4	3.3	4
11	HS 590	4	3	3	3.3	4
12	HS 591	4	2	3	3.0	4
13	HS 592	4	2	3	3.0	4
14	HS 593	5	2	3	3.3	5
15	HS 594	4	2	4	3.3	4
16	HS 595	4	2	4	3.3	4
17	UP 2890	4	2	4	3.3	4
18	UP 2891	4	2	3	3.0	4
19	VL 976	5	2	3	3.3	5
20	VL 977	4	2	3	3.0	4
20A	GW 173 (C) for RA	5	3	4	4.0	5
21	VL 1003	4	3	3	3.3	4
22	VL 1004	3	3	3	3.0	3
23	VL 3002	3	2	4	3.0	3
24	VL 3004	4	2	4	3.3	4
25	VL 3005	4	3	3	3.3	4
26	VL 3006	4	2	3	3.0	4
27	DBW 95	4	2	4	3.3	4
28	DBW 128	4	2	4	3.3	4
29	DBW 129	5	3	3	3.7	5
30	HD 3128	3	2	3	2.7	3
31	HD 3132	4	2	4	3.3	4
32	HD 3133	4	2	4	3.3	4
33	HD 3139	4	2	4	3.3	4
34	HD 4730	4	-	4	4.0	4
35	HUW 675	3	2	4	3.0	4
36	K 1204	4	2	4	3.3	4
37	MP 1277	4	2	4	3.3	4
38	PBW 677	4	3	3	3.3	4
39	PBW 692	3	2	3	3.0	3
40	PBW 695	-	2	3	2.7	-
40A	GW 173 (C) for RA	4	3	4	3.7	4
41	PBW 697	5	2	4	3.3	5
42	PBW 698	4	3	3	3.7	4
43	PBW 702	4	2	3	3.0	4

S. No.	Entry	Root Aphid Score (1-5)			Average	HS
		Ludhiana	Entkhedi	Karnal		
44	PBW 703	4	2	4	3.3	4
45	PBW 706	4	2	3	3.0	4
46	TL 2995	4	2	4	3.3	4
47	UAS 356	4	2	4	3.3	4
48	WH 1154	4	2	4	3.3	4
49	WH 1156	4	3	4	3.7	4
50	WH 1157	5	2	4	3.3	5
51	WH 1164	4	2	4	3.7	4
52	DBW 126	4	2	3	3.0	4
53	DBW 98	4	2	4	3.3	4
54	HD 3127	4	2	4	3.3	4
55	HUW 661	5	2	3	3.0	5
56	HUW 677	5	2	4	3.7	5
57	HUW 679	4	2	4	3.7	4
58	PBW 693	4	2	4	3.3	4
59	PBW 701	3	3	4	3.7	4
60	PBW 704	-	2	4	3.0	-
60A	GW 173 (C) for RA	4	3	4	3.7	4
61	UP 2855	4	3	3	3.3	4
62	WH 1132	4	2	4	3.3	4
63	CG 1010	4	2	3	3.0	4
64	DDW 30 (D)	5	2	3	3.3	5
65	GW 451	4	2	4	3.3	4
66	GW 455	4	2	3	3.0	4
67	HD 3146	4	3	3	3.3	4
68	HD 4728 (D)	4	3	4	3.7	4
69	HI 8750 (D)	4	4	3	3.7	4
70	HI 8755 (D)	4	3	4	3.7	4
71	K 1215	4	3	3	3.3	4
72	K 1217	5	4	4	4.3	5
73	MACS 3916 (D)	5	2	3	3.3	5
74	MACS 3927 (D)	4	2	4	3.3	4
75	MACS 6604	4	4	4	4.0	4
76	MP 1279	4	3	4	3.7	4
77	NIAW 2030	4	3	4	3.7	4
78	UAS 451 (D)	3	3	3	3.0	3
79	DDW 27 (D)	4	4	3	3.7	4
80	HI 8751 (D)	4	2	4	3.3	4
80A	GW 173 (C) for RA	4	3	4	3.7	4
81	HI 8754 (D)	4	2	4	3.3	4
82	K 1213	5	-	4	4.5	5
83	UP 2864	4	3	4	3.7	4
84	MACS 6507	4	2	3	3.0	4
85	UAS 358	5	2	3	3.3	5
86	DBW 154	4	2	3	3.0	4
87	DBW 155	4	2	4	3.3	4
88	MACS 5040	4	2	4	3.3	4
89	MACS 5031	4	2	3	3.0	4
90	DDK 1046	4	3	3	3.3	4
91	DDK 1044	4	2	4	3.3	4
92	HW 1099	5	2	3	3.3	5
93	TL 2996	4	2	4	3.3	4

S. No.	Entry	Root Aphid Score (1-5)			Average	HS
		Ludhiana	Entkhedi	Karnal		
94	TL 2997	4	2	3	3.0	4
95	TL 2998	4	2	3	3.0	4
96	TL 2999	5	3	3	3.7	5
97	TL 3000	4	4	3	3.7	4
98	TL 2942 (C)	3	3	4	3.3	4
99	TL 2969 (C)	4	2	3	3.0	4
100	PBW 722	4	3	3	3.3	4
100A	GW 173 (C) for RA	4	3	4	3.7	4
101	PBW 723	3	3	3	3.0	3
102	KB 2012-03	3	3	3	3.0	3
103	HD 2932+Sr26	4	2	3	3.0	4
104	HD 2932-Lr19/Sr25	3	3	3	3.0	3
105	MMBL 283	4	4	4	4.0	4
106	HUW 234 (C)	4	4	4	4.0	4
107	PBW 343 (C)	4	2	4	3.3	4

*** Kanpur and Niphad cooperative centre root aphid were not observed**

EXPT.2 MULTIPLE PEST SCREENING NURSERY

Given in plant pathology section of this report.

10.2 CHEMICAL CONTROL

I: Effect of insecticidal seed treatment on germination, termite damage and yield.

All the treatments were done a day before sowing. The EC formulations equivalent to a.i. amounts, were diluted with water to desired concentration and sprayed with hand sprayer over seed uniformly spread in a tray or polythene sheet on *pucca* floor. The seed were turned over frequently to ensure proper application and left over night for drying.

Observations Recorded:

1. Earmarked five spots of 2m-row length in each plot and counted the total number of seedlings three weeks after sowing (for subsequent germination, the observations may be deferred till few days after first irrigation) and data was presented as plant population per meter row in final table.
2. Recorded the total number of affected and healthy tillers in these spots at 3,4 and 5 weeks after sowing. Also recorded total number of effective tillers and those damaged in these spots at crop maturity and given as % damaged effective tillers / m row. For analysis, angular transformations of the percentages were used.
3. When the crop was nearing maturity but still green, then damaged ear heads were counted and removed. The total number of damaged ear heads from net plot (except the two border rows and 25 cm space at each end but inclusive of the damaged ear heads in premarked spots) was expressed as number of effective damaged tillers per hectare.
4. Recorded grain yield (a) from pre marked spots and expressed in g/m row length (b) from net plot (including the pre marked spots) and expressed in q/ha.
5. In the final table, the mean values followed by alphabets indices were given to denote statistical variations based on C.D. values.
6. This trial was not conducted at Bansathali centres

7. The details of results at each experimental site are given below:

Centre: Durgapura

An experiment was carried out at RARI, Durgapura, Jaipur to studies the effect of insecticidal seed treatments on the termite control in wheat crop under irrigated conditions and the results are summarized in Table10.6. The Wheat variety Raj-4229 was sown on 22.11.2013. Seeds were properly treated with seven insecticidal formulations one day before sowing separately by spraying on the spread layer of equal quantity of seed on polythene sheet. The treated seed was dried over night before sowing. There were eight treatments including untreated check and each was replicated thrice. For recording observations the plant population and damaged plant, five spots of 2-meter row length each, were earmarked in each plot. The plant population/m row counts were made after 3 weeks of sowing revealed that non-significant difference among all the treatments. Hence, none of the treatments affected the seed germination. No termite damage was observed during 3 to 4 weeks after sowing. However, after 5 weeks of sowing the maximum percent damage shoots/m row was observed (1.30:7.26) in untreated check, whereas it was minimum in the treatment of imidacloprid 600 FS (0.03: 0.60), which was at par with fipronil 5% SC, clothianidin 50 WDG (0.06:1.21) and imidacloprid 17.8% SL (010:1.81), followed by thiamethoxam 35 FS and chlorantranilipride 18.5 SC. The seed treatment with carbosulfan 25 DS was also effective in termite management. The seed treatment with imidacloprid 600 FS was found best exhibiting lowest per cent damaged effective tillers/m row (0.43:3.74), at ear head stage/crop maturity, at par with clothianidin (0.53:4.04), imidacloprid and (0.50:4.04) and fipronil (0.56:4.31), followed by chlorantraniliprride and thiamethoxam treated plots. The carbosulfan treatment was also effective when compared with untreated check (14.03:22.00). On the basis of number of damaged effective tillers/ha the] highest damage was recorded in untreated check (225.00:50775). The lowest damage was observed in the imidacloprid 600 FS (59.00:3509), at par with clothianidin (63.33:4050), fipronil (69.00:4849) and imidacloprid 17.8% SL (70.00:4916) followed by thiamethoxam and chlorantranilipride treatment. The carbosulfan treatment was found least effective against termite as compared to other seed treatment.

The maximum grain yield (g/m row) was obtained in the plots treated with imidacloprid 600 FS (32.00), at par with clothianidin (30.33), imidacloprid 17.8% SL (30.00) and fipronil (29.00), followed by thiamethoxam (27.66) chlorantraniliprride (25.66) as compared to minimum yield obtained in untreated check (19.33). All the treatments were significantly better than untreated check. The grain yield data computed on q/ha basis revealed that the highest yield was obtained in imidacloprid 600 FS (30.52) at par with clothianidin (32.38), fipronil (30.32) and imidacloprid 17.8% SL (30.13) followed by thiamethoxam and chlorantraniliprride All other treatments were significantly better than untreated check. However, carbosulfan was in next order of production as compared to minimum yield (20.69) in untreated check. Hence, all the insecticidal seed treatments gave significantly higher grain yield over untreated check.

Centre: Ludhiana

This experiment was conducted in the rainfed fields at Plant Breeding Research Farm PAU Ludhiana. The wheat variety PBW 644 was sown on 6th Nov 2013. Before sowing, the seed was treated with eight different insecticides separately by spraying on the spreaded layer of equal quantity of seed on polyethene sheet. The treated seed was dried overnight before sowing. There were nine treatments including untreated check and each was replicated thrice. For recording observations on the plant population and damage plants, five spots of 2 m row lengths each, were ear marked in each plot.

The data presented in (Table 10.7) revealed that plant population / m row recorded after 3 weeks of germination was non-significant among all the treatments. Hence, none of treatment used, affected the seed germination. Per cent damaged effective tillers / m row after 3, 4 & 5 weeks of germination indicated that all the insecticidal treatments recorded significantly lower per cent damaged effective tillers/ m row than the untreated check.

At ear head stage, the per cent damaged effective tillers per meter row (in marked spots) were minimum in the plot treated with chlorantranilipride (0.22) and which was at par with all the other treatments except lower dosage of imidacloprid 600 FS and untreated check. The number of damaged effective tillers/ha was lowest (4166) in plots treated with imidacloprid 600 FS@ 1.5ml/kg of seed. All these insecticide treated plots recorded significantly lower number of damaged tillers/ha as compare to untreated check.

The maximum grain yield (g/m row) was obtained in the plot treated with imidacloprid 600 FS@ 1.5ml/kg of seed (72.66) and there were non-significant difference among all the treatment. The grain yield (q/ha) obtained from different treatments revealed that all the insecticide treated plots showed significantly higher yield than the untreated check, however imidacloprid 600 FS@ 1.5ml/kg treated plots recorded maximum yield (45.25).

Centre: Kanpur

The experiment was conducted at Research Farm, Nawabganj, Kanpur under rainfed condition in 23 rows of 4m length in R.B.D. with seven treatments replicated thrice (Table 10.8). The initial plant population counts indicated that seed treatments with different insecticides no effect on germination per cent. The incidence of termite after 3 weeks of sowing was not seen in any of the treatments, However incidence of termite after 4 weeks of sowing was not seen in any of the treatment, while in untreated plot it was 0.75 per cent. The incidence of termite after 5 weeks of sowing range from 0.36 to 0.77 per cent, while in untreated plot it was 3.08 per cent, significantly less damaged shoot were recorded in untreated plot with clothianidin 50WDG, fipronil 5 SC and imidacloprid 48 per cent which was at par chlorantranilipride, and imidacloprid 17.8 per cent. Minimum damage was recorded in the treated plots with clothianidin 50WDG, fipronil 5 SC and imidacloprid 48 per cent which did not differ significantly with chlorantranilipride and imidacloprid 17.8 per cent. All the insecticidal treatments showed, superiority over untreated checks in minimizing the per cent damaged effective tillers. The damaged number of effective tillers/ha in different treatments ranged from 3916.66 to 6166.66 while it was 15166.66 in untreated plots. The minimum damaged number of effective tillers/ha were recorded in clothianidin 50WDG, fipronil 5 SC and imidacloprid (48%) treated plot followed by chlorantranilipride and imidacloprid 17.8 per cent.

All the treatments showed minimum damaged number of effective tillers/ha as compared to untreated check. Grain yield g./m row and q/ha was significantly higher in treated plot with clothianidin 50WDG, fipronil 5SC and imidacloprid 48 per cent, followed by chlorantranilipride and imidacloprid 17.8 per cent.

The result concluded that insecticide clothianidin 50WDG, fipronil 5SC and imidacloprid 48 per cent were superior to chlorantranilipride 18.5 per cent and imidacloprid 17.8 per cent.

Centre: Vijapur

The experiment for the control of termite through seed treatment was laid out at Centre of Excellence for Research on Wheat, Vijapur under irrigated conditions and the results are presented in Table 10.9. The plant population/m row were counted after 3 weeks of sowing revealed non-significant differences among all the treatments. In confirmative test on germination, where the counted no. of seeds of different treatments were sown separately in small replicated trial under field conditions also showed non-significant difference. Hence, none of the insecticidal treatments affected the seed germination. The data further revealed that termite damage was not observed during 3 weeks after sowing in all the insecticidal treatments including check. No termite damage was noticed during 4 and 5 weeks after sowing, while, in untreated plot it was 0.78 and 2.28 per cent, respectively. The data on per cent damaged effective tillers per meter row showed no damage in fipronil treatments which differed significantly from rest of the treatments. However, the untreated check had significantly highest termite damage. On the basis of number of damaged effective tillers/ha, the highest damage was recorded in untreated check. Whereas, lowest damage was recorded in fipronil and was at par with imidacloprid 600 FS. The maximum grain yield (g/m row) was observed in the plot treated with imidacloprid 600 FS and fipronil followed by clothianidin, both doses of chlorantranilipride and imidacloprid 200 SL as compared to untreated check. The grain yield data computed on the basis of q/ha from different treatments indicated non-significant differences among the treatments. However, the maximum grain yield was obtained from fipronil treated plot.

Table10.6: Effect of insecticidal seed treatment on the germination, termite damage and yield 2013-14 (Location: Durgapura)

S. No	Treatments	Dose g a.i./ ml/kg seed	Plant population/m row	Per cent damaged shoots/m row after 5 weeks	Per cent damaged effective tillers/m row at ear head stage	No. of damaged effective tillers/ha	Grain yield	
							g/m row	q/ha
1	Imidacloprid 600 FS Gaucho	0.72g (1.5 ml)	31.73a	0.03 (0.60)a*	0.43 (3.74)a*	3509 (59.00)a*	32.00a	30.52a
2	Chlorantranilipride 18.5 SC Coragen	0.185g (1.0 ml)	31.53a	0.23 (2.75)b	1.30 (6.55)b	14041 (118.33)c	25.66b	24.30b
3	Clothianidin 50WDG Dantosau	0.75g (1.5g)	30.80a	0.06 (1.21)a	0.53 (4.04)a	4050 (63.33)a	30.33a	30.38a
4	Thiamethoxam 35 FS Cruiser	0.7g (2.0 ml)	30.93a	0.30 (3.06)b	1.50 (7.02)b	10016 (100.00)b	27.66b	26.25b
5	Carbosulfan 25DS Marshal	1.0g (4.0 ml)	31.00a	0.40 (3.61)b	3.06 (10.08)c	26241 (161.67)d	25.33c	23.14c
6	Imidacloprid 17.8 % SL Confidor	0.6g (3.0ml)	30.73a	0.10 (1.81)a	0.50 (4.04)a	4916 (70.00)a	30.00a	30.31a
7	Fipronil 5% SC Regent	0.3g (6.0ml)	31.47a	0.06 (1.21)a	0.56 (4.31)a	4849 (69.00)a	29.00a	30.32a
8	Untreated		30.73a	1.30 (7.26)c	14.03 (22.00)d	50775 (225.00)e	19.33d	20.69d
	S. Em ±	-	0.49	0.46	0.25	5.60	0.83	0.91
	CD at 5%	-	NS	1.40	0.76	17.00	2.53	2.76

* Transformed values, Figures within parenthesis represent actual mean values; Figures with same alphabets are statistically at par

Date of sowing	: 22.11.2013	Plot size Gross	: 8 x 3 m	No. of rows/plot	: 10
Date of insecticidal application	: 21.11.2013	Net	: 7.5 x 2.5 m	Design	: RBD
Date of plant population counts	: 21.12.2013	Variety	: Raj 4229	Replication	: 3
Date of harvest	: 08.04. 2014	Condition	: Irrigated		

Table 10.7 : Effect of insecticidal seed treatment on germination, termite damage and yield 2013-14 (Location: Ludhiana)

S. No	Treatments	Dose g a.i./ kg seed	Dose g or ml / Kg seed	Plant population/m row	Per cent damaged shoots/m row			Per cent damaged tillers/m row at ear head stage	No. of damaged effective tillers/ha	Grain yield	
					3 weeks	4 weeks	5 weeks			g/m row	q/ha
1	Imidacloprid 600 FS (Gaucho)	0.24	0.5 ml	47.40	0.54 (5.86)	0.58 (5.97)	0.56 (5.88)	0.39 (5.41)	5750 (75.68)	62.00	43.95
2	Imidacloprid 600 FS (Gaucho)	0.48	1.0 ml	47.93	0.22 (4.85)	0.22 (4.85)	0.27 (5.03)	0.32 (4.88)	4333 (65.79)	65.33	44.75
3	Imidacloprid 600 FS (Gaucho)	0.72	1.5 ml	46.86	0.20 (4.78)	0.21 (4.81)	0.26 (4.99)	0.28 (4.72)	4166 (64.43)	72.66	45.25
4	Clothianidin 50 WDS (Dantotsu)	0.75	1.5 g	47.26	0.36 (5.33)	0.38 (5.39)	0.45 (5.60)	0.32 (5.21)	6250 (78.98)	67.33	44.13
5	Chlorantranilipride 18.5 SC(Coragen)	0.185	1.0 ml	47.33	0.42 (5.50)	0.44 (5.55)	0.32 (5.16)	0.22 (4.85)	4750 (68.78)	68.66	43.56
6	Chlorantranilipride 18.5 SC(Coragen)	-	2.0 ml	47.20	0.20 (4.79)	0.38 (5.39)	0.25 (4.97)	0.15 (4.61)	4500 (66.96)	73.33	45.00
7	Thiamethoxam 70 WS (Cruiser)	0.7	1.0 g	46.46	0.30 (5.12)	0.36 (5.33)	0.24 (4.94)	0.27 (5.04)	4666 (68.09)	66.66	45.13
8	Fipronil 5 SC (Regent)	0.3	6.0 ml	47.46	0.32 (5.18)	0.30 (5.09)	0.32 (5.15)	0.28 (5.08)	5916 (76.89)	69.33	44.18
9	Untreated check	-	-	47.20	2.63 (10.18)	2.61 (10.14)	2.55 (10.05)	2.33 (9.66)	13166 (114.62)	60.00	42.75
	CD (p=0.05)			(NS)	(0.57)	(0.96)	(0.88)	(0.63)	(9.26)	NS	1.35

* Figures in parentheses are transformed means

Date of sowing	:	06.11.2013	Plot size	:	40 m^2
Date of insecticidal application	:	05.11.2013	Variety	:	PBW 644
Date of harvest	:	22.04.2014	Replications	:	Three

Table 10.8 : Effect of insecticidal seed treatment on germination termite damage and yield 2013-14 (Location: Kanpur)

S. No	Treatments	Dose g a.i./ kg/ ha.	Plant population/m row	Per cent damaged shoots/m row			Per cent damaged effective tillers/m row at crop maturity	No. of damaged effective tillers/ha at harvest	Grain yield	
				3 weeks	4 weeks	5 weeks			g/m row	q/ha
1	Imidacloprid 600 FS (48%)	0.72	38.2	0.0	0.0	0.45	0.98	5166.66 (71.751)	71.92	27.16
2	Clothianidin 50 WDG	0.75	36.96	0.0	0.0	0.36	0.56	3916.66 (62.533)	74.38	28.04
3	Chlorantranilipride (Coragen) 18.5 SC	0.185	42.26	0.0	0.0	0.52	0.83	5250.00 (72.333)	70.44	26.54
4	Chlorantranilipride (Coragen) 18.5 SC	0.0925	39.36	0.0	0.0	0.73	1.08	5833.33 (76.069)	69.10	26.12
5	Imidacloprid (17.8%)	0.70	38.86	0.0	0.0	0.77	1.23	6166.66 (78.258)	65.71	26.00
6	Fipronil 5 SC (regent)	0.3	38.93	0.0	0.0	0.42	0.65	4000.00 (63.163)	72.49	27.28
7	Untreated	-	38.06	0.0	0.75	3.08	3.66	15166.66 (122.926)	56.29	20.58
	S. Em ±	-	-	-	-	0.1155	0.1789	3.6485	0.8075	0.2057
	CD at 5%	-	-	-		0.3571	0.5511	11.2400	2.4874	0.6329

* Ttransformed values, Figures within parenthesis represent actual mean values; Figures with same alphabets are statistically at par

Date of sowing	: 09.12.2013	Plot size Gross	: 4 x 5m = 20 Sqm.
Date of insecticidal application	: 08.12.2013	Design	: R.B.D.
Date of plant population counts	: 08.01.2014	Variety	: K8027
Date of harvest	: 20.04.2014	No. of rows/plot	: 23
Irrigated/ Unirrigated	: Unirrigated	Replication	: Three

Table-10.9. Effect of insecticidal seed treatment on germination termite damage and yield 2013-14 (Location: Vijapur)

Sr. No.	Treatment	Dose g a.i./ kg seed	Plant population /m row length	Confirmative test for seed germination	Per cent damaged shoots/m row after sowing			% Damaged effective tillers/ m row	No. of damaged effective tillers/ha	Grain yield	
					3 week	4 week	5 week			g/m	q/ha
1.	Imidacloprid 48 % (600 FS)	0.72	51	90.33	0.00* (0.00)	0.00*a (0.00)	0.00* a (0.00)	2.34*b (0.17)	2614**a (14582)	71a	39.14
2.	Clothianidin 50 WDS	0.75	50	88.33	0.00 (0.00)	0.00a (0.00)	0.00a (0.00)	3.70c (0.42)	3383b (24038)	68a	38.61
3.	Chlorantranilipride 18.5 SC	0.37	49	89.33	0.00 (0.00)	0.00a (0.00)	0.00a (0.00)	4.84d (0.72)	3525b (25962)	68a	38.25
4.	Chlorantranilipride 18.5 SC	0.185	48	89.67	0.00 (0.00)	0.00a (0.00)	0.00a (0.00)	5.35d (0.87)	3626b (27404)	66a	37.93
5.	Imidacloprid 17.8 % (200 FS)	0.6	51	88.33	0.00 (0.00)	0.00a (0.00)	0.00a (0.00)	2.88bc (0.25)	3038ab (19231)	68a	38.97
6.	Fipronil 5 SC	0.3	52	91.67	0.00 (0.00)	0.00a (0.00)	0.00a (0.00)	0.00a (0.00)	2522a (13303)	71a	39.22
7.	Untreated Check	-	52	90.33	0.00 (0.00)	5.05b (0.78)	8.70b (2.28)	9.39e (2.71)	6671c (92947)	53b	31.74
	S.Em.±		2	1.55	-	0.14	0.17	0.35	226	4	2.28
	C.D. at 5%		NS	NS	-	0.42	0.53	1.09	698	11	NS
	C.V.%		-	-	-	-	-	-	-	09.29	10.48

* Figures followed within same column are Arcsin percentage transformation

** Figures followed within same column are square root transformation

Figures given in parenthesis are actual mean value

Figures followed with same letter(s) are not differed statistically

Date of seed treatment : 20/11/2013 Date of sowing : 21/11/2013

Date of Plant population count : 11 /12/2012 Date of harvesting : 18 /03/2014

Design : R.B.D Replications : Three

Spacing : 20 cms between row No. of rows / plot : 12

Plot size : Gross : 14.0m x 2.40m Net : 13.0m x 1.60m Variety : GW 496 Condition : Irrigated

II: Management of termite damage through broadcasting of newer insecticides in standing wheat crop.

Centre: Ludhiana

This trial was also conducted under rainfed conditions along with experiment 3 at Plant Breeding Research Farm, PAU, Ludhiana. The wheat variety PBW 644 was sown on 6th Nov, 2013 in the replicated trial in the plots of 40 sq. m. The seed was treated with fipronil 5 SC and kept as standard check for comparing different treatments. The treated seed was dried overnight before sowing. There were eight treatments including broadcasting of fipronil 0.3 G granules at three different dosages, broadcasting of imidacloprid 600FS at two different dosages, broadcasting chlorpyriphos at one dose and untreated check. Each treatment was replicated thrice. The Fipronil 0.3 G granules were broadcasted 3 weeks after emergence of seedling. For recording observations on the plant population and damage plants, five spots of 2 m row lengths each, were ear marked in each plot.

Observations on the termite damage at the seedling stage (Table 10.10) revealed that at 3, 4 & 5 weeks after sowing, fipronil 0.3 G granules @ 17.5 and 20 kg/ha have significantly lower termite damage as compared to all other treatments. However, all the treatments showed significantly less damage as compared to untreated check.
At ear head stage, the percent damaged effective tillers/m row was lowest (0.20) in fipronil 0.3 G @ 20kg/ha broadcasted plots. All the insecticides recorded significantly less percent damaged effective tiller/m row than untreated check. The number of damaged effective tillers/ha were also lowest (4166) in fipronil 0.3 G @ 20kg/ha broadcast plots followed by fipronil @ 0.3 g.a.i./ha @ 17.5 kg/ha broadcasted plots (4833). All the treatments recorded significantly lower number of damaged effective tillers/ha than untreated check. Grain yield (q/ha) obtained from different plot was maximum (44.90) in fipronil 0.3 G granules @ 20 kg/ha treated plot followed by broadcasting of imidacloprid 600FS @ 1 liter/ha applied plots. However, all treatments produced significantly higher grain yield than untreated check and were statistically at par with each other.

Centre: Durgapura

(a) Management of termite damage through broadcasting of insecticides in standing wheat crop

For the management of termite damage in wheat standing crop through broadcasting of different doses of fipronil 0.3G with neonicotinoids group insecticides, a trial was carried out at RARI, Durgapura, Jaipur under irrigated conditions. The eight formulations of different insecticides including neonicotinoids group insecticides broadcasted at the time of termite infestation in standing wheat crop for the management of termite damage; the results are summarized in (Table 10.11a). Three different doses of fipronil 0.3 G at 45, 52.5 and 60 g a.i. /ha, two doses of imidacloprid 600 FS at 480 and 720 g a.i. /ha and fipronil 5 % SC at 125 g a.i. /ha were applied in standing wheat crop along with recommended insecticide chlopyriphos at 900 g a. i. / ha, which were mixed with soil/ sand at 80-100 Kg /ha and then broadcasted evenly in the plots at the time of termite appearance at crown root stage of crop (CRI) followed by irrigation. For recording observations on the termite damage plant, five spots of 2-meter row length each were earmarked in each plot. No termite damage was recorded at 3 weeks of sowing. Aftr 4 and 5 weeks of sowing the termite damage was negligible and at par with each other except untreated check. The minimum percent damaged of effective tillers / m row was lowest in fipronil 5 % SC at 125 g a. i. / ha (4.83:12.58), at par with fipronil 0.3 G at 60 g a. i./ha (5.20:13.13) and imidacloprid 600 FS at 720 g a. i. / ha (6.60:14.89), followed by it's lower dose 480 g a. i. / ha (7.10;15.45), fipronil 0.3 G at 52.5 g a. i. / ha (7.95:17.38) and it's lower dose 45 g a.i./ha (8.00:16.39). The recommended insecticide chlorpyriphos (10.70:19.07) was less effective as compared to other insecticides in protection as compared to maximum damaged in (13.20:21.30) untreated check. On the basis of number of damaged effective tillers/ha showed that highest damage was recorded in untreated check (151.67:23425). Whereas, the lowest damage was observed in the fipronil 5 % SC at 125 g a. i. (85:7242) and fipronil 0.3 G at 60 g a. i. /ha (93.33:8715), imidacloprid 600 FS at 720 g a. i. / ha (95:9042), all these doses were statistically at par followed by imidacloprid 600 FS at 480 g a. i. / ha (111.67:12492). The chlorpyriphos (128.33:16375) treatment was least effective against termite.

The grain yield data computed on q/ha basis revealed that the highest yield was obtained in Fipronil 5% SC at 125 g a.i. /ha, (30.39), which was at par with imidacloprid 600 Fs at 720 g a. i. / ha (29.45) and fipronil 0.3 G at 60 g a. i./ha (29.19), followed by imidacloprid 600 Fs at 480 g a. i. / ha (28.66), Whereas, chlorpyriphos treatment gave significantly higher yield (24.53) as compared to minimum yield (24.53 q/ha) in untreated check. However, chlorpyriphos treatment was least effective and poor in production as compared to newer insecticides when applied as broadcasting in wheat standing crop.

(b) Management of termite damage through broadcasting of newer insecticides in standing wheat crop.

For the control of termite damage in wheat standing crop through broadcasting of insecticides, a trial was carried out at RARI, Durgapura, Jaipur under irrigated conditions. The eight formulations of different insecticides including new neonicotinoid group insecticides broadcasted at the time of termite infestation in standing wheat crop to evaluate for the management of termite damage; the results are summarized in (Table 10.11b). The different doses of imidacloprid 17.8 % SL at 80 and 100 g a.i. /ha, imidacloprid 600 FS at 480 and 720 g a.i. /ha, fipronil 5% SC at 125 and 150 g a.i. /ha were applied in standing wheat crop along with recommended insecticide chlorpyriphos at 900 g a. i. / ha, which were mixed with soil/sand at 80-100 Kg /ha and then broadcasted evenly in the plots at the time of pest appearance at crown root stage of crop (CRI) followed by irrigation. For recording observations on the termite damage plant, five spots of 2-meter row length each were earmarked in each plot. No termite damage was recorded at 3 weeks of sowing. Aftre 4 and 5 weeks of sowing the termite damage was negligible and at par with each other except untreated check. The minimum percent damaged of effective tillers / m row was lowest in imidacloprid 17.8 % SL at 500 g a. i. / ha (4.76:12.60), at par with fipronil 5% SC at 150 g a. i. / ha (4.50:12.22) and it's lower dose at 125 g a. i. / ha , (4.83:12.58), imidacloprid 17.8 % SL at 80 g a. i. / ha (5.03:12.96) and imidacloprid 600 FS at 720 g a. i. / ha, (6.60:14.89), all these treatments were at par each other and followed by lower doses of imidacloprid 600 FS at 480 g a. i. / ha g (7.10:15.45. The recommended insecticide chlorpyriphos (10.70:19.07) was less effective as compared to tested newer insecticides in protection as compared to maximum damaged in (13.20:21.30) untreated check. On the basis of number of damaged effective tillers/ha showed that highest damage was recorded in untreated check (151.67:23425).Whereas, the lowest damage was observed in the fipronil 5% SC at 150 g a. i. and imidacloprid 600 FS at 720 g a. i. / ha (85.00:7627), at par with higher doses of imidacloprid 17.8 % SL at 100 g a. i. (8750:93.33) and lower dose of Fipronil 5% SC at 125 g a.i. /ha (95:9042), followed by lower dose of imidacloprid 600 FS at 480 g a. i. / ha (111.67:12492). The chlorpyriphos (128.33:16375) treatment was least effective against termite.

The grain yield data computed on q/ha basis revealed that the highest yield was obtained in fipronil 5 % SC at 150 g a. i. /ha, (31.26), at par with imidacloprid 600 FS at 720 g a. i. / ha (30.39), imidacloprid 17.8 % SL at 100 g a. i. (30.30) and lower dose of fipronil 5 % SC at 125 g a.i. /ha(29.45) imidacloprid 17.8 % SL at 80 g a. i. (29.17), followed by imidacloprid 600 FS at 480 g a. i. / ha (28.66), Whereas, chlorpyriphos (24.53) treatment gave significantly higher yield as compared to minimum yield (24.53 q/ha) in untreated check. However, chlorpyriphos treatment was least effective and poor in production as compared to newer insecticides when applied as broadcasting in wheat standing crop.

Centre: Vijapur

To test the efficacy of one dose of fipronil 5 SC, two different doses of imidacloprid 600 FS, three doses of fipronil 0.3 G and one dose of Chlorpyriphos 20 EC as broadcasting and fipronil 5 SC as seed treatment for the control of termite in wheat crop, an experiment was conducted under irrigated conditions at Centre of Excellence for Research on Wheat, Vijapur. The application of insecticides was made on 12-12-2013. The results are summarized in (Table 10.12). No termite damage was noticed up to 5 weeks after sowing in all the treatments except check where in 0.83 and 1.04 per cent damage was recorded in 4 and 5 weeks after sowing, respectively. At ear head stage, per cent damaged effective tillers/m row was zero in fipronil seed treated plot and broadcasting of fipronil 5 SC @ 125 g a.i./ha. The number of damaged effective tillers/ha was significantly higher in untreated check as compared to insecticidal treatments. Among the insecticidal treatments, it was significantly less in fipronil seed treated plot followed by broadcasting of fipronil 5 SC @ 125 g a.i./ha and higher dose of fipronil 0.3G @ 67.5 g a.i./ha. The grain yield in g/m row revealed significant difference among the treatments. The maximum grain yield was obtained in plot treated with fipronil seed treatment which was at par with broadcasting treatments of fipronil 5 SC @ 125 g a.i./ha, higher dose of fipronil 0.3 G @ 67.5 g a.i./ha fipronil 0 3G @ 60 g a.i./ha, both doses of imidacloprid 600 FS and fipronil 0.3G @ 52.5 g a.i./ha. The grain yield (q/ha) indicated non-significant differences.

Centre: Kanpur

The experiment was conducted at Research Farm, Nawabganj, Kanpur, under irrigated condition in 23 rows of 4 x 5m sown on 09.12.2013 and each treatment was replicated thrice (Table 10.13). The initial plant population counts indicated had no significant difference among all the treatments. No incidence of termite was observed up to three weeks of sowing in any of the treatment. However, the incidence of termite after four weeks of sowing was observed only in untreated plot (0.80%). The incidence of termite after five weeks of sowing range from 0.51 to 1.31 per cent in different treatments while in untreated plot it was 2.62 per cent. Significantly less damaged shoot were recorded in plot treated with fipronil 0.3G @ 22.5 kg/ha, fipronil 0.3G @ 20.0 kg/ha and imidacloprid 48 per cent 1.5 liter/ha, which was at par with fipronil 5SC @ 2.5 litre/ha and imidacloprid 48 per cent @ 1 litre/ha. All the insecticidal treatment showed superiority over untreated check in minimizing the per cent damage effective tillers. The number of effective tillers/ha in different treatments ranged from 3500 to 7333.33 while it was 14833.33 in untreated plots. The minimum damaged effective tillers/ha were recorded in fipronil 0.3G @ 22.5 kg/ha, fipronil 0.3G @ 20.0 kg/ha and imidacloprid 48 per cent @ 1.5 litre/ha treated plot followed by fipronil 5SC @ 2.5 litre/ha, imidacloprid 48 per cent @1 litre/ha and chlorpyriphos 20 EC @ 5 litre/ha. The grain yield g/m row and q/ha was significantly higher in plots treated with fipronil 0.3G @ 22.5 kg/ha, fipronil 0.3G @ 20 kg/ha and imidacloprid 48 per cent @ 1.5 litre/ha followed by fipronil 5SC @2.5 litre/ha, imidacloprid 48 per cent @ 1 litre/ha and chlorpyriphos 5 litre/ha. So, it was concluded that the insecticide fipronil 0.3G @ 22.5 kg/ha, fipronil 0.3G @ 20.0 kg/ha and imidacloprid 48 per cent @ 1.5 litre/ha were superior over fipronil 5SC @ 2.5 litre, imidacloprid 48 per cent @ 1.0 litre/ha and chlorpyriphos 5 litre/ha treated plots.

Table 10.10. Management of termite damage through broadcasting of newer insecticides in standing wheat crop 2013-14 (Centre: Ludhiana)

S.No.	Treatments	Dosage a.i./Kg seed	Dosage (L)/ha	Plant population/m row	Per cent damaged shoots/m row			Per cent damaged tillers/m row at earhead stage	No. of damaged effective tillers/ha	Grain yield	
					3 weeks	4 weeks	5 weeks			g/m row	q/ha
1	Imidacloprid 600 FS	480	1.0	45.66	0.36 (5.30)	0.40 (5.45)	0.52 (5.81)	0.54 (5.86)	6000 (77.45)	64.66	44.25
2	Imidacloprid 600 FS	720	1.5	44.86	0.26 (4.98)	0.20 (4.80)	0.33 (5.22)	0.34 (5.27)	4666 (68.25)	60.66	44.88
3	Fipronil 0.3 G	37.5	15	44.46	0.46 (5.61)	0.52 (5.81)	0.63 (6.09)	0.50 (5.73)	6000 (77.38)	63.33	43.95
4	Fipronil 0.3 G	45	17.5	44.46	0.28 (4.74)	0.30 (5.12)	0.36 (5.33)	0.27 (5.03)	4833 (69.49)	61.33	44.73
5	Fipronil 0.3 G	52.5	20	44.26	0.22 (4.50)	0.20 (4.81)	0.26 (5.00)	0.20 (4.78)	4166 (64.55)	60.00	44.90
6	Chlorpyriphos 20 EC	1000	5.0	44.33	0.34 (5.20)	0.24 (4.95)	0.28 (4.72)	0.28 (5.06)	5500 (74.15)	60.00	44.63
7	Fipronil 5SC (Seed treatment)	0.3 g a.i./kg seed	6 g/kg seed	44.20	0.34 (5.26)	0.24 (4.91)	0.26 (4.98)	0.17 (4.68)	5166 (71.85)	62.00	44.46
8	Untreated check			43.73	2.43 (9.85)	2.41 (9.82)	2.36 (9.74)	2.50 (9.97)	13833 (117.52)	60.66	42.85
CD (p=0.05)				(NS)	(0.77)	(0.54)	(0.69)	(0.59)	(6.16)	NS	1.10

* Figures in parentheses are transformed means

Date of sowing	:	06.11.2013	Plot size	:	40 m^2
Date of insecticidal application	:	25.11.2013	Variety	:	PBW 644
Date of harvest	:	23.04.2014	Replications	:	Three

Table10.11a. Management of termite damage through broadcasting of insecticides in standing wheat crop 2013-14 (Location: Durgapura)

S. No	Treatments &Dose g a. i./ha or L/ha	Per cent damaged effective shoot/m row at broadcasting	Per cent damaged effective tillers/m row at ear head stage	No. of damaged effective tillers/ha	Grain yield	
					q/ha	Increased Yield (q/ha) Over untreated
1	Fipronil 5% SC@ 125 g a. i./ ha or 2.5 L/ha (Regent)	3.40 (10.61)a*	4.83 (12.58)a	7242 (85.00)a	30.39a	8.63
2	Fipronil 0.3 G @ 45 g a. i./ha or 17.5 Kg/ha Broadcasted with first irrigation	3.30 (10.47)a	8.00 (16.39)b	22542 (150.00)cd	23.93c	2.17
3	Fipronil 0.3 G @ 52.5 g a. i./ha or 20 Kg/ha Broadcasted with first irrigation	3.30 (10.46)a	7.95 (17.38)b	12845 (113.33)b	27.51b	5.75
4	Fipronil 0.3 G @ 60 g a. i./ha or 22.5 Kg/ha Broadcasted with first irrigation	3.33 (10.62)a	5.20 (13.13)a	8715 (93.33)a	29.19a	7.43
5	Imidacloprid 600 FS @ 480 g a. i./ ha or 1.0 l/ha (Gauchau)	3.40 (10.63)a	7.10 (15.45)b	12492 (111.67)b	28.66b	6.90
6	Imidacloprid 600 FS @ 720 g a. i./ ha or 1.5 l/ha (Gauchau)	3.36 (10.56)a	6.60 (14.89)a	9042 (95.00)ab*	29.45a	7.69
7	Chlopyriphos 20 EC @ 900 g a. i./ ha or 4.5 L /ha (Lethal)	3.36 (10.57)a	10.70 (19.07)c	16375 (128.33)c	24.53c	2.77
8	Untreated check	3.50 (10.89)a	13.20 (21.30)d	23425 (151.67)d	21.76d	-
	S.Em ±	0.22	0.65	7.18	0.59	-
	CD at 5%	NS	1.99	21.79	1.82	-

* Transformed values, Figures within parenthesis represent actual mean values; Figures with same alphabets are statistically at par

Date of sowing	: 22.11.2013	plot size Gross	: 8 x 3	No. of rows/plot	: 10
Date of insecticidal application	:21.12.2014	Net	: 7.5 x2.5 m	Design	: RBD
Date of plant population counts	: 25.12.2013	Variety	: Raj - 42289	Replication	: 3
Date of harvest	: 08.04.2014	Condition	: Irrigated		

Table10.11b.Management of termite damage through broadcasting of newer insecticides in standing wheat crop 2013-14 (Location: Durgapura)

S. No	Treatments &Dose g a. i./ ha or L/ha	Per cent damaged effective shoot/m row at broadcasting	Per cent damaged effective tillers/m row at ear head stage	No. of damaged effective tillers/ha	Grain yield	
					q/ha	Increased Yield (q/ha) Over untreated
1	Fipronil 5% SC@ 125 g a. i./ ha or 2.5 L/ha (Regent)	3.40 (10.61)a*	4.83 (12..58)a	9042 (95.00)a*	29.45a	7.69
2	Fipronil 5% SC@ 150 g a. i./ ha or 3.0 L/ha (Regent)	3.36 (10.52)a	4.50 (12.22)a	7242 (85.00)a	31.26a	9.5
3	Imidacloprid 17.8% SL@ 80 g a. i./ ha or 400 ml/ha(Confidor)	3.50 (10.77)a	5.03 (12.96)a	10442 (101.67)a	29.17a	7.41
4	Imidacloprid 17.8% SL@ 100 g a. i./ ha or 500 ml/ha(Confidor)	3.36 (10.57)a	4.76 (12.60)a	8750 (93.33)a	30.30a	8.54
5	Imidacloprid 600 FS @ 480 g a. i./ ha or 1.0 l/ha (Gauchau)	3.40 (10.63)a	7.10 (15.45)b	12492 (111.67)b	28.66b	6.90
6	Imidacloprid 600 FS @ 720 g a. i./ ha or 1.5 l/ha (Gauchau)	3.36 (10.56)a	6.60 (14.89)a	7242 (85.00)a	30.39a	8.63
7	Chlopyriphos 20 EC @ 900 g a. i./ ha or 4.5 L /ha (Lethal)	3.36 (10.57)a	10.70 (19.07)c	16375 (128.33)c	24.53c	2.77
8	Untreated check	3.50 (10.89)a	13.20 (21.30)d	23425 (151.67)d	21.76d	-
	S.Em ±	0.23	0.61	6.93	0.64	-
	CD at 5%	NS	1.87	21.03	1.96	-

* Transformed values, Figures within parenthesis represent actual mean values; Figures with same alphabets are statistically at par

Date of sowing	: 22.11.2013	Plot size Gross	: 8 x 3	No. of rows/plot	: 10
Date of insecticidal application	: 05.02.2014	Net	: 7.5 x2.5 m	Design	: RBD
Date of plant population counts	: 25.12.2013	Variety	: Raj - 42289	Replication	: 3
Date of harvest	: 08.04.2014	Condition	: Irrigated		

Table 10.12. Management of termite damage through broadcasting of newer insecticides in standing wheat crop 2013-14 (Location: Vijapur)

Sr. No.	Treatment	Dose g a.i./ ha	Per cent damaged shoots/m row after sowing			Per cent Damaged effective tillers/ m row	No. of damaged effective tillers/ha	Grain yield	
			3 week	4 week	5 week			g/m	q/ha
1.	Fipronil 5 SC	125	0.00* (0.00)	0.00*a (0.00)	0.00a* (0.00)	0.00*a (0.00)	2739**ab (15707)	81a	42.08
2.	Imidacloprid 48 % 600 FS	480	0.00 (0.00)	0.00a (0.00)	0.00a (0.00)	1.91cde (0.18)	3550c (26284)	75abc	40.30
3.	Imidacloprid 48 % 600 FS	720	0.00 (0.00)	0.00a (0.00)	0.00a (0.00)	1.60bcd (0.13)	3211bc (21476)	75abc	41.94
4.	Fipronil 0.3 G Broadcasting with first irrigation	52.5	0.00 (0.00)	0.00a (0.00)	0.00a (0.00)	2.62de (0.23)	3556c (26442)	72abc	39.21
5.	Fipronil 0.3 G Broadcasting with first irrigation	60	0.00 (0.00)	0.00a (0.00)	0.00a (0.00)	1.13abc (0.06)	3172bc (20995)	77ab	41.99
6.	Fipronil 0.3 G Broadcasting with first irrigation	67.5	0.00 (0.00)	0.00a (0.00)	0.00a (0.00)	0.51ab (0.02)	2839ab (16827)	81a	42.04
7.	Chlorpyriphos 20 EC	1000	0.00 (0.00)	0.00a (0.00)	0.00a (0.00)	3.01e (0.28)	3488c (25639)	66b	37.52
8	Fipronil 5 SC (Seed Treatment)	0.3 g a.i./ kg seed	0.00 (0.00)	0.00a (0.00)	0.00a (0.00)	0.00a (0.00)	2448a (12500)	84a	42.72
9	Untreated Check	-	0.00 (0.00)	2.98b (0.83)	5.16b (1.04)	5.71f (1.04)	7029d (104005)	63c	34.93
	S.Em.±		-	0.02	0.17	0.44	175	4	2.46
	C.D. at 5%		-	0.06	0.52	1.32	525	13	NS
	C.V.%		-	-	-	-	-	09.90	10.56

* Figures followed within same column are Arcsin percentage transformation ** Figures followed within same column are square root transformation Figures given in parenthesis are actual mean value ,Figures followed with same letter(s) are not differed statistically

Date of sowing : 21/11/2013 Date of insecticide application : 12/12/2013, Date of harvesting : 18/03/2014 Design : R.B.D

Replications : Three, Spacing: 20 cms between row No. of rows/plot : 12 Plot size : Gross : 14.0m x 2.40m Net: 13.0m x 1.60m

Variety : GW 496 Condition : Irrigated

Table 10.13.Management of termite damage through broadcasting of newer insecticides in standing wheat crop 2013-14 (Centre: Kanpur)

S. No	Treatments	Dose g a.i./ kg/ ha.	Plant population/m row	Per cent damaged shoots/m row			Per cent damaged effective tillers/m row at crop maturity	No. of damaged effective tillers/ha at harvest	Grain yield	
				3 weeks	4 weeks	5 weeks			g/m row	q/ha
1	Fipronil 5 SC (Regent)	125	39.30	0.0	0.0	0.92	0.64	6666.66 (81.637)	71.60	29.93
2	Imidacloprid 600 FS (48%)	0.480	39.33	0.0	0.0	1.31	0.70	7100.00 (84.220)	69.38	27.08
3	Imidacloprid 600 FS (48%)	0.720	42.23	0.0	0.0	0.63	0.46	3666.66 (60.523)	74.57	30.95
4	Fipronil 0.3 G	45	38.76	0.0	0.0	0.73	0.60	4333.33 (65.650)	68.33	26.86
5	Fipronil 0.3 G	52.5	39.8	0.0	0.0	0.76	0.59	3883.33 (62.273)	71.82	30.83
6	Fipronil 0.3 G	60.0	41.13	0.0	0.0	0.51	0.44	3500.00 (59.090)	75.67	31.48
7	Chlorpyriphos 20EC	1000	38.36	0.0	0.0	1.27	0.72	7333.33 (85.533)	69.71	27.08
8	Untreated check	-	39.83	0.0	0.80	2.62	3.32	14833.33 (121.710)	53.12	24.41
	S. Em ±	-				0.3375	0.2151	5.3499	5.5423	0.3475
	CD at 5%	-				0.1111	0.0707	1.7638	1.8272	0.1140

* Transformed values, Figures within parenthesis represent actual mean values; Figures with same alphabets are statistically at par

Date of sowing	: 09.12.2013	Plot size Gross	: 4 x 5m = 20 Sqm.
Date of insecticidal application	: Broadcasting 1st Irri.	Design	: R.B.D.
Date of plant population counts	: 08.01.2014	Variety	: K0402
Date of harvest	: 20.04.2014	No. of rows/plot	: 23
Irrigated/ Unirrigated	: Irrigated	Replication	: Three

V: Chemical control of foliage feeding wheat aphid.

Objectives:

The main purpose of conducting this experiment was to find out molecules of new chemistry, which are more efficient, at lower doses and are less hazardous to environment than presently recommended molecules.

Methodology:

The experiment consisted eight treatments with three replications was conducted at four locations *viz.,* Ludhiana, Niphad Pantnagar and Kanpur. The details of the treatments and their doses are given below:

S.No	Treatment	Dosage a.i. / ha
1	Confidor (Imidacloprid 200 SL)	20
2	Dantotsu (Clothianidin 50 WDS)	15
3	Fame (Flubendamide 480 SC)	20
4	Pride (Acetamiprid 20SP)	20
5	Actara (Thiamethoxam 25 WG)	12.5
6	Coragen (Chlorantranilipride 18.5 SC)	20
7	Crusier (Thiamethoxam 35 FS)	20
8	Rogor (Dimethoate 30 EC)	300
9	Control	-

Five tillers were tagged from each plot and aphids were counted from these tagged plants before spray and after spray to know the efficacy of each treatment. The grain yield was recorded to know the preventable losses by these treatments.

Summary:

- The spray of Pride (Acetamiprid 20SP) @ 20 g.a.i./ha was found to be very promising in checking aphid population at all centres.
- The application of a new formulation Fame (Flubendamide 480 SC) @ 20 g.a.i./ha was also found to be quite effective in managing the aphid.

The details of results of experiment of each location are as below:

Centre: Ludhiana

This trial was conducted under irrigated conditions at Plant Breeding Research Farm, PAU, Ludhiana. The wheat variety HD 2967 was sown on 7th Nov.2013 in the plots of 6 rows of 6m length in a replicated trial. Eight insecticides were sprayed when the aphid population reached at 4-5 aphids/earhead. There were total of nine treatments including untreated check and each was replicated three times. For recording observations, five shoots were ear marked in each plot and from these plants observations were recorded one day before spray and then 1, 2, 7 and 15 days after spray.

Aphid population did not differ significantly among all treatments one day before spray except seed treated plots where it was significantly lower than all other treatments (Table-10.14). When observed one day after spray, flubendamide recorded minimum (1.06 aphids/earhead) and was at par with all other insecticidal treatments except dimethoate (1.61 aphids/earhead) and untreated check (35.76 aphids/earhead). Two days after treatment, acetamiprid (0.72 aphids/earhead) recorded minimum aphid population and was at par with all other insecticidal treatments except dimethoate (1.27 aphids/earhead) and untreated check (34.82 aphids/earhead). Seven and fifteen days after spray, flubendamide was the best treatment, however it was at par with all other insecticidal treatment but better than untreated check.

Grain yield (q/ha) obtained was maximum from acetamiprid (58.31) treated plots followed by flubendamide (57.95) treated plots. However, all the insecticidal treatments recorded higher grain yield than untreated check (54.84).

Centre: Niphad

Data recorded on average population of survived foliage feeding aphids is presented in (Table-10.15) it is revealed that all the insecticidal treatments were effective against aphids as they showed significantly lower aphids population than untreated control. At 1 day after spray, the plots treated with thiamethoxam 25 WG @ 12.5 g a.i./ha registered significantly minimum (1.50) number of aphids/shoot/plant followed by acetamiprid 20 SP @ 50g a.i./ha (2.00), imidacloprid 17.8 SL @ 20g a.i./ha (2.30) and clothianidin 50 WDG @ 15 g.a.i./ha (3.00). At 15 DAS, thiamethoxam 25 WG @ 12.5g a.i./ha recorded minimum number of 2.80 aphids/shoot/plant.

At 7 DAS, the population of natural enemies were not observed in plots sprayed with imidacloprid 17.8 SL @ 20g a.i./ha, clothianidin 50 WDG @ 15 g.a.i./ha, acetamiprid 20 SP@ 50g a.i./ha, thiamethoxam 25 WG @ 12.5g a.i./ha and thiamethoxam 35 FS @ 70 g a.i./ha. The highest (0.73 and 1.83) number of natural enemies were observed in untreated plot.

Maximum yield of 63.91 q/ha was obtained in plot treated with clothianidin 50 WDG @ 15 g.a.i./ha which was at par with thiamethoxam 35 FS @ 70 g a.i./ha (63.11), acetamiprid 20 SP@ 20 g a.i./ha (62.99 q/ha), thiamethoxam 25 WG @ 12.5g a.i./ha (62.65) and imidacloprid 17.8 SL @ 20g a.i./ha (59.42) as against lowest in control plot (35.97 q/ha).

Centre: Pantnagar

The application of chemical sprays was done twice after interval of 15 days of during the peak period (February and March 2014) of the aphid infestation on wheat crop. The data presented in (Table-10.16) demonstrated the efficacy of different chemicals against foliage aphids on wheat with non-significant difference in aphid population before Ist insecticidal sprays which was ranged from mean aphid population 17.53 /shoot to 21.60/shoot. After first day of Ist spraying significantly less aphid population (8.47/shoot) was counted in Coragen 18.5 SC @ 40g followed by Acetamiprid 20 SP (8.60/shoot) and Dantatsu (9.73/shoot). On the second day after insecticidal application, the significantly lowest mean aphid population was observed in Imidacloprid 17.8 SL (5.87/shoot) followed by Coragen 18.5 SC @ 40g (5.53/shoot), Clothianidin 50 WDG (7.00/shoot) and Flubendamide 480SG (9.80/shoot). After 7 days of Ist spraying, significantly lower population of foliage aphid was observed in Clothianidin 50 WDG(1.97/shoot) followed by Imidacloprid 17.8 SL (2.00/shoot), Flubendamide 480 SG (3.13/shoot), Acetamiprid 20 SP (4.93/shoot), Dimethoate 30 EC (6.67/ shoot) and Coragen 18.5 SC @ 40g (8.73/shoot). On the 15th day after 1st spraying, significantly lowest mean aphid population was recorded on Clothianidin 50WDG (2.33/shoot) followed by Imidacloprid 17.8 SL (4.20/shoot), Thiamethoxam 25 WG (5.27/shoot) and Dimethoate (7.70/shoot) whereas among the other treatments the mean aphid population was ranged from 10.80/shoot to 15.60/shoot.

The data regarding the mean aphid population before IInd spray showed non significant difference among the treatments with aphis population ranged from 11.60/shoot to 15.27/shoot. After one day of second insecticidal spray the mean aphid population became less among the treatments were ranged from 7.00/shoot to

10.40/shoot in comparison to untreated control (25.00/shoot). A drastic change in mean aphid population was observed in after 2nd day of IInd insecticidal spray with significantly lowest mean aphid population among the treatments ranged from 2.20/shoot in Imidacloprid 17.8SL to 9.00/shoot in Flubendamide 480SG in comparison to untreated control (26.70/shoot) .

The data collected after the 7 days of IInd spray clearly showed the significant decrease in aphid population among the treatments as the lowest aphid population was counted in Imidacloprid 17.8 SL (1.07/shoot) followed by Clothianidin 50 WDG (2.57/shoot), Acetamiprid 20SP (3.47/shoot), Thiamethoxam 25 WG (3.73/shoot), Dimethoate 30 EC(4.60/shoot),Coragen 18.5 SC @ 20g (5.20/shoot), Coragen 18.5 SC @40g (5.27/shoot) and Flubendamide 480 SG (7.27/shoot). A lowest mean aphid population was counted after 15 days of 2nd insecticidal spray which was in Imidacloprid 17.8 SL (2.90/shoot) followed by in Acetamiprid 20 SP 3.60/shoot and Thiamethoxam 25WG followed by Clothianidin 50 WDG (3.67/shoot), dimethoate 30EC (4.27/shoot), Coragen 18.5 SC @ 40g (4.60/shoot), Coragen 18.5 SC @ 20g (4.80/shoot) and Flubendamide 480SG (6.13/shoot) which were superiors in comparison to untreated control (16.80/shoot).

The grain yield was found highest in Imidacloprid 17.8 SL (28.71 q/ha) followed by Coragen 18.5 SG as compared to untreated control (20.64 q/ha).

Centre: Karnal

Aphid population did not differ significantly among all treatments one day before spray. When observed one day after spray, flubendamide recorded minimum (4.33 aphids/earhead) and was at par with all other insecticidal treatments except dimethoate (5.67 aphids/earhead) and untreated check (25.33 aphids/earhead). Two days after treatment, acetamiprid (2.80 aphids/earhead) recorded minimum aphid population and was at par with all other insecticidal treatments except dimethoate (3.87 aphids/earhead) and untreated check (22.67 aphids/earhead). Seven days after spray, Clothianidin 50 WDG recorded minimum aphid population (2.00 aphids/earhead was at par with all other insecticidal treatments. Fifteen days after spray, again flubendamide recorded minimum (1.07 aphids/earhead) followed by Chlorantranilipride 18.5 SC (2.00 aphids/earhead) (Table-10.17).

Grain yield (q/ha) obtained was maximum from acetamiprid (45.42.) treated plots followed by flubendamide (44.50) treated plots. However, all the insecticidal treatments recorded higher grain yield than untreated check (34.58.).

Table. 10.14. Chemical control of foliage feeding aphid on wheat 2013-14 (Location: Ludhiana)

S. No.	Treatments	Dose ml or g / ha	Dosages (g a.i./ha)	Aphid population per earhead					Grain Yield (q/ha)
				Before spray	After spray				
				1 day	1 day	2 days	7 days	15 days	
1	Confidor (Imidacloprid 200 SL)	100 ml	20	34.00 (5.91)	1.54 (1.59)	0.98 (1.40)	0.74 (1.31)	0.40 (1.17)	57.60
2	Dantotsu (Clothianidin 50 WDS)	30 gm	15	34.60 (5.96)	1.24 (1.49)	0.87 (1.37)	0.50 (1.22)	0.27 (1.12)	58.13
3	Fame (Flubendamide 480 SC)	250 ml	20	34.60 (5.96)	1.06 (1.43)	0.77 (1.33)	0.42 (1.19)	0.19 (1.09)	57.95
4	Pride (Acetamiprid 20SP)	100 gm	20	35.20 (6.01)	1.07 (1.43)	0.72 (1.31)	0.46 (1.20)	0.20 (1.09)	58.31
5	Actara (Thiamethoxam 25 WG)	50 gm	12.5	34.66 (5.97)	1.28 (1.51)	0.73 (1.31)	0.56 (1.25)	0.26 (1.12)	57.77
6	Coragen (Chlorantraniliptide 18.5 SC)	100 ml	20	35.73 (6.05)	1.06 (1.43)	0.90 (1.37)	0.56 (1.24)	0.26 (1.12)	56.44
7	Rogor (Dimethoate 30 EC)	375 ml	300	35.73 (6.05)	1.61 (1.61)	1.27 (1.50)	0.82 (1.35)	0.52 (1.23)	56.97
8	Control	-	-	35.00 (5.99)	35.76 (6.06)	34.82 (5.98)	32.52 (5.78)	29.51 (5.52)	54.84
	CD (p=0.05)			(NS)	(0.17)	(0.14)	(0.20)	(0.16)	2.10

* Figures within parentheses are transformed means

Date of sowing	:	07.11.2013	Plot size	:	7.5 m^2
Date of insecticidal application	:	03.03.2014	Variety	:	HD 2967
Date of harvest	:	23. 04.2014	Replications	:	Three

Table 10.15: Chemical control of foliage feeding aphid on wheat 2013-14 (Location: Niphad)

SN	Treatment details	Dose g a.i./ha	Av. Population of survived foliage feeding wheat aphids per shoot.					1000 grain wt. (gm)	Yield q/ha	Population of N. Enemies/ m^2	
			Pre count	1DAS	2DAS	7DAS	15DAS			7 DAS	15DAS
1	Imidacloprid 200 SL	20	54.20 (7.43)	2.30 (1.81)	0.00 (1.00)	0.00 (1.00)	3.70 (2.17)	51.48	59.42	0.00 (1.00)	0.13 (1.06)
2	Clothianidin 50 WDG	15	57.50 (7.65)	3.00 (2.00)	0.00 (1.00)	0.00 (1.00)	3.40 (2.10)	52.25	63..91	0.00 (1.00)	0.10 (1.05)
3	Flubendamide 480 SC	20	55.70 (7.53)	15.80 (4.10)	6.00 (2.65)	8.90 (3.15)	19.00 (4.47)	51.40	51.59	0.17 (1.08)	0.57 (1.25)
4	Acetamiprid 20 SP	20	57.30 (7.64)	2.00 (1.73)	0.00 (1.00)	0.00 (1.00)	3.30 (2.07)	51.74	62.99	0.00 (1.00)	0.13 (1.06)
5	Thiamethoxam 25 WG	12.5	55.90 (7.54)	1.50 (1.26)	0.00 (1.00)	0.00 (1.00)	2.80 (1.95)	51.53	62.65	0.00 (1.00)	0.10 (1.05)
6	Chlorantranilipride 18.5 SC	20	57.80 (7.67)	21.90 (4.79)	10.40 (3.38)	14.90 (3.99)	30.10 (5.58)	51.24	42.09	0.30 (1.14)	0.57 (1.25)
7	Thiamethoxam 35 FS	70	58.50 (7.71)	4.80 (2.41)	0.00 (1.00)	0.00 (1.00)	4.30 (2.30)	52.11	63.11	0.00 (1.00)	0.13 (1.06)
8	Dimethoate 30 EC	300	58.30 (7.70)	19.80 (4.56)	6.70 (2.77)	10.30 (3.36)	26.20 (5.22)	51.37	51.40	0.23 (1.11)	0.53 (1.24)
9	Untreated control	-	58.10 (7.69)	129.80 (11.44)	136.10 (11.71)	153.50 (12.43)	177.90 (13.38)	47.84	35.97	0.73 (1.32)	1.83 (1.68)
	SE ±		0.02	0.05	0.03	0.11	0.04	0.32	3.53	0.02	0.03
	CD at 5%		NS	0.15	0.08	0.34	0.12	0.95	10.58	0.05	0.10

DAS- Days After spray, figures in parentheses indicate V_{n+1} transformed value,

Date(s) of Insecticidal application : i)16/12/2013 ii) 31/12/2013 Date of Harvest : 25/03/2014

Table 10.16 CHEMICAL CONTROL OF FOLIAGE FEEDING APHIDS ON WHEAT

S.No.	Treatments	Dosage g a.i./ha	Aphid population per shoot					Aphid population per shoot					Grain Yield (q/ha)
			Before Spray	After I st spray				Before Spray	After II nd Spary				
			1 day	I day	2 days	7 days	15 days	1 day	I day	2 days	7 days	15 days	
1.	Confidor (Imidacloprid 17.8 SL)	20ml	21.60 (27.58)*	11.13 (19.49)	05.87 (13.96)	02.00 (8.07)	04.20 (11.80)	15.27 (22.99)	07.47 (15.83)	02.20 (8.12)	01.07 (5.88)	02.90 (9.52)	28.71 (32.93)
2.	Dantatsu (Clothianidin 50 WDG)	15g	17.53 (24.70)	09.73 (18.16)	07.00 (15.27)	01.97 (7.97)	02.33 (8.75)	14.87 (22.60)	07.00 (15.29)	03.13 (10.05)	02.57 (9.07)	03.67 (10.92)	24.72 (29.36)
3.	Fame (Flubendamide480 SC)	20g	18.26 (25.17)	10.40 (18.84)	09.80 (18.21)	03.13 (10.17)	14.07 (21.88)	11.73 (19.98)	10.40 (18.75)	09.00 (17.42)	07.27 (15.59)	06.13 (14.24)	22.38 (28.34)
4.	Pride (Acetamiprid 20SP)	20ml	20.73 (26.87)	08.60 (17.06)	10.73 (19.10)	04.93 (12.80)	14.00 (21.96)	11.60 (19.89)	07.40 (5.74)	05.53 (13.58)	03.47 (10.64)	03.60 (10.91)	26.31 (30.80)
5.	Actara (Thiamethoxam 25 WG)	12.5g	19.33 (26.02)	12.33 (20.56)	15.53 (23.17)	09.73 (18.14)	05.27 (3.22)	14.20 (22.03)	08.20 (6.59)	04.40 (12.08)	03.73 (11.00)	03.60 (10.83)	26.94 (31.13)
6.	Chlorantranilipride 18.5 SC (Coragen)	20g	20.53 (26.87)	11.80 (20.10)	18.07 (25.09)	17.47 (24.68)	10.80 (19.17)	12.63 (20.79)	10.00 (18.43)	06.40 (14.55)	05.20 (13.05)	04.80 (12.49)	27.33 (32.16)
7.	Chlorantranilipride 18.5 SC (Coragen)	40g	21.20 (27.41)	08.47 (16.92)	05.53 (13.58)	08.73 (17.18)	15.60 (23.24)	12.73 (20.85)	09.73 (18.03)	06.60 (14.82)	05.27 (13.12)	04.60 (12.17)	26.94 (31.18)
8.	Rogor (Dimethoate 30 EC	300ml	18.53 (25.48)	11.20 (19.56)	10.27 (18.58)	06.67 (14.95)	07.70 (16.02)	12.87 (20.91)	07.07 (15.28)	04.40 (12.08)	04.60 (12.36)	04.27 (11.88)	24.42 (29.41)
9.	Untreated Control	-	18.40 (25.34)	23.13 (28.59)	24.93 (29.90)	24.20 (29.36)	24.10 (29.32)	24.20 (29.36)	25.00 (29.75)	26.70 (31.09)	24.70 (29.65)	16.80 (24.15)	20.64 (26.92)
	SEm±		2.13 (1.50)	1.48 (1.21)	1.32 (1.03)	1.19 (0.98)	1.27 (1.06)	1.38 (1.16)	1.13 (1.12)	0.78 (1.08)	0.84 (1.09)	0.92 (1.22)	0.006 (0.007)
	Cd 5%		6.39 (4.51)	4.43 (3.64)	3.97 (3.10)	3.59 (2.94)	3.80 (3.18)	4.15 (3.47)	3.38 (3.37)	2.35 (3.25)	2.51 (3.28)	2.76 (3.66)	0.018 (0.023)

*Figures in parenthesis are angular transformed values

Date of sowing:02/12/2013 Plot size: 10.5 sq. m Date of Harvest: 27/04/2014

Date of I[st] Insecticidal application: I[st] 08/02/2014 and II[nd] 27/02/2014 Variety sown: UP 2465 Replications:03

Table 10.17: Chemical control of foliage feeding aphid on wheat (Location: Karnal) 2013-14

S. No.	Treatments	Dosage (g a.i./ha.)	Aphid population per shoot					Grain yield (q/ha)
			Before spray	After Spray				
				1 Day	2 Day	7 Day	15 Day	
1	Confidor (Imidacloprid 17.8 SL)	20 ml	28.67 (5.43)	5.40 (2.53)	3.67 (2.16)	2.40 (1.84)	2.53 (1.88)	43.75
2	Dantotsu (Clothianidin 50 WDG)	15 g	26.67 (5.25)	4.80 (2.41)	3.20 (2.05)	2.00 (1.73)	1.67 (1.63)	39.57
3	Flubendamide (Fame 480 SC)	20 g	30.33 (5.59)	4.33 (2.31)	2.80 (1.95)	1.67 (1.62)	1.07 (1.44)	44.50
4	Pride (Acetamiprid 20SP)	20	28.00 (5.38)	4.60 (2.36)	3.07 (2.02)	1.73 (1.65)	1.27 (1.50)	45.42
5	Actara (Thiamethoxam 25 WG)	12.5	30.00 (5.57)	5.27 (2.50)	3.47 (2.11)	2.27 (1.80)	2.33 (1.82)	42.08
6	Chlorantranilipride 18.5 SC(Coragen)	20 g	28.33 (5.40)	5.00 (2.45)	3.33 (2.08)	2.20 (1.79)	2.00 (1.73)	40.83
7	Rogar (Dimethoate 30 EC)	300	27.00 (5.29)	5.67 (2.58)	3.87 (2.20)	2.53 1.88	2.87 (1.96)	41.33
8	Untreated check	-	27.33 (5.32)	25.33 (5.13)	22.67 (4.86)	19.33 (4.51)	17.33 (4.28)	34.58
S.Em±			0.21	0.08	0.07	0.06	0.06	3.17
CD at 5%			0.64	0.25	0.23	0.18	0.18	9.58

Figures in parentheses indicate V_{n+1} transformed value

Date of sowing : 19-11-2013
Date of insecticide application : 26-02-2014
Date of harvest : 15-04-2014

Plot size : Six row of six meter length at 25 cm spacing
Variety : H D 2967
Replication: Three

VI: Biorationals for the management of foliage feeding aphids

Objectives:

(1) To identify the promising botanicals and bio-agents for management of foliar aphid of wheat

(2) To manage aphids on wheat by eco-friendly products.

(3) To reduce indiscriminate use of chemical insecticides.

Treatment details:

1. Neem Seed Extract (NSE)	5 %
2. *Azadirahctin* 1500 ppm	3.0 ml/l
3. Vekhand powder (*Acorus calamus*)	5 g/l
4. *Verticillium lecanni* (2 x 10^8c.f.u)	3 g/l
5. *Beauveria bassiana* (2 x 10^8c.f.u)	5 g/l
6. *Metarhizium anisopliae*	3 g/l
7. Dimethoate 30EC	0.03ml/l
8. Untreated control	

Centre: Ludhiana

This trial was conducted under irrigated conditions at Plant Breeding Research Farm, PAU, Ludhiana. The wheat variety HD 2967 was sown on 7^{th} Nov. 2013 in the plots of 6 rows of 6m length in a replicated trial. Five botanicals/bio-agents were sprayed when the aphid population reached at 4-5 aphids/earhead. There were total of six treatments including untreated check and each was replicated three times. For recording observations, five shoots were earmarked in each plot and from these plants observations were recorded one day before spray and then 1st, 2nd and 7^{th} days after spray.

Aphid population did not differ significantly among all treatments one day before spray (Table 10.18). When observed one day after spray, oxydemton methyl recorded minimum (1.20) aphids/earhead and was significantly lower than all other insecticidal treatments. Similar trend were obtained at 2^{nd} and 7^{th} days after treatments.

Grain yield (q/ha) obtained was maximum (52.44) from oxydemton methyl treated plots and was significantly better than all biorational methods of management of wheat aphids.

Centre: Niphad

The data from (Table 10.19) revealed that among botanicals and biocontrol agents *Azadirahctin* 1500 ppm 3.0 ml/l recorded significantly lower (47.40) population of aphids/shoot/plant at 1 day after spraying followed by NSE 5% (51.70) and *Metarhizium anisopliae* (2 x 10^8 cfu) @ 3g/l (52.90). At 2 DAS, *Metarhizium anisopliae* (2 x 10^8 cfu) @ 3g/l recorded lowest (35.20) population of aphid/shoot/plant. At 7 and 15 DAS, the treatment with *Metarhizium anisopliae* (2 x 10^8 cfu) @ 3g/l recorded minimum (20.60 and 23.90) number of aphids/shoot/plant, followed by NSE 5% (25.00 and 28.70) and *Verticillium lecanii* (2 x 10^8 cfu) @ 3g/l (31.40 and 34.20)

The maximum population of aphids were recorded in untreated control plot recorded maximum number of 60.00, 64.10, 72.10 and 119.70 aphids/shoot/plant at 1, 2, 7 and 15 days after first spray, respectively. The plots treated with dimethoate 30 EC 0.3 ml/l registered significantly minimum number of aphids as compared to rest of the treatments at 1, 2, 7 and 15 days after spray.

Among botanicals and biopesticides, the minimum (18.70, 11.30, 3.90 and 1.10) number of aphids/shoot/plant was recorded in plots sprayed with *Metarhizium anisopliae* (2 x 10^8 cfu) @ 3g/l at 1, 2, 7 and 15 days after second spray, respectively.

The data presented in (Table 10.19) revealed that the lowest (0.10 and 0.33) population of natural enemies was recorded in dimethoate 30 EC 0.3 ml/l at 7 and 15 days after spraying. The yield differences due to spraying of botanicals and biological biopesticides were significant. Among the botanicals and biopesticides, *Metarhizium anisopliae* (2 x 10^8cfu) @ 3g/l recorded highest yield of 50.36 q/ha which was at par with all botanicals and biopesticides except vekhand powder @ 5g/l. Lowest yield was observed from untreated control plot (34.49 q/ha).

Centre: Pantnagar

The data presented in (Table 10.20) showed the efficacy of eco-friendly formulations in comparison to chemical and untreated control. The mean aphid population before Ist spray was not significantly different, it was ranged from 18.53/shoot to 25.27/shoot. After one day of first spray the significantly lowest mean aphid population was recorded in chemical treatment i.e. Dimethoate 30 EC (07.73/shoot) However, among botanicals/bio agent, the lowest mean aphid population was observed in Neem Seed Extract (NSE) @ 5%(16.73/shoot) which was at par with Azadirachtin (17.87/shoot), *Verticillium lecanni* and *Metarhizium anisopliae* (18.00/shoot), *Beauveria bassiana* (18.53/shoot). After second day of Ist spraying, the significantly lower aphid population was observed in Dimethoate 30 EC (5.80/shoot) whereas no significant difference was found among the other treatments where mean aphid population was 15.73/shoot in NSE @ 5% followed by *V. lecanni* (17.67/shoot), *M. anisopliae* (17.80/shoot), Azadirachtin (17.93/shoot), Vekhand powder (20.87/shoot) which was at par with *B. bassiana* (22.00/shoot).

After 7days of Ist spraying lowest aphid population was observed in Dimethoate 30EC (07.07/shoot) whereas among the biorationals sprays the lowest mean aphid population was in NSE @5% (15.80/shoot) in comparison to untreated control (24.07).On the 15th day of Ist spray, it has been clearly noticed that mean aphid population was increased than the aphid population which was recorded on 7th day after spray. The lowest aphid population was found in Dimethoate 30 EC (14.27/shoot), followed by Azadirachtin (15.77/shoot) NSE @ 5% (19.93/shoot).

The mean aphid population before 2nd spray showed that in Dimethoate 30 EC the aphid population was (15.00/shoot) which was significantly different from other biorationals which was ranged from (20.00-27.93/shoot) in comparison to control (26.70).After one day of IInd spraying again the mean aphid population was counted significantly less in Dimethoate 30 EC (7.87/shoot) in comparison to other treatments. Among the biorational treatments the aphid population was significantly different in Azadirachtin (16.00/shoot) followed by NSE (17.60/shoot). Similarly on the 2nd day of IInd spray significantly less mean aphid population was observed in Dimethoate 30 Ec (5.67/shoot) whereas among biorationals, Azadirachtin (14.27/shoot) and NSE @5% (16.60/shoot) had significantly less aphid population in comparison to other biorationals. On 7 and 15th day after II nd spraying , mean aphid population was again significantly less in Dimethoate 30 EC (5.10 and 5.13/shoot) whereas among the biorationals the lowest aphid population was counted in Azadirachtin (10.93) which was at par with NSE @5%(11.27/shoot).

The grain yield clearly revealed the efficacy of biorationals with highest grain yield in NSK @5 (**36.81**q/ha), Azadirachtin (36.51 q/ha), *V. lecanni* (35.25q/h), *M. anisopliae* (**34.95** q/ha), *B bassiana* (**33.69**q/ha) and Vekhand Powder (*Acorus calamus*) (**31.71**/ha) in comparison to chemical Dimethoate 30 EC (29.88 q/ha) and untreated control (24.81 q/ha).

Centre: Karnal

The data from Table 10.21 revealed that the treatments among botanicals and bioagents, *Metarhizium anisopliae* 3 g/l recorded significantly lowest (16.33) population of aphids/shoot/plant at 1 day after spraying. followed by *Beaveria bassiana* (2 x 10^8c.f.u) @5 g/l(19.00) and *Verticillium lecanni* (2 x 10^8c.f.u) @ 3g/l (21.00). At 2 DAS, in treatment with *Metarhizium anisopliae* (2 x 10^8 cfu) @ 3g/l recorded lowest (12.13) population of aphid/shoot/plant. At 7 and 15 DAS, the treatment with *Metarhizium anisopliae* (2 x 10^8 cfu) @ 3g/l recorded minimum (4.93 and 10.00) number of aphids/shoot/plant followed by *Verticillium lecanni* (2 x 10^8c.f.u) @ 3g/l, *Beaveria bassiana* (2 x 10^8c.f.u) @ 5 g/l and *Azadirahctin* 1500 ppm 3.0 ml/ (10.33, 12.67 and 14.00 aphids/shoot/plant).

As against in untreated control plot recorded maximum number of 30.60, 28.20, 22.13 and 25.00 aphids/shoot/earhead/plant at 1, 2, 7 and 15 days after first spray, respectively. The plots treated with dimethoate 30 EC 0.3 ml/l registered significantly minimum number of aphids as compared to rest of the treatments at 1, 2, 7 and 15 days after spray.

The data presented Table 10.21 revealed that yield differences due to spraying of botanicals and biological biopesticides were significant. Among the botanicals and biopesticides, *Metarhizium anisopliae* (2 x 10^8cfu) @ 3g/l recorded highest yield of 48.75 q/ha which was at par with all botanicals. Lowest yield was observed from untreated control plot (37.08 q/ha).

Table 10.18. Biorational for the management of foliage feeding aphids 2013-14 (Centre: Ludhiana)

S. No.	Treatments	Dosages	Aphid population per earhead				
			Before spray	After spray			
			1 day	1 day	2 days	7 days	Grain Yield (q/ha)
1	Neem seed extract	5%	32.40 (5.77)	22.53 (4.85)	20.40 (4.62)	18.86 (4.45)	54.13
2	*Verticillium* sp.	5g/1	32.40 (5.77)	23.06 (4.90)	21.46 (4.73)	17.26 (4.27)	53.86
3	*Beauveria bassiana*	5g/1	31.86 (5.72)	24.66 (5.06)	20.66 (4.65)	17.60 (4.31)	53.95
4	*Metarhizium anisopliae*	3g/1	32.46 (5.78)	23.80 (4.97)	21.80 (4.77)	18.60 (4.42)	54.04
5	Metasystox 25 EC (oxydemton methyl)	125 g ai/ha	32.26 (5.76)	1.52 (1.58)	1.30 (1.51)	1.04 (1.42)	56.08
6.	Control	-	32.73 (5.80)	30.66 (5.62)	28.60 (5.44)	23.53 (4.95)	52.44
CD (p=0.05)			(NS)	(0.19)	(0.22)	(0.25)	1.71

* Figures within parentheses are transformed means

Date of sowing	:	07.11.2013	Plot size	:	7.5 m^2
Date of application	:	07.03.2014	Variety	:	HD 2967
Date of harvest	:	23. 04.2014	Replications	:	Three

Table 10.19. Effect of various bioagents on survival population of foliage feeding wheat aphids, natural enemies and yield 2013-14 (Centre: Niphad)

SN	Treatment details	Dose g a.i./ha	Av. Population of survived foliage feeding wheat aphids/shoot/plant									Population of N. Enemies/ m²		1000 grain weight (gm)	Yield q/ha
				I Spray				II Spray							
			Pre-	1DAS	2DAS	7DAS	15DAS	1DAS	2DAS	7DAS	15DAS	7 DAS	15 DAS		
1	Neem Seed Extract (NSE)	5%	56.90 (7.61)	51.70 (7.26)	46.50 (6.89)	25.00 (5.10)	28.70 (5.45)	24.90 (5.09)	14.30 (3.90)	9.10 (3.17)	12.50 (3.68)	0.77 (1.33)	1.37 (1.54)	51.06	41.45
2	*Azadirahctin* 1500 ppm	3ml/l	56.60 (7.59)	47.40 (6.95)	38.10 (6.25)	34.70 (5.97)	38.50 (6.28)	32.00 (5.74)	22.00 (4.80)	13.00 (3.74)	16.70 (4.21)	0.80 (1.34)	1.40 (1.55)	50.54	40.91
3	Vekhand powder (*Acorus calamus*)	5 g/l	57.30 (7.64)	56.30 (7.57)	51.80 (7.25)	44.30 (6.73)	45.50 (6.81)	40.70 (6.45)	25.70 (5.17)	25.20 (5.12)	34.30 (5.94)	1.40 (1.55)	1.90 (1.70)	47.16	34.96
4	*Verticillium lecanni* (2 x 10^8cfu)	3 g/l	56.90 (7.61)	53.60 7.39)	43.40 (6.66)	31.40 (5.69)	34.20 (5.93)	26.90 (5.28)	14.00 (3.87)	7.00 (2.83)	3.90 (2.22)	0.93 (1.39)	0.83 (1.35)	51.34	45.39
5	*Beaveria bassiana* (2 x 10^8cfu)	5 g/l	56.40 (7.58)	55.10 (7.49)	44.90 (6.78)	32.50 (5.78)	36.40 (6.11)	29.90 (5.53)	18.00 (4.36)	8.50 (3.09)	5.30 (2.52)	0.90 (1.38)	0.87 (1.37)	51.16	41.44
6	*Metarhizium anisopliae*	3 g/l	55.90 (7.54)	52.90 (7.34)	35.20 (6.01)	20.60 (4.65)	23.90 (4.99)	18.70 (4.44)	11.30 (3.51)	3.90 (2.22)	1.10 (1.43)	0.80 (1.34)	0.87 (1.37)	51.66	46.38
7	Dimethoate 30 EC	0.3 ml/l	57.30 (7.64)	21.70 (4.77)	6.60 (2.76)	13.00 (3.74)	17.10 (4.25)	7.00 (2.83)	2.90 (1.98)	6.00 (2.65)	8.90 (3.15)	0.10 (1.05)	0.33 (1.15)	52.10	50.36
8	Untreated control	-	57.10 (7.62)	60.00 (7.81)	64.10 (8.07)	72.10 (8.55)	119.70 (10.99)	127.80 (11.35)	168.80 (13.0)	224.10 (15.0)	210.50 (14.54)	1.70 (1.64)	2.10 (1.76)	47.09	34.49
	SE ±		0.03	0.06	0.06	0.07	0.05	0.04	0.07	0.06	0.07	0.03	0.02	0.10	3.21
	CD at 5%		NS	0.17	0.19	0.21	0.14	0.13	0.20	0.18	0.21	0.09	0.06	0.31	9.71

- DAS- Days After spray, figures in parentheses indicate V_{n+1} transformed value,
- Date(s) of Insecticidal application: i) 16/12/2013ii) 31/12/2013   Date of Harvest: 25/03/2014

TABLE 10.20 ECO-FRIENDLY MANAGEMENT OF FOLIAGE FEEDING APHIDS ON WHEAT (2013-2014)

S.No.	Treatments	Dosage g a.i./ha	Aphid population per shoot					Aphid population per shoot					Grain Yield (q/ha)
			Before Spray	After I st spray				Before Spray	After II nd Spary				
			1 day	1day	2days	7days	15 days	1 day	I day	2 days	7 days	15 days	
1.	Neem seed Extract (NSE)	5%	21.40 (27.52)*	16.73 (24.06)	15.73 (23.32)	15.80 (23.37)	19.93 (26.50)	22.60 (28.37)	17.60 (24.76)	16.60 (24.02)	14.67 (22.49)	11.27 (19.59)	**36.81** (40.78)
2.	Azadirachtin 1500 ppm	3.0ml/l	25.27 (30.14)	17.87 (24.99)	17.93 (25.01)	18.53 (25.47)	15.77 (23.33)	20.00 (26.51)	16.00 (23.51)	14.27 (22.13)	13.13 (21.11)	10.93 (19.29)	**36.51** (40.92)
3.	Vekhand Powder (*Acorus calamus*)	5g/l	24.20 (29.44)	21.53 (27.62)	20.87 (27.14)	19.87 (26.41)	27.53 (31.63)	27.53 (31.63)	24.07 (29.37)	22.73 (28.46)	27.38 (21.20)	16.03 (23.56)	31.71 (36.33)
4.	*Verticillium lecanni* (2x10[8] c.f.u.)	3g/l	19.40 (26.13)	18.00 (25.10)	17.67 (24.84)	18.00 (25.06)	25.93 (30.56)	27.93 (31.89)	24.80 (29.84)	24.60 (29.72)	23.27 (28.83)	15.67 (23.24)	**35.25** (39.32)
5.	*Beauveria bassiana* (2x108 c.f.u.)	5g/l	19.00 (25.78)	18.53 (25.40)	22.00 (27.94)	21.30 (27.48)	28.40 (32.20)	27.07 (31.34)	24.63 (29.74)	24.53 (29.67)	21.53 (27.62)	15.40 (23.10)	**33.69** (38.42)
6.	*Metarhizium anisopliae*	3g/l	18.53 (25.43)	18.00 (25.02)	17.80 (24.86)	18.00 (24.98)	25.00 (29.99)	25.20 (30.12)	25.00 (29.99)	23.73 (29.14)	19.63 (26.29)	17.13 (24.43)	**34.95** (38.82)
7.	Dimethoate 30 EC	0.3ml/l	20.80 (27.09)	07.73 (16.13)	05.80 (13.93)	07.07 (15.38)	14.27 (22.18)	15.00 (22.76)	7.87 (16.28)	5.67 (13.73)	05.10 (13.04)	05.13 (13.04)	29.88 (33.62)
8.	Untreated control	-	20.00 (26.55)	22.73 (28.46)	24.70 (29.37)	24.07 (29.35)	25.60 (30.39)	26.70 (31.09)	26.27 (30.79)	26.33 (30.85)	24.07 (29.34)	17.53 (24.74)	24.81 (28.24)
	SEm±		1.50 (1.20)	1.66 (1.24)	1.45 (1.08	1.55 (1.13)	1.35 (0.93)	1.19 (0.81)	1.41 (0.99)	1.18 (0.86)	1.38 (1.03)	1.01 (0.85)	0.006 (0.010)
	Cd 5%		4.51 (3.63)	5.04 (3.76)	4.40 (3.28)	4.71 (3.44)	4.10 (2.83)	3.62 (2.47)	4.28 (3.01)	3.58 (2.60)	4.20 (3.14)	3.08 (2.58)	0.019 (0.031)

*Figures in parenthesis are angular transformed values

Date of sowing:02/12/2013 Plot size: 10.5 sq. m Date of Harvest: 27/04/2014

Dates of Insecticidal applications: I[st] 08/02/2014 and II[nd] 27/02/2014 Variety sown: UP 2465 Replications:03

Table 10.21. Eco-friendly management of foliage feeding aphids on wheat during 2013-14 (Centre: Karnal)

S. No.	Treatments	Dose ml or g / ha	Aphid population per shoot					Grain yield (q./ha.)
			Before spray	After Spray				
				1 Day	2 Day	7 Day	15 Day	
1.	*Azadirahctin* 1500 ppm	3.0 ml/1	30.67 (5.63)	22.60 (4.86)	14.40 (3.92)	11.40 (3.52)	14.00 (3.87)	45.05
2.	Vekhand powder (*Acorus calamus*)	5 g/1	29.33 (5.51)	28.33 (5.42)	23.00 (4.90)	19.60 (4.54)	20.67 (4.65)	45.37
3.	*Verticillium lecanni* (2 x 10^8c.f.u)	3 g/1	28.67 (5.45)	21.00 (4.69)	13.20 (3.77)	7.67 (2.94)	10.33 (3.37)	47.48
4.	*Beaveria bassiana* (2 x 10^8c.f.u)	5 g/1	28.33 (5.42)	19.00 (4.47)	18.60 (4.43)	8.60 (3.10)	12.67 (3.70)	42.92
5.	*Metarhizium anisopliae*	3 g/1	32.67 (5.80)	16.33 (4.16)	12.13 (3.62)	4.93 (2.44)	10.00 (3.32)	48.75
6.	Dimethoate 30 EC	0.3ml/1	29.00 (5.48	10.00 (3.32)	5.40 (2.53)	8.40 (3.07)	20.80 (4.67)	43.33
7.	Untreated control	-	29.67 (5.54)	30.60 (5.62)	28.20 (5.40)	22.13 (4.81)	25.00 (5.10)	37.08
S.Em±			0.14	0.11	0.13	0.14	0.15	1.89
CD at 5%			0.42	0.33	0.40	0.43	0.45	5.83

Figures in parentheses indicate V_{n+1} transformed value

Date of sowing : 19-11-2013
Date of bio-agent application : 26-02-2014
Date of harvest : 15-04-2014

Plot size : Six row of six meter length at 25 cm spacing
Variety : H D 2967
Replication :Three

VII: Additional Experiment.

AE 1: Management of wheat root aphid *(Rhopalosiphum rufiabdominalis)* with seed treatment of different insecticides.

Centre: Ludhiana

Management by seed treatment: This experiment was conducted in the rainfed fields at Plant Breeding Research Farm PAU Ludhiana. The wheat variety PBW 175 was sown on 6th Nov 2013. Before sowing, the seed was treated with five different insecticides separately by spraying on the spreaded layer of equal quantity of seed on polyethene sheet. The treated seed was dried overnight before sowing. There were six treatments including untreated check and each was replicated thrice.

The data on root aphid incidence indicated that 21 days after seed treatment, minimum root aphid population was observed in imidacloprid 600 FS (4.06) treated plots and which was significantly lower than untreated control but at par with all other treatments (Table 10.22). Similarly after 28 days, minimum root aphid population (4.66) was observed in imidacloprid 600 FS followed by thiamethoxam 70WS treated plots (6.66). Similarly 35 days after seed treatment, root aphid population/tiller was significantly low in thiamethoxam 70WS treated plots which were at par with other insecticidal treatment but better than untreated check. Thus, it was concluded that seed treatment with imidacloprid 600 FS @ 1.0 ml/kg seed followed by thiamethoxam 70WS @ 1.0 g/kg seed can be used for the management of root aphid.

AE 2: Eco-friendly management of foliage aphid on wheat through animal origin product cow urine based treatments.

Centre: Pantnagar

The trial was conducted on the use of cow urine at different concentrations @ 10%, 20%, 50% and 100% and neem leaf and seed powder extracts@ 2% were prepared in cow urine (10%) for management of foliage aphid on wheat. In this trial, in place of chemical fertilizer organic manure was prepared using cow dung and cow urine and applied in the plots every after 21 days after sowing, whereas in other experiments urea was applied twice after sowing in the plots. The data presented in (Table 10.23) showed that before one day of Ist spraying the mean aphid population was not significantly different among the treatments (19.00-20.80/shoot). After one day of Ist spray mean aphid population was significantly different in Dimethoate 30 EC (11.50/shoot) whereas in remaining treatments there were no significance difference in aphid population i.e. ranged from 19.30/shoot to 20.73/shoot. After 2nd day of I st spray significant less mean aphid population was observed in dimethoate 30 EC (07.43/shoot) followed by NSCUE (14.80/shoot) in comparison to untreated control (24.87/shoot). On the 7 day of Ist spray, mean aphid population was lowest in Dimethoate 30 EC (5.20/shoot) followed by NSCUE @ 2% (14.53/shoot). After 15 days of Ist spray, Dimethoate 30 EC spray showed the least mean aphid population (06.33/shoot)but among the eco-friendly cow urine treatments significant less aphid population was observed in @ 20% (15.07/shoot) which was at par with NSCUE @2% (15.37/shoot), cow urine @10% (16.93/shoot) in comparison to untreated control (24.93/shoot).

In the observations made before one day of IInd spraying, the mean number of aphids was ranged from 9.33/shoot (dimethoate 30EC) to 21.07/shoot (cow urine @100%)

treated plots. However, in all the treatments, the populations of wheat aphids were not significantly different from each other. After one day of IInd spraying, among the treatments, maximum number of aphids (20.33/shoot) were found in the plot treated with cow urine @10%,while the minimum (05.67% aphids/shoot) was observed in Dimethoate 30 EC treated plot. Among the eco-friendly cow urine based treatments the significantly lowest mean aphid population was recorded in NSCUE @ 2% (14.66/shoot) followed by cow urine @20% (15.53%). In all treatments, after 2, 7, and 15 days of spraying, aphid population varied non significantly among the cow urine based treatments but significantly lowest population was found in NSCUE @2% (10.23/shoot). In comparison to eco-friendly cow urine based treatments significant decrease in the mean aphid population was observed after 15 days of application in chemical , Dimethoate 30EC (3.87/shoot).

The grain yield in eco-friendly cow urine treatments was found significantly highest in NSCUE @2% in comparison to untreated control.

CONCLUSIONS

The high population of natural enemies (natural control) was observed in the plots of eco-friendly management approaches such as application of biorationals and cow urine based treatments. The natural enemies such as predators: nymph and adults of Coccinella beetle, larvae of chrysopa and maggots of syrphid fly and braconid parasitoid. *Diaeretiella rapae* laid eggs inside the bodies of aphid which turned dead and mummified on the foliage. Predatory bugs and spiders were also found in the plots of eco-friendly management approaches in wheat crop. The cocoons of *Cotesia* (larval parasitoid) were also observed during March 2014 when *Helicoverpa armigera* larval population (only 5-10%) was seen in wheat foliage cocoon.

The aphid population was significantly high on wheat foliage in eco-friendly treatments (biorationals and cow urine) in comparison to chemical treated wheat foliage. Chemical application was hazardous and killed the higher aphid population with significantly less grain yield in comparison to eco-friendly treatments may be due to ill effects of chemicals on crop physiology. In cow urine treatments clear observations were made during spraying of cow urine @ 50 %and 100% which caused scorching of wheat foliage which affected the grain yield.

Thus, it may be concluded that animal origin product, cow urine is safe, eco-friendly, readily available, almost free of cost to farmers and have long term effect without having any adverse effect on crop (if applied in diluted form (@ 20%), environment and human health in comparison to hazardous chemicals.

Further studies are surely required to come to the final conclusions regarding the role of cow urine and its combination with plant extracts and use of biorationals for management of foliar aphids in wheat crop.

Table 10.22. Effect of different seed treatments on the population dynamics root aphid during 2013-14 (Centre: Ludhiana)

S.No.	Treatments	Dosage a.i./Kg seed	Dose ml or g / kg of seed	Number of root aphid/tiller		
				21 days after sowing	28 days after sowing	35 days after sowing
1	Imidacloprid 600 FS (Gaucho)	480	1.0 ml	4.06 (2.24)	4.06 (2.24)	4.53 (2.34)
2	Clothianidin 50 WDS (Dantotsu)	0.75	1.5 g	5.26 (2.50)	5.86 (2.62)	4.80 (2.40)
3	Chlorantranilipride 18.5 SC(Coragen)	0.185	1.0 ml	5.20 (2.48)	6.40 (2.71)	4.60 (2.36)
4	Thiamethoxam 70 WS (Cruiser)	0.7	1.0 g	4.46 (2.32)	4.66 (2.37)	4.33 (2.30)
5	Fipronil 5 SC (Regent)	0.3	6.0 ml	5.73 (2.59)	6.26 (2.69)	5.46 (2.53)
6	Untreated check	-	-	14.26 (3.90)	13.60 (3.81)	11.46 (3.52)
CD (p=0.05)				(0.29)	(0.24)	(0.35)

* Figures in parentheses are transformed means

Date of sowing	: 06.11.13	Plot size	:	40 m^2
Date of insecticidal application	: 05.11.2013	Variety	:	PBW 644
Date of harvest	: 22. 04.2014	Replications	:	Three

TABLE 10.23: ECO-RIENDLY MANAGEMENT OF APHIDS ON WHEAT (2013-2014)

S.No.	Treatments	Conc. %	Aphid population per shoot					Aphid population per shoot					Grain Yield (q/ha)
			Before Spray	After I^st spray				Before Spray	After II ^nd Spary				
			1 day	1 day	2days	7 days	15 days	1 day	I day	2 days	7 days	15 days	
1.	Cow Urine	10%	19.87 (26.45)*	19.80 (26.40)	21.07 (27.31)	20.13 (26.65)	16.93 (24.06)	18.60 (25.50)	20.33 (26.72)	19.53 (26.17)	19.27 (26.02)	19.47 (26.14)	27.81 (32.34)
2.	Cow urine	20%	20.80 (27.08)	19.30 (29.27)	19.33 (26.05)	25.00 (29.95)	15.07 (22.82)	16.00 (23.55)	15.53 (23.20)	15.33 (23.04)	15.47 (22.55)	13.10 (21.56)	**33.36** (38.33)
3.	Cow urine	50%	19.00 (25.81)	19.40 (26.09)	20.47 (26.88)	28.27 (32.11)	20.20 (26.67)	19.50 (26.14)	18.93 (25.75)	17.53 (24.73)	16.07 (23.13)	15.27 (21.21)	28.71 (32.73)
4.	Cow Urine	100%	19.47 (26.16)	19.53 (26.22)	20.73 (27.07)	22.87 (28.53)	19.60 (26.23)	21.07 (27.30)	19.93 (26.50)	17.60 (24.77)	15.30 (23.57)	14.07 (22.91)	27.33 (32.16)
5.	Neem Leaf Cow urine Extract (NLCUE)	2% (in cow urine 10%)	19.27 (25.99)	19.80 (26.37)	21.27 (27.44)	22.53 (28.19)	19.0 (25.85)	19.73 (26.29)	17.27 (24.49)	16.60 (23.99)	14.73 (22.99)	13.53 (21.98)	**34.92** (38.81)
6.	Neem Seed Cow urine Extract (NSCUE)	2% (in cow urine 10%)	19.67 (26.31)	20.73 (27.06)	14.80 (22.58)	14.53 (22.40)	15.37 (23.07)	16.87 (24.23)	14.66 (22.49)	13.27 (21.31)	10.23 (18.61)	10.33 (18.68)	**36.45** (40.90)
7.	Dimethoate	0.3ml/l/l	20.40 (26.84)	11.50 (26.04)	07.43 (15.81)	05.20 (13.14)	06.33 (14.56)	09.33 (15.67)	05.67 (11.02)	04.80 (9.60)	04.20 (8.49)	03.87 (7.83)	28.11 (32.46)
8.	Untreated Control		20.20 (26.69)	23.93 (19.80)	24.87 (29.89)	25.07 (30.04)	24.93 (29.95)	23.67 (29.10)	23.13 (28.74)	22.93 (28.60)	22.80 (28.51)	19.27 (26.02)	25.68 (30.41)
	SEm±		1.17 (0.83)	1.28 (0.93)	1.12 (0.82)	1.70 (1.18)	1.74 (1.33)	1.51 (1.14)	1.32 (0.98)	1.23 (0.96)	1.04 (0.86)	1.29 (1.06)	0.15 (0.13)
	Cd 5%		3.54 (2.51)	3.88 (2.81)	3.40 (2.48)	5.15 (3.58)	5.29 (4.03)	4.59 (3.45)	3.99 (2.97)	3.72 (2.90)	3.15 (2.61)	3.90 (3.22)	0.44 (0.40)

*Figures in parenthesis are angular transformed values

Date of sowing:02/12/2013 Plot size: 10.5 sq. m Replications:03

Date of I^st Spray Application:08/02/2014 and II^nd spray:27/02/2014 Variety sown: UP 2465 Date of Harvest: 27/04/2014

Experiment No.7. Chemical control of foliage feeding brown wheat mites (*Petrobia latens*) on wheat crop

Centre: Durgapura

A trial was laid out at RARI, Durgapura, Jaipur for the management of brown wheat mites *Petrobia latens* on the wheat crop through foliar application of acaricide and conventional insecticides. There were eight treatments including untreated check and each treatment was replicated thrice .The wheat variety Raj-4229 was sown on 22.11.2013 in plots of 16 sq m size. The mites/10 cm^2 area on three tagged plants from each plot separately was recorded from different replications at 3, 5, 7 and 15 days after spray whereas, yield was recorded at harvest. The infested plants were tapped over 4 glycerine-smeared slides held in a thermo Cole sampler at ground level for recording the mite population. The observations were recorded from 3 spots per plot. The average of the data was computed to number of mites/10 cm^2 area. The percent reduction was calculated by Henderson and Tilton's formula. The data presented in (Table 10.23) revealed that all the treatments reduced the mite population significantly and increased the grain yield as compared to untreated check. Initially or before spray the mites population was statically non significant, after 3rd day of spray the minimum mites population was spiromesifen at 1.0 ml/L (8.33:69.75) at par with propargite at 1.5 ml/L(8.66:68.69), fenazquine 2.0 ml/L (9.55:65.72) and profenofos at 1.0 ml/L (9.66:65.39) when compared to untreated check (27.66). Observations taken after 5rd day of spray indicated that the minimum mite population was observed in spiromesifen (7.00:76.21), at par with all treatments except dicofol (8.99:69.), followed by ethion (9.33:68.29) All the.se treatments were significantly better than untreated check (29.55). On 7th day the mite population was recorded minimum in spiromesifen (5.88:81.73) at par with bifenthrin at 0.8 ml/L (6.11:80.94), fenazquine (6.89:78.78) and profenofos 7.11:78.20). The mite population in all treatments were significantly lower than untreated check (32.33).

The mite population count was slightly increases by 15th day of spray and reorded minimum in spiromesifen (7.78:76.40) at par with bifenthrin (8.88:72.95) propargite (9.55:71.16) and fenazquine (9.55:71.28) and profenofos (10.00:70.07) as compare to maximum mite population in untreated check (33.11). On the basis of pooled average mite population of all four intervals, the minimum mite population with higher percent reduction was recorded in spiromesifen (7.24:76.28), propargite (8.21:73.22), bifenthrin (8.27:72.79), fenazquine (8.41:7269) and dicofol (9.13:69.96) as compared to standard check ethion (10.97:64.07, the maximum average mite population after all four intervals was recorded in untreated check (30.66). The maximum grain yield (q/ha) was observed in plots treated with spiromesifen (31.08) at par with propargite (30.12) followed by other treatments and at par each other and better than ethion (26.48) which was significantly better than untreated check (22.50).

Centre: Ludhiana

This trial was conducted under unirrigated conditions at Experimental Area, Department of Plant Breeding, Genetics and Biotechnology, Punjab Agricultural University, Ludhiana.. The wheat variety PBW 644 was sown on 7.11.2013 in the plots of 6 rows, 6m long in a replicated trial. There were eight treatments including untreated control. The population form each plot was recorded and expressed as mites/10 cm^2 slide area. All the pesticides were applied on 21.03.2014 when mite population reached at its peak. Observations were recorded one day before and one, two and seven days after spraying randomly from each plot. The data on grain yield per plot was recorded and converted to q/ha.

The data on mean mite incidence one day before spray indicted non-significant differences among all the treatments (Table 10.24). When observed one day after spray, propargite @ 1.5 g a.i./ha treated plots recorded significantly lower mites/10cm^2 area (2.46) as compared to all other treatments. However, the mite population in all these treatments was significantly lower than untreated control (43.06). Similarly, two days after spray, all the insecticidal treatments had significantly lower mite population than untreated control. Also 7 days after treatments observations revealed that propargite @ 1.5 g a.i./ha was superior treatment in their efficacy against brown wheat mite.

The efficacy of insecticidal treatments in protecting the grain yield revealed that, propargite @ 1.5 g a.i./ha (47.28) was superior recording highest yield and were at par with all other insecticidal treatments.

Table 10.23. Chemical control of foliage feeding brown wheat mites (*Petrobia latens*) on wheat crop 2013-14 (Centre: Durgapura)

S. No	Treatments	Dose ml./L	Average number of mites population/10 cm2 after spray					Av. mites Overall average population after sprays	Grain yield (q/ha)	Increased Yield (q/ha) Over untreated
			Before spray	3Days	5 Days	7 Days	15 Days			
1	Dicofol 18.5 EC (Colonel)	2.0 ml	25.33a	10.00a (63.53)*	8.99b (69.31)	7.22b (77.47)	10.33b (68.53)	9.13 (69.96)*	29.05b	6.55
2	Propargite 57 SC (Omite)	1.5 ml	25.55a	8.66a (68.69)	7.88a (73.33)	6.77a (79.06)	9.55a (71.16)	8.21 (73.22)	30.12a	7.62
3	Spiromesifen 240 SC (Oberon)	1.0 ml	25.44a	8.33a (69.75)	7.00a (76.21)	5.88a (81.73)	7.78a (76.40)	7.24 (76.28)	31.08a	8.58
4	Bifenthrin 10EC (Talstar)	0.8 ml	25.33a	10.55b (61.53)	7.55a (74.23)	6.11a (80.94)	8.88a (72.95)	8.27 (72.79)	28.78b	6.28
5	Profenofos 50EC (Karina)	1.0 ml	25.78a	9.66a (65.39)	7.77a (73.97)	7.11a (78.20)	10.00a (70.07)	10.86 (64.90)	28.66b	6.16
6	Fenazquine10 EC (Majester)	2.0 ml	25.66a	9.55a (65.72)	7.66a (74.19)	6.89a (78.78)	9.55a (71.28)	8.41 (72.69)	29.45b	6.95
7	Ethion 50 E C	1.0 ml	25.44a	14.11c (48.77)	9.33c (68.29)	9.22c (71.36)	11.22b (65.97)	10.97 (64.07)	26.48c	3.98
8	Control	-	25.55a	27.66d	29.55d	32.33d	33.11c	30.66	22.50d	-
	S. Em ±		0.36	0.60	0.52	0.65	0.80	-	0.43	-
	CD 5%		NS	1.84	1.59	1.98	2.44	-	1.30	-

Figures followed by same alphabets are statistically at par, **Figures in parenthesis are reduction percent based on Henderson-Tilton's formula,

Date of sowing	: 22.11.20113	Plot size	: 4.0 x 3.0 sq.m.
Date of insecticidal spray	: 15.03.2014	Variety	: Raj-4229
Date of harvesting	: 08.4.2014	Replications	: Three

Table 10.24. Chemical control of foliage feeding brown wheat mites (*Petrobia latens*) on wheat 2013-14 (Centre: Ludhiana)

S.No.	Treatments	Dosages (ga.i./ha)	Brown wheat mite population/ 10cm²				Grain Yield (q/ha)
			Before spray	After spray			
			1 day	1 day	2 days	7 days	
1	Dicofol 18.5 EC (Colonel)	2.0	43.46 (6.66)	3.93 (2.22)	2.60 (1.89)	2.86 (1.96)	46.75
2	Propargite 57 SC (Omite)	1.5	42.26 (6.57)	2.46 (1.86)	2.13 (1.76)	2.33 (1.81)	47.28
3	Spiromesifen (Oberon 240 SC)	1.0	42.33 (6.58)	3.46 (2.11)	2.53 (1.87)	3.33 (2.07)	46.93
4	Fenazquine (Majester 10 EC)	2.0	42.86 (6.62)	3.53 (2.12)	2.73 (1.93)	3.26 (2.05)	46.40
5	Bifenthrin 10EC (Talstar)	0.8	43.26 (6.65)	3.46 (2.11)	2.80 (1.94)	3.26 (2.06)	46.13
6	Profenofos 50EC (Karina)	1.0	42.93 (6.62)	3.20 (2.04)	3.06 (2.00)	2.40 (1.84)	45.77
7	Dimethoate 30 EC (Rogor)	1.0	43.53 (6.67)	3.26 (2.06)	2.73 (1.93)	2.93 (1.98)	45.78
8.	Control	-	43.06 (6.63)	39.93 (6.39)	36.80 (6.14)	30.53 (5.61)	44.17
	CD (p=0.05)		(NS)	(0.16)	(0.21)	(0.24)	2.70

* Figures within parentheses are transformed means

Date of sowing	: 07. 11.13	Plot size	: 7.5m²
Date of insecticidal application	: 22. 03.2014	Variety	: PBW 644
Date of harvest	: 23. 04.2014	Replications	: Three

10.3 INTEGRATED PEST MANAGEMENT

I: Survey of pests infesting wheat and their natural enemies

Centre: Durgapura

Survey of pests infesting wheat and barley and their natural enemies was carried out during the crop season 2013-2014. The termite damage in wheat fields remained moderate throughout the crop season (Table 10.25). Population of brown wheat mite was medium and noticed on the later or ear head stage of the crop. However, the attack of pink stem borer in wheat was also observed during survey of wheat crop. The incidence of *Spodoptera litura* and *Helicoverpa armigera* was very low but widespread. To explore the bio-diversity of insect pests and their natural enemies in barley during the crop season, the aphid population was moderate to high and predators like Coccinellid beetles *Coccinella septempunctata* was also observed as predating on barley aphids. The *Rhopalosiphum maidis* was observed as the predominant species of aphid in almost all the surveyed of barley crop locations in the zone. The termite infestation in barley crop was remained 5-10 per cent in the zone. Occasionally reports of *Spodoptera litura* and *Helicoverpa armigera* infesting barley fields were also received from some locations during surveyed.

Centre: Niphad

Survey of wheat field was carried out in some villages of Nasik and Dhule districts. The aphid population in Nasik district was heavy. The severity of damage was recorded up to 5 to 35 per cent. The infestation of root aphid was observed in medium intensity in Dhule district. The *Coccinellid* grubs and beetles were also seen frequently in the fields infested with aphids (Table 10.27). The farmers adopted the control measure for the management of aphids.

Centre: Ludhiana

In order to monitor the insect pest of wheat, survey of Punjab state were undertaken during 2013-14 crop season. Sporadic incidence of termites was observed in village Bargari, District Faridkot. Moderate to severe incidence of wheat aphid was observed in some village of Karnal (Bastli), Kaithal (Batta and Dakala), Jind (Danola), Hisar (DWR research Farm), Mukatsar (Chakdiwala), Sarenaga (Sekha Kalan) and Moga. Moderate termite damage was recorded in some parts of Karnal (Basthali) and Kaithal (Batta) while minor incidence of Pink stem borer was observed in village Bilaspur, district Dabwali and some parts of Nawanshahr district. The grubs and adults of coccinellid beetles were seen frequently in fields infested with aphids. In most parts of Punjab, farmers practiced 1-2 sprays to control wheat aphid in their field. Low level of root aphid incidence was also observed in few fields in KVK, Bahowal and adjoining areas.

Centre: Vijapur

Survey of wheat & barley fields were carried out in the state during the crop season. The termite damage in wheat fields remained moderate through the crop season. The population of *H. armigera*, pink stem borer, aphid, surface grasshopper, *Spodoptera*, thrips, shoot fly, brown mite, jassids and cut worm were negligible. In barley fields, the aphid population was low to moderate. Among natural enemies, *Campolatis chlorideae* a larval parasite of *H. armigera* was observed. Predators like coccinellid beetles, chrysoperla and syrphid fly were frequently noticed predating wheat and barley aphids.

Centre: Kanpur

Survey was made at Daleep Nagar and Bojhha Farm dated 30.01.2014. The incidence of shoot fly was observed (12%) in varieties PBW343, DBW 39, K 9107 and Halna. The incidence of termite was observed in irrigated crop 20 per cent and cut worm infestation 1.5 per cent in same varieties.

During the survey of pest infesting wheat crop in IInd week of Feb. 2014 at Village. Deegh, Murlipur, Muradpur, Devipurwa and Mati were observed at booting stage of termite infestation 20 per cent in irrigated wheat crop, Aphid infestation was observed in barley crop moderately resistance in different cultivar on varieties K502, Halna, HD 2733, DBW 39, K 0307 and K551 (Barley). Survey of 2nd week of Feb. 2014 pest infestation fields wheat & barley in village Bhailamau was observed termite infestation 12 per cent in irrigated fields on varieties DBW 39, PBW 343, HD 2733 & Halna, in Barley Var. K 551. The infestations of shoot fly 12.0 per cent in wheat crop. The minor incidence of pink stem borer 2.0 per cent (Table 10.28).

Centre: Karnal

The survey of wheat in Punjab and Haryana state were undertaken during 2013-14 crop season. Moderate to severe incidence of wheat aphid was observed in some village (Table 10.30) of Karnal (Bastli), Kaithal (Batta and Dakala), Jind (Danola), Hisar (DWR research Farm), Mukatsar (Chakdiwala), Sarenaga (Sekha Kalan) and Moga. Moderate termite damage was recorded in some parts of Karnal (Basthali) and Kaithal (Batta). Minor incidence of Pink stem borer was observed in village-Harsoda, district Karnal in village Bilaspur, district Dabwali and some parts Nawanshahr district. The grubs and adults of coccinellid beetles were seen frequently in fields infested with aphids.

Table 10.25. Survey of wheat and barley pests and their natural enemies (Centre: Durgapura) 2013-14.

Locality and date of visit	Area surveyed (Rainfed) / Irrigated	No. of samples observed	Variety and stages of growth	Crop Pests			Natural enemy	
				Name	Status Major/minor	Intensity Attack (% damage or population	Name	Stage Parasitisation/ predation
10.12.2013 Chomu & adjoined area	Irrigated	15	Raj-3077 Raj-3765 Raj-4037 Barley-RD-387 Barley-RD-2592	Termite	Major	1-2%	-	-
18.01.2014 Diggi & adjoined area	Unirrigated	10	Raj-3077 Raj-3765 Raj-4037 Barley 2552 Barley-RD-2592	Termite Aphids	Major Major	2-5 % 15-20 aphids/shoots	- *Coccinella*	- Predatory
20.02.2014 Bassi, Dausa & adjoined area	Irrigated	15	Raj-3077 Raj-3765 Raj-4037 Barley-RD-2592	Aphids Termite Mites *Heliothis* *Spodoptera*	Major Major Minor Minor	20-30 aphids/shoot 8-10% 1-2% 0-1%	*Coccinella*	Predatory
05.03.2014 Shahapura & adjoined area	Irrigated	10	Raj-3077 Raj-3765 Barley-RD-2592 Barley 2552	Aphids Termite *Heliothis* *Spodoptera*	Major Major Minor Major	15-20 aphids/shoot 10-15% 1-2% 0.5 1 %	-	

Table 10.26. Survey of pests infesting wheat and their natural enemies 2013-14 (Centre: Shillongani)

Locality & date		Area surveyed (Rainfed/Irrigated)	No. of samples observed	Variety & Stage of Growth	Crop Pest Name, Intensity of damage, Status of attack	Natural enemy
2 FN, Dec.,13	Bhakatgaon, Nagaon	Rainfed	3	Vegetative stage	Sporadic infestation of Cutworm, Field Cricket	
	Sesamukh, Nagaon	- do-	2	CBW 38	- do -	
	Mohkhuli, Dhing	- do-	2	- do -	- do -	
	Solmari, Dhing	- do-	5	- do -	- do -	
	Karati Pam, Morigaon	- do-	10	- do -	- do -	
1 FN, Jan.,14	Bhakatgaon, Nagaon	- do-	3		Sporadic infestation of Flea Beetle (*Monolepta signata*) & Foliar aphid	
	Sesamukh, Nagaon	- do-	2		- do -	
	Mohkhuli, Dhing	- do-	2		- do -	
	Karati Pam, Morigaon		10		- do -	
	Milikbasti, Hojai		5		- do -	
2 FN, Jan.,14	Bhakatgaon, Nagaon	- do-	3		Sporadic infestation of Foliar aphid	
	Sesamukh, Nagaon	- do-	2		- do -	
	Solmari, Dhing	- do-	5		- do -	
	Karati Pam, Morigaon		10		- do -	
	Milikbasti, Hojai		5		- do -	
1 FN, Feb., 14	Bhakatgaon, Nagaon	- do-	3	Reproductive stage	Beginning of Sporadic infestation of Wheat Aphid (*Sitobion miscanth*)	*Micraspis discolor*, *Coccinella repanda*, *Cccinella septempunctata* are the predators recorded in the wheat fields in the reproductive stage of the crop. *M.*
	Sesamukh, Nagaon	- do-	2		- do -	
	Mohkhuli, Dhing	- do-	2		- do -	
	Solmari, Dhing	- do-	5		- do -	
	Karati Pam, Morigaon		10		- do -	
	Milikbasti, Hojai		5		- do -	
2 FN, Feb., 14	Bhakatgaon, Nagaon	- do-	3		White ear head (WEH), 10%	
	Sesamukh, Nagaon	- do-	2		White ear head (WEH), 8%	
	Mohkhuli, Dhing	- do-	2		Aphid (*Sitobion miscanthi*) infestation 16 %, WEH (%) = 4	
	Solmari, Dhing	- do-	5		*Heliothis armigera* larvae, *Nezara viridula* recorded. Aphid infestation 12%, WEH (%) = 10	

Locality & date		Area surveyed (Rainfed/Irrigated)	No. of samples observed	Variety & Stage of Growth	Crop Pest Name, Intensity of damage, Status of attack	Natural enemy
	Karati Pam, Morigaon		10		Aphid infestation 20 %, WEH (%) = 8	*discolor* and C. *repanda* are the common predators of aphid. Syrphid larvae are also good predators of aphid.
	Milikbasti, Hojai		5		*Heliothis armigera* larvae, *Nezara viridula*, Euproctis larvae recorded	
1 FN, Mar., 14	Bhakatgaon, Nagaon	- do-	3		Aphid infestation 8 %, WEH (%) = 6	
	Sesamukh, Nagaon	- do-	2		Aphid infestation14 %, WEH (%) = 10	
	Mohkhuli, Dhing	- do-	2		*Heliothis armigera* larvae, *Nezara viridula*	
	Solmari, Dhing	- do-	5		Aphid infestation 9 %, WEH (%) = 5	
	Karati Pam, Morigaon		10		Aphid infestation 16 %, WEH (%) = 8	
	Milikbasti, Hojai		5		Aphid infestation 6 %,	
2 FN, Mar., 14	Bhakatgaon, Nagaon		3		No major pests recorded	
	Sesamukh, Nagaon		2		- do -	
	Mohkhuli, Dhing		2		- do -	
	Solmari, Dhing		5		- do -	

Table 10.27. Survey & surveillance of wheat growing areas 2013-14 (Centre: Niphad)

Locality and date of visit	Area surveyed (Rainfed/ Irrigated)	No. of samples observed	Variety and Stage of growth	Crop pest			Natural enemy
				Name	Type of damage	Intensity	
Bhoyegeon, Chandwad, Nandurdi 11.12.2013	Irrigated	30	HD 2189, LOK-1, Mohan wonder, Ajit 102 Vegetative, flowering	Aphids	Major	Heavy	*Coccinella septumpunctata* Beetles
Pimpri, Raulas 30.12.2013	Irrigated	40	NIAW 301, LOK-1, Private companies Vegetative, Booting	Aphids	Major	Heavy	*Coccinella septumpunctata* Beetles
Shirpur, Waghadi, Bharwade 03.01.2014	Irrigated	35	NIAW 34, DBW 343, HD 2189, NIAW 301, Ajit 102, Mohan wander Vegetative, Booting	Aphids Root aphid	Major Medium	Heavy Medium	*Coccinella septumpunctata* Beetles
Kasbe Sukene, Bhausaheb Nagar 10.01.2014	Irrigated	50	LOK-1, Private companies, NIAW 301, HD 2189 Flowering, grain filling	Aphids	Major	Heavy	*Coccinella septumpunctata* Beetles
Bhagurdi, Wanjari 20.01.2014	Irrigated	40	LOK-1, Private companies, NIAW 301, HD 2189 Booting, Flowering,	Aphids	Major	Heavy	*Coccinella septumpunctata* Beetles
Abhona and Golakhal 20.01.2014	Irrigated	50	LOK-1, Private companies, NIAW 301, HD 2189 Booting, Flowering,	Aphids	Major	Heavy	*Coccinella septumpunctata* Beetles
Dahyane, Manur 30.01.2014	Irrigated	50	LOK-1, Private companies, NIAW 301, HD 2189 Booting, Flowering	Aphids	Major	Heavy	*Coccinella septumpunctata* Beetles

Table 10.28. Survey of wheat and barley pests and their natural enemies 2013-14(Centre: Kanpur)

Locality and date of visit	Rainfed / Irrigated	No. of samples	Variety and stage of grwoth	Crop pest			Natural enemies	
				Name	Status	Intesntiy (Attack % damage or population)	Name	Stage Parastization / Predation
30.01.2014 Daleep Nagar, Bojha Farm	Irrigated & Rainfed	10	PBW343, DBW39, K9107, Halna (full growing stage), Barley variety K551	Shootfly Termite Cutworm Aphid	Minor Major Minor Major	12% 20% 1.5% Susceptable Index 4.0	- - - -	- - - -
13.02.2014 Deegh, Murlipur, Muradpur, Devipurwa, Mati	Irrigated & Rainfed	15	K502, Halna (late sown), HD2733, DBW39, K0307	Shootfly Termite Aphid Cutworm	Minor Major Major Minor	12% 20% Late sown wheat (M.R.) 3.0 and major in barley 1.0%	- - *Coccinella septumpunctata*	- - Adult and grubs
15.02.2014 Bhailamau	Irrigated & Rainfed	15	DBW-39, PBW343, HD2733 and Halna, K551 (Barley)	Termite Aphid Shoot fly Pink Stem borer	Major Major Minor Minor	12% Index 4.0 12% 2.0%	- *Coccinella Septumpunctata* *Chrysoperla*	- Adult and grubs Predator

Table 10.29. Survey of wheat and barley pests and their natural enemies 2013-14 (Centre: Pantnagar)

Locality and date of visit	Area surveyed (Rainfed) / Irrigated	No. of samples observed	Variety and Stage of growth	Crop pest			Natural enemies
				Name	Type of damage	Intensity (%)	
Village Haridaspur Rudrapur 18/02/2014	Irrigated	25	Vegetative	Aphids	Patches and streaks due to sucking	40-50	Predator- Coccinella
Village Bhagwanpur Rudrapur 18/02/2014	Irrigated	25	Vegetative	Aphids	Patches and streaks due to sucking	50-60	Predator - *Coccinella* Parasitoids- *Diaeretiella rapae*
Village Halduchaur 24/02/2014	Irrigated	25	Vegetative	Aphids	Patches and streaks due to sucking	40-50	Predator- Coccinella Syrphid
At (NBCRC)Pantnagar Experimental field Feb-March2014	Irrigated	5 samples/plot	Vegetative	Aphids	Patches and streaks due to sucking	30-40	*Coccinella* Parasitoids- *Diaeretiella rapae*
Pantnagar	Irrigated	5 samples/plot	Grain filled	*Helicoverpa armigera*	Biting and cutting of leaves and chaffy glumes	5-10	*Cotesia* cocoons
During survey of nearby areas of Pantnagar , thrips were not seen on wheat foliage.							

Table 10.30. Survey of wheat and barley pests and their natural enemies 2013-14 (Centre: Karnal)

Locality and date of visit	Rainfed/ Irrigated	No. of samples	Variety and stage of grwoth	Crop pest			Natural enemies
				Name	Status	Intesntiy	Name
Village Sarand,Sanewal,Ludhiana 10-12-2013	Irrigated	10	Vegetative	Root aphid Terrmite	Minor	-	- -
Village Ugada, Dhanora, Bilaspur, Pheruwada and Sagoda RRS,Flowerdale Shimla 21-22 Dec.2013	Irrigated	15	Vegetative	Aphid	Minor	-	
Village- Harsoda 23-12-2013	Irrigated	5	Vegetative	Pink Stemborer	Minor	2.0%	
Village-Bastali(Karnal), Bata(Kethal), Dhakala Danola Barwada, Hisar (DWR,Farm), Badopal (Fatehabad) Bilashpur, and Maina.Sahwala-I, **Abohar-** Balluana(Malot),,Aulakh, chakadubiwala(Maktasar) Malke, Shekhain kalian ,Sarainaka,Moga ,Khanna ,Rajpur (Ludhiana) 12-13 March 2014	Irrigated	25	Reproductive phase	Aphid Termite Stem borer	Major Minor Minor	3.0%	Predator-Coccinella
Villages - Radana, Den, Mayyar, Raipur ,DWR, Hisar farm, Vadya Dhanoda Mundari(Kethal) 07-04-2014	Irrigated	16	Grain filling stage	Aphid Termite	Major Minor	3.0%	Predator-Coccinella

Experiment No.9. Incidence and population build of major insect pest in different dates of sowing. (New trial)

Objective:

1) To test the response of various wheat varieties/lines of wheat to aphid attack on different sowing dates under field condition.
2) To determine the effect of sowing dates on population built up of aphids on wheat.

The experiment conducted for incidence and population build of major insect pest in different dates of sowing at 15 days interval under irrigated conditions 2013-14 at Niphad, Ludhiana and Karnal centre (New trial).

Methodology and observations to be recorded

The crop was sown at three different dates of sowing at 15 days interval and no insecticide was applied to control any pest in this trial. However, all other agronomic practices were followed for crop raising. The data on all major pests viz. foliage feeding aphids, root aphid, BWM, termites pink stem borer etc. were recorded at fortnightly interval starting from 21 days after sowing until maturity of crop. The first incidence and population build of different pests were recorded and documented in tabular form.

Centre: Niphad

Results:

Aphids: Date of sowing:

From the data presented in Table 10.31a indicated that the aphid infestation started in mid of Dec. and gradually increased during vegetative growth of wheat crop. The population reached to its peak in the month of Jan. The decline in population of aphids was recorded at the end of Jan. when the maximum and minimum temperature raised. The population of aphids was not recorded on crop sown at 1st Nov. (D1), 16th Nov. (D2) and 1st Dec. (D3) at 26 days after sowing. The crop sown at 1st Jan (D5) recorded the maximum (4.36) number of aphids. The crop sown at 16th Dec. (D4) recorded the maximum (6.90) number of aphid at 33 days after sowing. The minimum (1.18) number population of aphids was recorded on the crop which was sown on 16th Nov. (D2).

At 40, 47, 54, 61, 68 and 75 days after sowing, the maximum number of aphids of 43.72, 73.79, 90.17, 260.86, 389.91 and 35.70 per shoot/plant were recorded on 1st Nov. (D1) sown crop. The increase in population of aphids in D1 was noticed since 40 days after sowing to 68 days.

At 54 and 61 days after sowing the population of aphids on crop sown at 16th Dec. (D4) and 1st Jan. (D5) was not observed. Among the crop sown at 1st Nov. (D1), 16th Nov. (D2) and 1st Dec. (D3), 1st Dec. (D3) recorded minimum number of 0.00, 5.35 and 10.14 aphids/shoot/plant at 68, 61, 54 days after sowing. At 68 and 75 days after sowing, the crop sown at 1st Dec. (D3), 16th Dec. (D4) and 1st Jan. (D5) was free from attack of aphids.

Varieties:

The data presented in **(Table 10.31a)** revealed that the varieties showed significant differences among each other. The variety NIAW 917 (V1) showed significantly less (0.44, 1.16, 3.81, 12.25, 16.29, 29.84, 44.11 and 4.28) number of aphids/shoot/plant at 26, 33, 40, 47, 54, 61, 68 and 75 days after sowing. The maximum number of aphids of 3.64, 9.62, 39.58, 70.39, 78.54, 127.93, 130.52 and 10.24/shoot/plant were recorded on susceptible check variety A-9-30-1 (V5) at 26, 33, 40, 47, 54, 61, 68 and 75 days after sowing, respectively.

Sowing date x variety interaction:
Sowing date x variety interaction was significant. Among interaction of 1st Nov. (D1), 16th Nov. (D2) and 1st Dec. (D3) the lowest (5.4, 3.7 and 2.5) number of aphids at 47, 54 and 61 days after sowing was found in variety NIAW- 917 sown on 1st Dec. (D3), respectively which was statistically identical with D3V8 (5.10) at 47 days after sowing and followed by D3V8 (5.40), D3V6, D3V7 (6.70) at 54 days after sowing and D3V8 (2.6), D3V7 (3.9), D3V2 (4.3) and D3V3 (6.3) at 61 days after sowing.
Shoot fly:
Infestation of shoot fly was not recorded on crop sown at 1st Nov. (D1), 16th Nov. (D2) and 1st Dec. (D3). Maximum (24.28) per cent infested shoot by shoot fly was recorded on crop sown at 1st Jan. (D5). Among the various varieties, the lowest (0.80) per cent infested shoot was recorded in NIAW-34. Due to the interaction effect of sowing date x variety the crop sown at 1st Jan. (D5) and variety LOK-1 (V8) recorded maximum (64.00) per cent infested shoot. Among the crop sown at 16th Dec. (D4) and 1st Jan. (D5) the variety NIAW-1415 recorded minimum number of 0.80% infested shoot by shoot fly followed by NIDW 295 (V6) (1.96%).
Yield:
Among the sowing dates, varieties and sowing dates X varieties, the grain yield differences were significant (Table 5). The highest average (50.68 q/ha) yield of wheat was found in crop sown at 1st Dec. (D3). It was at par with D2 i.e. crop sown at 16th Nov. (46.42 q/ha).
In case of varieties, the highest grain yield of 49.36 q/ha was recorded in variety NIAW 917 (V1). It was at par with variety NIAW 301 (V7) (45.93 q/ha). Among sowing date X variety interaction the highest (58.86 q/ha) grain yield of wheat was obtained in the combination viz. D3V1 sowing dates 1st Dec. X variety NIAW-917 (V1). It was at par with D2V1 (58.44), D3V6 (57.94), D3V3 (56.44), D3V7 (55.24), D4V1 (54.08), D2V7 (52.26), D3V2 (51.25), D2V2 (50.30), D2V3 (50.45), D4V2 (50.05).
In the present study, the decline in aphid population was observed from end of Jan. This may be due to the increasing maximum and minimum temperature during onwards period. The crop sown at 16th Dec. and 1st Jan. was found very less number of aphid population but it was heavily affected by shoot fly and resulted to yield losses, addition to this environmental condition was not sufficiently favorable for wheat crop growth during that period. Delayed sowing adversely affects the physiological metabolic activity of the crop and resulted in stunted growth reduced number of tillers and consequent reduction in grain yield.
Morphological plant characters:
Due to the effect of sowing date and variety the plant height, earhead length, leaf area, number of grains per head and 1000 grain weight were significantly affected (Table 10.31b). The highest (88.28, 8.37, 40.07, 41.13 and 43.18) height of the plant, earhead length, leaf area, number of grains per head and 1000 grain weight were found in crop sown at 1st Dec. (D3). The result shows that the plant height, earhead length, leaf area, number of grains per head and 1000 grain weight were increased with each successive delay in sowing after 1st Nov. (D1) up to 1st Dec. (D3) and further delay in sowing after 1st Dec. all the plant characters, number of grains per earhead and 1000 grain height again started to decreased.
The highest number of grains per earhead (50.67) and 1000 grain weight (42.24) were found in NIAW 1415 (V3) and NIDW 295 (V6), respectively. Due to interaction effect of sowing dates and variety number of grains per earhead and 1000 grain weight are significantly affected (Table 5). The highest (54.67 and 49.30) number of grains and 1000 grain weight were found in D3V3 and D3V6, respectively.

Centre: Ludhiana

This experiment was conducted in the irrigated fields at Plant Breeding Research Farm, PAU Ludhiana. The wheat variety HD 2967 was sown at three different dates of sowing at 15 days interval and no insecticide was applied to control any pest in this trial. However, all other agronomic practices were followed as per recommendations of PAU package of practices. The data on major pests viz. foliage feeding aphids, root aphid, pink stem borer, termites etc. was recorded throughout crop growing season at fortnightly intervals (Table 10.32).

1. **Termite damage**: The termite damage recorded at seedling stage indicated that early sown crop (1Nov. 2013) suffered significantly more termite damage as compared to timely and late sown crop. Thereafter no termite damage was recorded up to ear emergence stage. At earing stage, again termite damage was maximum in early sown crop followed by timely and late sown crop.
2. **Aphid incidence**: The aphids first appeared in late January to early February in different dates of sowing. The aphid incidence was significantly more in early sown on 14.02.2014 as compared to timely and late sown crop. On 28.02.2014 and 14.03.2014, aphids incidence was significantly more in early sown crop as compared to timely and late sown crop. On 28.03.2014, maximum aphid incidence was recorded on late sown crop as compared to timely and early sown crop.
3. **Root aphid incidence**: The root aphids first appeared in early sown crop followed by timely and late sown. The root aphid incidence was significantly more in early sown on 23.12.2013 as compared to timely and late sown crop. On 30.12.2014, root aphids incidence was significantly more in timely sown crop as compared to early and late sown crop.
4. **Pink stem borer Damage**: The pink stem borer damage was significantly more in early sown crop on 23.12.2013 as compared to timely and late sown crop. On 30.12.2014, pink stem borer damage was minimum in timely sown crop as compared to early and late sown crop. On 06.01.2014, there was no significant difference in pink stem borer damage among different dates of sowing.

Centre: Karnal

1. **Aphid incidence:** From the data presented in (Table 10.33a) indicated that the aphid infestation started in mid of Dec. and gradually increased during vegetative growth of wheat crop. The population reached to its peak in the month of February since second to last week. The decline in population of aphids was recorded at the end of February. The population of aphids was not recorded on crop sown at 1st Nov. (D1), 16th Nov. (D2) at 60 days after sowing. The crop sown at 16th Dec. (D4) recorded the maximum (32.80) number of aphids. The crop sown at 1th Dec. (D3) recorded the maximum (43.80) number of aphid at 88 days after sowing. The minimum (2.80) number population of aphids was recorded on the crop which was sown on 1st Nov. (D1).
2. **Pink stem borer damage:** Maximum (0.30) per cent dead heart by stem borer was recorded in crop sown on 16th Dec. (D4). Minimum (0.25) per cent dead heart by stem Borer was recorded on crop sown 1st Dec. (D1). There was no significant difference in pink stem borer damage among different dates of sowing (Table 10.33b).
3. **Termite damage**: The termite damage recorded at maturity stage indicated that crop sown at 16th Dec.(D4) suffered significantly more termite damage (6.91 % damage effective tillers/m row) as compared to 1st Nov.(D1), 16th Nov.(D2) and 1st Dec.(D3) sown crop. There was no termite damage recorded at seedling stage (Table 10.33b).

Yield: The highest average (46.30 q/ha) yield of wheat was found in crop sown at 1st Dec. (D3). It was at par with D2 i.e. crop sown at 16th Nov. (43.10 q/ha) (Table 10.33b).

Table 10.31a. Effect of sowing dates and varieties on wheat aphids 2013-14 (Centre-Niphad)

Sr. No	Treatments	Av. population of aphids/shoot/plant							
		26 DAS	33 DAS	40 DAS	47 DAS	54 DAS	61 DAS	68 DAS	75 DAS
1	D1	0.00 (1.00)	3.24 (2.05)	43.72 (6.68)	73.79 (8.64)	90.17 (9.54)	260.86 (16.18)	389.91 (19.71)	35.70 (6.05)
2	D2	0.00 (1.00)	1.18 (1.47)	2.07 (1.75)	47.31 (6.95)	62.46 (7.96)	76.59 (8.80)	5.52 (2.55)	0.00 (1.00)
3	D3	0.00 (1.00)	4.10 (2.25)	7.70 (2.94)	16.97 (4.23)	10.14 (3.33)	5.35 (2.51)	0.00 (1.00)	0.00 (1.00)
4	D4	2.81 (1.95)	6.90 (2.81)	4.81 (2.41)	4.40 (2.32)	0.00 (1.00)	0.00 (1.00)	0.00 (1.00)	0.00 (1.00)
5	D5	4.36 (2.31)	4.30 (2.30)	0.00 (1.00)	0.00 (1.00)	0.00 (1.00)	0.00 (1.00)	0.00 (1.00)	0.00 (1.00)
SE ±		0.009	0.03	0.03	0.03	0.05	0.03	0.02	0.01
CD at 5%		0.03	0.09	0.08	0.08	0.18	0.09	0.07	0.03
9	V1	0.44 (1.20)	1.16 (1.46)	3.81 (2.19)	12.25 (3.64)	16.29 (4.15)	29.84 (5.55)	44.11 (6.71)	4.28 (2.29)
10	V2	1.24 (1.49)	3.31 (2.07)	7.51 (2.91)	21.75 (4.76)	24.12 (5.01)	56.69 (7.59)	70.45 (8.45)	5.83 (2.61)
11	V3	0.96 (1.40)	2.32 (1.82)	6.27 (2.69)	12.33 (3.65)	18.95 (4.46)	39.53 (6.36)	66.35 (8.20)	6.91 (2.81)
12	V4	2.98 (1.99)	7.04 (2.83)	16.03 (4.12)	45.43 (6.81)	47.13 (6.93)	107.27 (10.40)	107.05 (10.39)	8.97 (3.15)
13	V5	3.64 (2.15)	9.62 (3.25)	39.58 (6.37)	70.39 (8.44)	78.54 (8.91)	127.93 (11.35)	130.52 (11.46)	10.24 (3.35)
14	V6	0.86 (1.36)	5.01 (2.45)	9.76 (3.28)	34.84 (5.98)	41.67 (6.53)	81.76 (9.09)	86.64 (9.36)	8.28 (3.04)
15	V7	0.84 (1.35)	1.87 (1.69)	5.04 (2.45)	18.16 (4.37)	18.29 (4.39)	54.80 (7.46)	65.53 (8.5)	6.63 (2.76)
16	V8	0.52 (1.23)	1.23 (1.49)	5.29 (2.50)	12.80 (3.71)	15.43 (4.05)	50.67 (7.18)	62.03 (7.93)	5.99 (2.64)
SE ±		0.012	0.03	0.02	0.03	0.04	0.02	0.03	0.01
CD at 5%		0.034	0.80	0.06	0.08	0.12	0.06	0.07	0.03
17	D1V1	0.00 (1.00)	0.10 (1.04)	11.90 (3.59)	17.00 (4.24)	40.20 (6.41)	104.80 (10.28)	219.40 (14.84)	21.40 (4.73)
18	D1V2	0.00 (1.00)	2.90 (1.97)	26.70 (5.26)	46.70 (6.90)	56.60 (7.58)	227.10 (15.10)	346.50 (18.64)	29.10 (5.48)
19	D1V3	0.00 (1.00)	0.40 (1.18)	22.70 (4.86)	19.00 (4.47)	40.50 (6.44)	139.50 (11.85)	324.80 (18.04)	34.50 (5.95)
20	D1V4	0.00 (1.00)	3.10 (2.02)	49.60 (7.04)	118.70 (10.94)	123.80 (11.17)	406.30 (20.18)	525.30 (22.94)	44.90 (6.77)
21	D1V5	0.00 (1.00)	7.50 (2.91)	161.30 (12.73)	216.50 (14.74)	251.00 (15.87)	484.70 (22.03)	645.00 (25.41)	51.20 (7.22)
22	D1V6	0.00 (1.00)	9.30 (3.20)	37.10 (6.17)	88.20 (9.44)	116.30 (10.83)	297.70 (17.28)	427.70 (20.70)	41.40 (6.51)
23	D1V7	0.00 (1.00)	2.20 (1.78)	19.10 (4.48)	47.90 (6.99)	49.50 (7.10)	217.10 (14.76)	322.50 (17.98)	33.10 (5.83)
24	D1V8	0.00	0.60	21.40	36.30	43.50	209.70	308.10	29.90

Sr. No	Treatments	Av. population of aphids/shoot/plant							
		26 DAS	33 DAS	40 DAS	47 DAS	54 DAS	61 DAS	68 DAS	75 DAS
		(1.00)	(1.26)	(4.73)	(6.10)	(6.67)	(14.51)	(17.58)	(5.55)
25	D2V1	0.00 (1.00)	0.00 (1.00)	0.00 (1.00)	36.30 (6.10)	37.50 (6.20)	41.90 (6.54)	1.10 (1.48)	0.00 (1.00)
26	D2V2	0.00 (1.00)	0.00 (1.00)	0.00 (1.00)	45.70 (6.83)	51.30 (7.23)	52.10 (7.28)	5.80 (2.60)	0.00 (1.00)
27	D2V3	0.00 (1.00)	0.00 (1.00)	0.00 (1.00)	27.10 (5.30)	33.00 (5.83)	51.80 (7.26)	6.90 (2.81)	0.00 (1.00)
28	D2V4	0.00 (1.00)	4.30 (2.30)	7.20 (2.86)	70.90 (8.47)	99.10 (10.00)	122.90 (11.13)	9.90 (3.30)	0.00 (1.00)
29	D2V5	0.00 (1.00)	5.10 (2.46)	9.30 (3.20)	82.20 (9.12)	129.80 (11.43)	147.10 (12.16)	7.60 (2.93)	0.00 (1.00)
30	D2V6	0.00 (1.00)	0.00 (1.00)	0.00 (1.00)	62.90 (7.99)	85.30 (9.28)	103.00 (10.19)	5.50 (2.54)	0.00 (1.00)
31	D2V7	0.00 (1.00)	0.00 (1.00)	0.00 (1.00)	32.80 (5.81)	35.30 (6.02)	53.10 (7.35)	5.20 (2.48)	0.00 (1.00)
32	D2V8	0.00 (1.00)	0.00 (1.00)	0.00 (1.00)	20.60 (4.64)	28.30 (5.41)	41.00 (6.48)	2.00 (1.73)	0.00 (1.00)
33	D3V1	0.00 (1.00)	0.70 (1.30)	3.70 (2.16)	5.40 (2.52)	3.70 (2.16)	2.50 (1.87)	0.00 (1.00)	0.00 (1.00)
34	D3V2	0.00 (1.00)	3.30 (2.07)	8.10 (3.01)	11.40 (3.52)	12.70 (3.70)	4.30 (2.30)	0.00 (1.00)	0.00 (1.00)
35	D3V3	0.00 (1.00)	1.90 (1.70)	5.30 (2.50)	8.70 (3.11)	21.30 (4.72)	6.30 (2.70)	0.00 (1.00)	0.00 (1.00)
36	D3V4	0.00 (1.00)	6.90 (2.81)	11.30 (3.50)	30.00 (5.56)	12.70 (3.70)	7.10 (2.84)	0.00 (1.00)	0.00 (1.00)
37	D3V5	0.00 (1.00)	10.50 (3.39)	18.70 (4.43)	47.40 (6.95)	11.90 (3.59)	7.90 (2.98)	0.00 (1.00)	0.00 (1.00)
38	D3V6	0.00 (1.00)	6.30 (2.70)	9.20 (3.19)	19.90 (4.57)	6.70 (2.77)	8.10 (3.01)	0.00 (1.00)	0.00 (1.00)
39	D3V7	0.00 (1.00)	1.90 (1.70)	2.90 (1.97)	7.70 (2.94)	6.70 (2.77)	3.90 (2.21)	0.00 (1.00)	0.00 (1.00)
40	D3V8	0.00 (1.00)	1.50 (1.58)	2.40 (1.84)	5.10 (2.46)	5.40 (2.52)	2.60 (1.89)	0.00 (1.00)	0.00 (1.00)
41	D4V1	0.70 (1.30)	3.30 (2.07)	3.50 (2.12)	2.50 (1.87)	0.00 (1.00)	0.00 (1.00)	0.00 (1.00)	0.00 (1.00)
42	D4V2	1.50 (1.58)	4.90 (2.42)	2.70 (1.90)	5.00 (2.44)	0.00 (1.00)	0.00 (1.00)	0.00 (1.00)	0.00 (1.00)
43	D4V3	2.10 (1.76)	6.10 (2.66)	3.30 (2.07)	6.90 (2.81)	0.00 (1.00)	0.00 (1.00)	0.00 (1.00)	0.00 (1.00)
44	D4V4	7.30 (2.88)	12.50 (3.67)	12.00 (3.60)	7.50 (2.91)	0.00 (1.00)	0.00 (1.00)	0.00 (1.00)	0.00 (1.00)
45	D4V5	6.40 (2.72)	15.10 (4.01)	8.50 (3.08)	5.80 (2.60)	0.00 (1.00)	0.00 (1.00)	0.00 (1.00)	0.00 (1.00)
46	D4V6	2.30 (1.81)	7.30 (2.88)	2.50 (1.87)	3.20 (2.04)	0.00 (1.00)	0.00 (1.00)	0.00 (1.00)	0.00 (1.00)
47	D4V7	1.10 (1.44)	3.30 (2.07)	3.30 (2.07)	2.40 (1.84)	0.00 (1.00)	0.00 (1.00)	0.00 (1.00)	0.00 (1.00)
48	D4V8	1.10 (1.44)	2.60 (1.89)	2.70 (1.92)	1.90 (1.70)	0.00 (1.00)	0.00 (1.00)	0.00 (1.00)	0.00 (1.00)
49	D5V1	1.50 (1.58)	1.70 (1.64)	0.00 (1.00)	0.00 (1.00)	0.00 (1.00)	0.00 (1.00)	0.00 (1.00)	0.00 (1.00)
50	D5V2	4.70	5.50	0.00	0.00	0.00	0.00	0.00	0.00

Sr. No	Treatments	Av. population of aphids/shoot/plant							
		26 DAS	33 DAS	40 DAS	47 DAS	54 DAS	61 DAS	68 DAS	75 DAS
		(2.38)	(2.54)	(1.00)	(1.00)	(1.00)	(1.00)	(1.00)	(1.00)
51	D5V3	2.70 (1.92)	3.30 (2.07)	0.00 (1.00)	0.00 (1.00)	0.00 (1.00)	0.00 (1.00)	0.00 (1.00)	0.00 (1.00)
52	D5V4	7.60 (2.93)	8.50 (3.08)	0.00 (1.00)	0.00 (1.00)	0.00 (1.00)	0.00 (1.00)	0.00 (1.00)	0.00 (1.00)
53	D5V5	11.80 (3.57)	9.90 (3.30)	0.00 (1.00)	0.00 (1.00)	0.00 (1.00)	0.00 (1.00)	0.00 (1.00)	0.00 (1.00)
54	D5V6	2.00 (1.73)	2.20 (1.78)	0.00 (1.00)	0.00 (1.00)	0.00 (1.00)	0.00 (1.00)	0.00 (1.00)	0.00 (1.00)
55	D5V7	3.10 (2.02)	1.90 (1.70)	0.00 (1.00)	0.00 (1.00)	0.00 (1.00)	0.00 (1.00)	0.00 (1.00)	0.00 (1.00)
56	D5V8	1.50 (1.58)	1.50 (1.58)	0.00 (1.00)	0.00 (1.00)	0.00 (1.00)	0.00 (1.00)	0.00 (1.00)	0.00 (1.00)
SE ± Interaction)		0.03	0.08	0.07	0.07	0.15	0.08	0.06	0.03
CD at 5% (Interaction)		0.08	0.18	0.14	0.16	0.29	0.14	0.16	0.07

Figures in parentheses indicate V_{n+1} transformed value DAS= days after sowing

Table 10.31b. Effect of sowing dates and varieties on shoot fly, plant characters and yield's of wheat.

Sr. No	Treatments	(%) per cent infested shoot by shoot fly	Plant height (cm)	Earhead Length (cm)	Leaf area (cm^2)	No. of grain per earhead	1000 grain weight (g)	Yield (q/ha)
1	D1	0.00 (0.00)	86.00	8.40	33.18	37.88	42.01	32.56
2	D2	0.00 (0.00)	86.07	8.27	32.02	39.29	42.36	46.42
3	D3	0.00 (0.00)	88.28	8.37	40.07	41.13	43.18	50.68
4	D4	9.64 (18.05)	87.85	8.00	34.66	36.08	36.87	42.18
5	D5	24.28 (29.53)	84.21	7.91	33.43	32.96	31.50	23.75
SE ±		0.43	0.21	0.02	0.42	0.20	0.05	1.59
CD at 5%		1.42	0.68	0.05	1.40	0.65	0.17	5.27
9	V1	5.02 (12.92)	83.51	8.57	37.67	47.07	38.12	49.36
10	V2	8.40 (16.85)	82.99	8.78	39.96	35.73	39.16	44.56
11	V3	0.80 (5.13)	84.04	9.47	39.88	50.67	36.34	44.27
12	V4	10.18 (18.63)	80.47	8.27	33.88	28.13	39.65	34.31
13	V5	3.15 (10.31)	95.55	7.33	27.02	21.67	36.12	22.14
14	V6	1.96 (7.92)	85.37	6.57	26.14	40.00	42.24	41.76
15	V7	7.33 (15.68)	94.91	9.30	38.13	41.80	39.94	45.93
16	V8	17.42 (24.65)	84.99	7.23	34.68	34.67	41.89	30.59
SE ±		0.19	0.22	0.03	0.35	0.24	0.06	1.40
CD at 5%		0.55	0.63	0.09	0.98	0.67	0.18	3.95
17	D1V1	0.00 (0.00)	82.53	9.00	37.80	52.67	40.20	44.75
18	D1V2	0.00 (0.00)	85.90	8.33	37.83	34.67	39.09	38.95
19	D1V3	0.00 (0.00)	84.47	9.77	39.90	51.67	40.43	37.74
20	D1V4	0.00 (0.00)	81.73	7.93	34.20	28.67	38.53	18.80
21	D1V5	0.00 (0.00)	94.63	8.10	21.13	20.33	42.49	16.07
22	D1V6	0.00 (0.00)	82.90	6.93	24.30	37.67	44.10	31.09
23	D1V7	0.00 (0.00)	92.03	9.23	37.50	41.67	44.40	44.50
24	D1V8	0.00 (0.00)	83.77	7.93	32.77	35.67	46.83	31.59
25	D2V1	0.00 (0.00)	83.77	8.97	36.20	53.00	43.50	58.44
26	D2V2	0.00 (0.00)	83.43	8.53	38.17	36.33	43.23	50.30

Sr. No	Treatments	(%) per cent infested shoot by shoot fly	Plant height (cm)	Earhead Length (cm)	Leaf area (cm^2)	No. of grain per earhead	1000 grain weight (g)	Yield (q/ha)
27	D2V3	0.00 (0.00)	79.30	9.70	38.07	53.33	39.29	50.45
28	D2V4	0.00 (0.00)	82.57	7.97	32.10	29.00	41.13	37.88
29	D2V5	0.00 (0.00)	93.97	7.97	20.47	24.00	39.63	33.54
30	D2V6	0.00 (0.00)	83.93	6.50	24.03	41.00	42.20	48.55
31	D2V7	0.00 (0.00)	94.97	9.03	36.80	42.33	41.53	52.26
32	D2V8	0.00 (0.00)	86.63	7.47	30.30	35.33	48.33	39.99
33	D3V1	0.00 (0.00)	84.03	8.97	39.17	53.67	41.70	58.86
34	D3V2	0.00 (0.00)	83.47	9.17	44.03	41.67	43.83	51.25
35	D3V3	0.00 (0.00)	85.77	9.67	47.40	54.67	37.37	56.44
36	D3V4	0.00 (0.00)	82.20	8.20	40.33	29.67	45.07	47.89
37	D3V5	0.00 (0.00)	96.60	7.90	39.43	23.67	39.10	33.89
38	D3V6	0.00 (0.00)	88.50	6.43	31.43	43.33	49.30	57.94
39	D3V7	0.00 (0.00)	98.03	9.17	39.23	44.67	43.70	55.24
40	D3V8	0.00 (0.00)	87.60	7.43	39.50	37.67	45.37	43.99
41	D4V1	8.00 (16.43)	84.27	8.73	39.93	44.33	33.07	54.08
42	D4V2	10.44 (18.81)	83.43	9.10	40.13	33.67	38.37	50.05
43	D4V3	1.33 (6.55)	85.77	9.43	36.87	50.00	34.00	47.15
44	D4V4	15.11 (22.87)	82.13	8.60	31.53	26.67	38.23	44.16
45	D4V5	6.44 (14.65)	98.37	5.60	28.97	20.33	34.27	18.66
46	D4V6	2.67 (9.46)	86.13	6.43	25.50	39.33	40.30	47.12
47	D4V7	10.00 (18.44)	97.40	9.43	38.67	41.00	36.67	49.33
48	D4V8	23.11 (28.73)	85.27	6.70	35.70	33.33	40.07	26.90
49	D5V1	17.11 (21.43)	82.97	7.17	35.27	31.67	32.13	33.70
50	D5V2	31.56 (34.20)	78.70	8.77	39.63	32.33	31.30	32.30
51	D5V3	2.66 (9.46)	84.90	8.77	37.17	43.67	30.63	29.62
52	D5V4	35.78 (36.75)	73.73	8.63	31.23	26.67	35.27	22.92
53	D5V5	9.33 (17.76)	94.20	7.10	25.10	20.00	25.10	8.58
54	D5V6	7.11 (15.45)	85.40	6.57	25.43	38.67	35.30	24.15
55	D5V7	26.67 (31.11)	92.13	9.63	38.47	39.33	33.40	28.27
56	D5V8	64.00 (53.13)	81.67	6.63	35.13	31.33	28.83	10.53
SE ± Interaction)		1.21	0.59	0.05	1.19	0.55	0.14	4.50
CD at 5% (Interaction)		1.34	1.45	0.21	2.30	1.57	0.41	9.17

Figures in parentheses indicate arc sin value

Table 10.32. Effect of sowing dates on population build of major insect pests in wheat 2013-14 (Centre-Ludhiana)

	Termite Damage (%)				
Date of Sowing	**23.12.2013**	**30.12.2013**	**6.1.2014**	**21.2.2014**	**28.2.2014**
1 Nov., 2013 (Early sown)	3.13 (10.19)	3.01 (9.99)	2.51 (9.10)	2.85 (9.72)	2.42 (8.94)
15 Nov., 2013 (timely sown)	2.44 (8.95)	2.14 (8.39)	1.96 (8.03)	2.50 (9.09)	2.15 (8.43)
30 Nov., 2013 (late sown)	2.07 (8.26)	1.79 (7.67)	1.73 (7.55)	2.21 (8.53)	1.84 (7.78)
CD (p= 0.05)	(0.75)	(0.76)	(0.41)	(0.31)	(0.35)
Aphid incidence (aphids/tiller)					

Termite Damage (%)					
Date of Sowing	**23.12.2013**	**30.12.2013**	**6.1.2014**	**21.2.2014**	**28.2.2014**
Date of Sowing	14.02.2014	28.02.2014	14.03.2014	28.03.2014	
1 Nov., 2013 (Early sown)	5.01 (2.44)	13.13 (3.75)	20.01 (4.58)	0.85 (1.36)	
15 Nov., 2013 (timely sown)	3.14 (2.02)	10.19 (3.34)	18.71 (4.43)	1.50 (1.58)	
30 Nov., 2013 (late sown)	2.79 (1.94)	8.22 (3.04)	17.23 (4.26)	2.36 (1.83)	
CD (p= 0.05)	(0.26)	(0.19)	(0.14)	((0.07)	
Root aphid inicidence (aphids/tiller)					
Date of Sowing	23.12.2013	30.12.2013	6.1.2014		
1 Nov., 2013 (Early sown)	4.46 (2.33)	2.76 (1.94)	1.46 (1.56)		
15 Nov., 2013 (timely sown)	3.39 (2.09)	3.10 (2.02)	1.51 (1.58)		
30 Nov., 2013 (late sown)	2.79 (1.94)	2.07 (1.75)	1.93 (1.71)		
CD (p= 0.05)	(0.23)	(0.05)	(NS)		
Pink stem borer Damage (%)					
Date of Sowing	23.12.2013	30.12.2013	6.1.2014		
1 Nov., 2013 (Early sown)	1.69 (7.46)	1.20 (6.29)	0.67 (4.68)		
15 Nov., 2013 (timely sown)	1.03 (5.82)	0.43 (3.74)	0.45 (3.61)		
30 Nov., 2013 (late sown)	1.51 (7.04)	0.83 (5.21)	0.60 (4.23)		
CD (p= 0.05)	(0.49)	(0.64)	(NS)		

* Figures in parentheses are transformed value

Table 10.33a. Effect of sowing dates on population build of major insect pests in wheat, New trial 2013-14 (Centre-Karnal)

	Aphid incidence (aphids/tiller)							
Treatments	**60DAS**	**67DAS**	**74DAS**	**81DAS**	**88DAS**	**95DAS**	**102DAS**	**Yield (qt./ha.)**
D1(01-11-2013)	0.00 (1.00)	0.00 (1.00)	0.00 (1.00)	2.80 (1.95)	25.84 (5.18)	38.20 (6.26)	15.60 (4.07)	36.4
D2(16-11-2013)	0.00 (1.00)	0.00 (1.00)	12.60 (3.69)	15.68 (4.08)	42.80 (6.62)	60.40 (7.84)	54.00 (7.42)	43.1
D3(01-12-2013)	6.20 (2.68)	16.80 (4.22)	32.80 (5.81)	26.60 (5.25)	43.80 (6.69)	0.00 (1.00)	0.00 (1.00)	46.3
D4(16-12-2013)	11.60 (3.55)	32.80 (5.81)	8.00 (3.00)	0.00 (1.00)	0.00 (1.00)	0.00 (1.00)	0.00 (1.00)	38.2

Treatments	Aphid incidence (aphids/tiller)							Yield (qt./ha.)
	60DAS	67DAS	74DAS	81DAS	88DAS	95DAS	102DAS	
SE $\pm$	0.10	0.06	0.07	0.30	0.13	0.12	0.10	1.76
CD at 5%	0.32	0.18	0.22	0.93	0.39	0.38	0.31	5.38

Table 10.33b. Effect of sowing dates on Pink stem borer and Termite Damage in Wheat. New trial 2013-14 (Centre-Karnal)

Treatments	Plant pop / m row	Pink Stem borer damage	Termite Damage (%)	Grain yield (q /ha)
		% Dead hearts	% damage effective tillers / m row at maturity	
D1(01-11-2013)	66.20	0.25	6.07	36.40
D2(16-11-2013)	67.00	0.26	5.96	43.10
D3(01-12-2013)	68.00	0.26	4.94	46.30
D4(16-12-2013)	66.20	0.30	6.91	38.20
SE $\pm$	0.91	0.02	0.22	1.76
CD at 5%	NS	NS	0.68	5.38

II: Basic studies for development of IPM

II a: Pest modelling for foliage aphids.

Centre: Ludhiana

The data was recorded by randomly selected ten individual tillers from 500m^2 area while moving in a diagonal path in the field. The population of *Coccinella septempunctata* was recorded in 1m^2 area around the individual plant. Weekly observations were recorded to study the first incidence and population build up of aphid and Coccinellid beetle.

Population dynamics of Wheat aphid: The aphid first appeared on 24.1.2014 on wheat crop and it started rising and reached it's peak on 14.03.2014 (Table 10.33a). Thereafter population of wheat aphid started declining and it drastically decreased by 04.04.2014. The population of Coccinellid beetle remained low up to 07.03.2014 (one week after the peak period of activity of wheat aphid) and thereafter it started rising and reach it's peak on 21.03.2014.

Population dynamics of barley aphid: The aphid population was high as compared to wheat during the whole crop season (Table 10.33b). It first appeared on 17.01.2014 on barley crop and it started rising and reached its first peak on 21.02.2014. Thereafter population of barley aphid started declining for sometime which again rose to it maximum on 14.03.2014. Thereafter its population started declining and become almost negligible on 04.04.2014. The population of coccinellid beetles remained low up to 07.03.2014 (the peak period of activity of barley aphid) and thereafter it stated rising and reached its peak on 21.03.2014.

Thus, it can be concluded from the data comparatively high population of aphid appeared on barley as compared to wheat crop. The data also indicated that coccinellid beetle appeared after the peak period of aphid infestation on wheat and barley crop.

Table 10.33a. Forecasting of wheat aphid trial (population dynamics of wheat aphid and Coccinellid beetle.

Date of observation	Plant No.(No. of aphids/tiller)											Collateral host (Barley)			
	P1	P2	P3	P4	P5	P6	P7	P8	P9	P10	Avg.	P1	P2	P3	Avg.
24.01.2014	0	0	0	0	2	0	0	0	0	1	0.3	0	0	6	2.00
31.01.2014	0	0	1	1	0	0	3	0	1	2	0.8	0	0	0	0.00
07.02.2014	0	0	1	2	0	3	0	1	1	0	0.8	0	12	15	9.00
14.02.2014	0	1	4	0	0	0	1	2	2	0	1	0	0	14	4.67
21.02.2014	1	4	5	8	0	4	2	6	0	5	3.5	22	19	21	20.67
28.02.2014	10	11	17	22	17	29	14	5	10	18	15.3	11	15	16	14.00
07.03.2014	14	17	22	32	18	20	23	10	10	39	20.5	14	12	14	13.33
14.03.2014	18	25	29	35	18	33	14	32	36	12	25.2	44	39	32	38.33
21.03.2014	8	10	8	10	17	14	0	15	19	14	11.5	4	8	15	9.00
28.03.2014	0	7	8	7	8	0	8	4	11	8	6.1	2	0	0	0.67
0.4.04.2014	0	0	0	0	0	0	0	0	1	0	0.1	2	0	0	0.67
Date of observation	Plant No.(Coccinellid beetle/sq m area)											Collateral host (Barley)			
	P1	P2	P3	P4	P5	P6	P7	P8	P9	P10	Avg.	P1	P2	P3	Avg.
24:01.2014	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00
31.01.2014	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0.33
07.02.2014	0	0	0	0	0	1	0	0	0	0	0.1	0	0	0	0.00
14.02.2014	0	0	0	0	0	0	0	0	3	0	0.3	0	0	1	0.33
21.02.2014	2	0	0	0	0	1	0	1	0	1	0.5	0	0	4	1.33
28.02.2014	0	0	0	0	3	0	0	0	1	1	0.5	8	4	7	6.33
07.03.2014	0	1	2	6	1	6	2	2	3	4	2.7	0	1	4	1.67
14.03.2014	8	2	2	8	11	0	4	10	18	5	6.8	8	7	12	9.00
21.03.2014	4	17	5	17	8	8	9	5	9	10	9.2	7	4	8	6.33
28.03.2014	6	5	2	4	8	9	0	0	5	4	4.3	0	2	14	5.33
0.4.04.2014	0	0	0	0	0	1	0	0	0	0	0.1	0	2	0	0.67

Table 10.33b. Forecasting of barley aphid trial (population dynamics of barley aphid and Coccinellid beetle).

Date of observation	Plant No.(No. of aphids/tiller)											Collateral host (wheat)			
	P1	P2	P3	P4	P5	P6	P7	P8	P9	P10	Avg.	P1	P2	P3	Avg.
17.01.2014	0	0	0	1	0	0	0	0	0	0	0.1	0	0	0	0.00
24.01.2014	0	0	6	0	5	0	2	4	0	0	1.7	0	0	0	0.00
31.01.2014	0	0	0	4	7	4	0	8	8	2	3.3	0	0	0	0.00
07.02.2014	0	12	15	0	18	10	21	14	17	21	12.8	0	0	1	0.33
14.02.2014	0	0	14	0	22	34	19	0	18	22	12.9	0	0	1	0.33
21.02.2014	22	19	21	22	36	0	14	21	16	15	18.6	0	1	4	1.67
28.02.2014	11	15	16	18	10	18	10	21	11	14	14.4	1	4	5	3.33
07.03.2014	14	12	14	0	18	19	14	22	21	26	16	10	11	8	9.67

Date of observation	Plant No.(No. of aphids/tiller)											Collateral host (wheat)			
	P1	P2	P3	P4	P5	P6	P7	P8	P9	P10	Avg.	P1	P2	P3	Avg.
14.03.2014	44	39	32	26	22	28	23	38	25	41	**31.8**	14	17	22	**17.67**
21.03.2014	4	8	15	18	11	14	8	7	7	0	**9.2**	18	14	10	**14.00**
28.03.2014	2	0	0	0	4	2	0	0	0	0	**0.8**	8	4	8	**6.67**
0.4.04.2014	2	0	0	0	0	1	0	0	0	0	**0.3**	0	2	4	**2.00**

Date of observation	Plant No.(Coccinellid beetle/sq m area)											Collateral host (wheat)			
	P1	P2	P3	P4	P5	P6	P7	P8	P9	P10	Avg.	P1	P2	P3	Avg.
17.01.2014	0	0	0	0	0	0	0	0	0	0	**0**	0	0	0	**0.00**
24.01.2014	0	0	0	0	0	0	1	0	0	0	**0.1**	0	0	0	**0.00**
31.01.2014	0	0	1	0	0	0	0	0	0	0	**0.1**	0	0	0	**0.00**
07.02.2014	0	0	0	0	0	0	0	0	0	0	**0**	0	0	0	**0.00**
14.02.2014	0	0	1	0	0	0	2	2	1	4	**1**	0	0	0	**0.00**
21.02.2014	0	0	4	8	4	0	2	0	4	2	**2.4**	2	0	0	**0.67**
28.02.2014	8	4	7	4	0	0	4	8	4	2	**4.1**	0	0	0	**0.00**
07.03.2014	0	1	4	5	7	6	7	5	2	0	**3.7**	0	1	2	**1.00**
14.03.2014	8	7	12	11	0	5	0	0	0	6	**4.9**	8	2	2	**4.00**
21.03.2014	7	4	8	5	10	12	11	18	12	17	**10.4**	4	17	5	**8.67**
28.03.2014	0	2	14	15	15	0	8	7	15	11	**8.7**	6	5	2	**4.33**
0.4.04.2014	0	2	0	2	2	0	12	8	0	11	**3.7**	0	0	0	**0.00**

Centre: Niphad

The data presented in (Table 10.34) in respect of weekly observations on wheat aphids along with different weather parameters. The maximum number of 407.90 aphids/shoot/plant were observed in 2nd MW when maximum and minimum temperature were 27.0 and 9.7 °C, respectively and average humidity was 62 per cent. The maximum (32.30) natural enemies/m^2 were also recorded in 2nd MW.

Table 10.34. Seasonal incidence of the aphids and lady bird beetle on wheat

Meteo. Weeks	No. of Aphids /Shoot/plant	Population of natural enemies/m^2	Temperature (°C)		Relative Humidity (%)		Rainfall (mm)
			Max.	Min.	Morn.	Even.	
45	0.0	0.0	31.2	15.8	82	42	0.0
46	0.0	0.0	29.1	10.8	84	41	0.0
47	0.0	0.0	30.3	9.2	84	49	20.2
48	0.0	0.0	28.9	13.4	86	66	0.0
49	9.80	0.0	28.6	10.8	89	48	0.0
50	20.00	0.0	28.4	6.0	83	25	0.0
51	62.50	1.80	28.6	7.3	81	32	0.0
52	94.50	6.10	27.4	11.7	87	42	0.0
1	296.50	20.10	27.5	10.5	86	39	0.0
2	407.90	32.30	27.0	9.7	82	41	0.0
3	33.90	21.30	27.6	10.1	84	42	0.0
4	5.10	10.90	27.2	12.0	84	40	1.0
5	0.50	7.20	28.0	8.1	85	31	0.0

Meteo. Weeks	No. of Aphids /Shoot/plant	Population of natural enemies/m²	Temperature (°C)		Relative Humidity (%)		Rainfall (mm)
			Max.	Min.	Morn.	Even.	
6	0.00	4.20	29.7	8.1	82	24	0.0
7	0.00	1.90	25.3	8.0	85	39	0.0
8	0.00	0.00	29.0	11.6	84	35	4.0
9	0.00	0.00	28.7	9.9	80	37	0.0

Centre: Vijapur

II b: Basic studies on seasonal incidence and parasitism of *Helicoverpa*

a. *Seasonal incidence of H. armigera*

Study on seasonal incidence of *H. armigera* was undertaken at Centre of Excellence for Research on Wheat, Vijapur. For this, wheat crop was observed at weekly interval for the presence of larval population right from germination to harvest of the crop. Data presented in (Table 10.35a) revealed that the first appearance of the pests was noticed in the second week of February that continued till the first week of March with peak incidence observed during fourth week of February.

b. *Studies on parasites of wheat crop pests*

With a view to know the parasites of wheat pests present in nature, periodical collection of larvae of *H. armigera* from the wheat crop was made and brought to the laboratory for rearing and further study. Data on parasitism given in (Table 10.35b) indicated 11.63 per cent parasitism by *Campolatis chlorideae* on *H. armigera* larvae.

Table 10.35a. Seasonal activity of *H .armigera* (Location: Vijapur)

Sr. No.	Date of observation	No. of larval / 50 plant
1.	23/1/14	0
2.	30/1/14	0
3.	6/2/14	0
4.	13/2/14	1
5.	20/2/14	1
6.	27/2/14	2
7.	6/3/14	1
8.	13/3/14	0

Table 10.35b. Studies on natural parasitism of *H. armigera* (Location: Vijapur)

Sr. No.	Life stage observed	Date of collection	No. of larvae observed	No. of larvae parasitized	Percent parasitism	Name of parasite
1.	Larval	23/1/14	0	0	11.63%	**Campolatis chlorideae**
		30/1/14	0	0		
		6/2/14	0	0		
		13/2/14	8	1		
		20/2/14	10	1		
		27/2/14	12	1		
		6/3/14	13	1		
		13/3/14	10	1		

IIc. Centre: Durgapura:

Seasonal incidence of brown wheat mites *Petrobia latens*

The data of brown wheat mite *Petrobia latens* on wheat crop were recorded randomly on ten individual selected plants from 1000 sq.m area while moving in a diagonal path in the field. Weekly observations were recorded to study the first incidence and population build up of brown wheat mite.

Population dynamics of brown wheat mite: The brown wheat mite first appeared on 20.2.2014 on wheat crop and it started rising and reached it's peak on 13.3.2014.Thereafter population of brown wheat mite started declining and drastically decreased by 27.3.2014(Table 10.36).

Table.10.36. Seasonal incidence of brown wheat mites.

S. No.	Date	Plant No.(Numbers of mites/10 sq cm area)										Avg.
		P1	P2	P3	P4	P5	P6	P7	P8	P9	P10	
1	20.02.2014	0	0	2	0	2	2	0	0	0	2	0.8
2	27.02.2014	6	8	6	6	6	8	8	6	6	4	6.4
3	06.03.2014	10	16	18	16	18	18	16	18	16	15	16.1
4	13.03.2014	15	20	22	25	20	22	20	25	15	20	20.4
5	20.03.2014	18	20	20	20	20	20	20	20	15	18	19.1
6	27.03.2014	0	0	0	0	0	0	0	0	0	0	0.00
7	04.04.2014	0	0	0	0	0	0	0	0	0	0	0.00

Centre: Karnal

The data was recorded by randomly selecting ten individual tillers from 500m^2 area while moving in a diagonal path in the field. The population of *Coccinella septempunctata* was recorded in 1m^2 area around the individual plant. Weekly observations were recorded to study the first incidence and population build up of aphid and Coccinellid beetle.

Population dynamics of Wheat aphid: The aphid first appeared on 27.1.2014 on wheat crop and it started rising and reached it's peak on 26.02.2014 (Table 10.37a). Thereafter population of wheat aphid started declining and it drastically decreased on 25.03.2014. The population of Coccinellid beetle started from 04-02-2014 and reach it's peak on 05.03.2014.

Population dynamics of barley aphid: The aphid population was high as compared to wheat during the whole crop season (Table 10.37b). It first appeared on 20.01.2014 on barley crop and it started rising and reached its peak on 18.02.2014. Thereafter its population started declining and become almost negligible on 25.03.2014. The population of coccinellid beetles remained low up to 18.02.2014 (the peak period of activity of barley aphid) and thereafter it stated rising and reached its peak on 26.02.2014.

Thus, it can be concluded from the data comparatively high population of aphid appeared on barley as compared to wheat crop. The data also indicated that coccinellid beetle appeared after the peak period of aphid infestation on wheat and barley crop.

Table 10.37a. Forecasting of wheat aphid trial (population dynamics of wheat aphid and Coccinellid beetle.

Date of observation	Plant No.(No. of aphids/tiller)											Collateral host (Barley)			
	P1	P2	P3	P4	P5	P6	P7	P8	P9	P10	Avg.	P1	P2	P3	Avg.
27.01.2014	0	0	0	8	0	0	0	0	0	10	1.80	22	25	15	20.67
04.02.2014	15	17	20	18	25	20	15	22	17	14	18.30	55	60	80	65.00
11.02.2014	25	45	7	9	18	15	25	16	25	6	19.10	150	165	14	109.67
18.02.2014	65	55	60	70	75	65	80	60	55	45	63.00	115	135	150	133.33
26.02.2014	70	100	90	45	65	75	70	50	27	65	65.70	90	115	125	110.00
05.03.2014	30	40	20	50	0	60	0	0	18	0	21.80	50	30	10	30.00
12.03.2014	8	10	15	0	0	12	20	10	0	25	10.00	15	70	25	36.67
19.03.2014	0	0	0	0	0	0	0	0	7	0	0.70	10	0	5	5.00
25.03.2014	0	0	0	4	0	0	0	1	0	0	0.50	0	0	0	0.00
Date of observation	Plant No.(Coccinellid beetle/sq m area)											Collateral host (Barley)			
	P1	P2	P3	P4	P5	P6	P7	P8	P9	P10	Avg.	P1	P2	P3	Avg.
27.01.2014	0	0	0	0	0	0	0	0	0	0	0.00	0	0	0	0.00
04.02.2014	0	0	1	0	0	0	0	0	0	0	0.10	0	1	0	0.33
11.02.2014	0	0	0	1	0	0	0	1	0	0	0.20	1	0	1	0.67
18.02.2014	0	0	0	0	0	2	0	0	0	1	0.30	0	2	1	1.00
26.02.2014	0	1	0	0	1	0	1	0	1	0	0.40	1	1	0	0.67
05.03.2014	1	0	2	0	0	2	0	1	1	0	0.70	2	0	1	1.00
12.03.2014	0	0	0	1	0	0	0	0	0	0	0.10	0	1	0	0.33
19.03.2014	0	0	2	0	0	0	0	0	0	0	0.20	1	0	2	1.00
25.03.2014	4	0	0	0	3	0	0	0	6	0	1.30	3	2	0	1.67

Table 10.37b: Forecasting of barley aphid trial (population dynamics of barley aphid and Coccinellid beetle).

Date of observation	Plant No.(No. of aphids/tiller)											Collateral host (wheat)			
	P1	P2	P3	P4	P5	P6	P7	P8	P9	P10	Avg.	P1	P2	P3	Avg.
20.01-2014	0	0	10	0	0	0	0	5	0	8	2.09	0	0	0	0.00
27.01.2014	10	10	7	20	13	6	70	40	15	18	20.9	4	5	3	4.00
04.02.2014	30	15	18	40	25	50	150	80	35	55	49.8	9	7	11	9.00
11.02.2014	70	75	135	145	180	155	90	115	200	190	135.5	15	18	20	17.67
18.02.2014	140	135	125	110	160	100	155	180	140	160	140.5	40	55	60	51.67
26.02.2014	80	60	150	175	90	115	125	110	160	90	115.5	90	115	100	101.67
05.03.2014	20	40	60	80	0	30	25	45	10	30	34	60	50	40	50.00
12.03.2014	5	10	0	0	15	0	12	8	0	2	5.2	15	10	20	15.00
19.03.2014	0	0	8	0	0	4	0	0	3	0	1.5	0	0	0	0.00

25.03.2014	2	0	0	0	0	0	1	0	0	0	0.3	0	0	0	0.00
Date of observation	**Plant No.(Coccinellid beetle/sq m area)**											**Collateral host (wheat)**			
	P1	**P2**	**P3**	**P4**	**P5**	**P6**	**P7**	**P8**	**P9**	**P10**	**Avg.**	**P1**	**P2**	**P3**	**Avg.**
20.01-2014	0	0	0	0	0	0	0	0	0	0	**0.00**	0	0	0	**0.00**
27.01.2014	0	0	0	0	0	0	0	0	0	0	**0.00**	0	0	0	**0.00**
04.02.2014	0	0	1	0	0	0	0	0	1	0	**0.20**	1	0	1	**0.67**
11.02.2014	0	0	0	0	1	0	0	0	0	0	**0.10**	0	0	0	**0.00**
18.02.2014	1	0	0	2	0	0	1	0	0	0	**0.40**	0	0	0	**0.00**
26.02.2014	0	3	0	0	7	0	0	0	5	0	**1.50**	1	0	0	**0.33**
05.03.2014	0	0	0	2	1	0	0	2	1	2	**0.80**	1	0	0	**0.33**
12.03.2014	0	1	0	0	0	2	0	0	0	4	**0.70**	0	0	0	**0.00**
19.03.2014	0	0	1	0	0	1	0	0	0	0	**0.20**	2	0	1	**1.00**
25.03.2014	0	1	0	1	0	0	0	0	0	0	**0.20**	0	1	1	**0.67**

11.4. Stored Grain pests

EXPT: 11 Studies on the insecticidal treatment on viability of store grain pests under ambient condition

Centre: Ludhiana

The experiment was conducted at Wheat Entomological Laboratories, PAU, Ludhiana during 2013-14. Freshly harvested seed with high percentage of germination and low moisture content (>10 %) was taken for experimental purpose. Seven insecticidal treatments were done with required quantity of insecticides diluted in 5 ml water to treat the 1 kg of seed for proper coating. After drying in shade, out of 1 kg seed, only 100 grams of seeds were placed in battery jars covered with muslin cloth and kept under ambient condition in B.O.D. and each treatment was replicated thrice.

The data recorded (one month after insecticidal application) revealed that spinosad (5.12% damage) was the most effective treatment which was at par with Emamectin benzoate(5.46% damage), indoxacarb (5.96% damage) and deltamethrin (6.30% damage) (Table 10.38a). All other treatments were significant better than untreated control (11.60% damage). Two months after treatment, spinosad (5.44% damage) was again the best treatment and significantly better than all other treatment. Similar trend was observed up to four months after treatment.

Centre: Durgapura

(a) **Studies on the insecticidal treatment on viability of store grain pests under ambient condition**

The experiment was conducted at Seed Testing Laboratory, RARI, Durgapura, Jaipur during 2013-14. Freshly harvested seed with high percentage of germination and low moisture content (>10 %) was taken for experimental purpose. For the Insecticidal seed treatment required quantity of insecticides diluted in 5 ml water to treat the 1kg of seed for proper coating. After drying in shade, seeds were packed in gunny bags and replicated thrice for each treatment. After that there bags were kept in storage under ambient conditions. Wheat variety Raj 3765 were used for experiment and stored for 12 months. Spinosad 45 SC and Novaluron 10 EC, both gave complete protection to wheat seed against storage insects up to 3 months and at par with Emamectin benzoate and Deltamethrin treatment. Experiment is in progress (Table 10.38b)

(b) Effect of insecticidal seed treatment on seed germination and damage

Seed germination was maintained in all the treatments except control (untreated seed) in which 31.66% seed was damaged up to storage period of 3 months. Experiment is in progress (Table 10.38c)

Table 10.38a: Studies on the effect of insecticidal seed treatment on seed viability during storage under ambient conditions against store grain pests 2013-14 (Centre-Ludhiana)

S. No.	Treatments	Dosage	Damage (%)		
			1 month	2 month	4 months
1	Emamectin benzoate (Proclaim)	40.0 mg/kg	5.46 (2.53)	6.88 (2.80)	7.74 (2.95)
2	Spinosad (Tracer)	4.4. mg/Kg	5.12 (2.46)	5.44 (2.53)	6.82 (2.79)
3	Indoxacarb (Avaut)	13.8 mg/kg	5.96 (2.63)	6.36 (2.71)	10.49 (3.38)
4	Rynaxypyr (Coragen)	99 mg/kg	7.20 (2.86)	7.36 (2.89)	7.01 (2.82)
5	Novaluron (Rimon)	0.02ml/kg	8.68 (3.10)	9.26 (3.20)	10.04 (3.32)
6	Novaluron (Rimon)	0.05 ml/kg	7.32 (2.88)	7.48 (2.91)	8.84 (3.13)
7	Deltamethrin 2.8 EC	0.04 ml/kg	6.30 (2.69)	7.16 (2.85)	13.18 (3.76)
8	Untreated check	-	11.60 (3.54)	24.12 (5.01)	37.12 (6.17)
	CD (p =0.05)		(0.32)	(0.15)	(0.22)

Table 10.38b: Studies on the effect of insecticidal seed treatment on seed viability during storage under ambient conditions against store grain pests 2013-14 (Centre-Durgapura)

S. No.	Treatments	Damage (%)			
		3 month	6 month	9 months	12 month
T1	Emamectin benzoate (Proclaim 40.0 mg/kg)	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)	1.66 (7.33)
T2	Spinosad (Tracer 4.4 mg/kg)	8.00 (16.34)	15.66 (23.20)	20.00 (26.45)	68.66 (56.07)
T3	Indoxacarb (Avaut 13.8 mg/kg)	5.00 (12.64)	13.33 (21.36)	17.66 (24.81)	65.00 (53.76)
T4	Rynaxypyr (Coragen 99 mg/kg)	6.33 (14.50)	15.66 (22.98)	19.00 (25.80)	80.33 (63.82)
T5	Chlorfenapyr (Intrepid 0.02 ml/kg)	0.00 (0.00)	4.33 (11.89)	10.00 (18.37)	71.66 (57.98)
T6	Novaluron (Rimon 0.02 ml/kg)	0.00 (0.00)	1.00 (6.02)	6.33 (14.50)	25.00 (29.92)
T7	Novaluron (Rimon 0.05 ml/kg)	0.00 (0.00)	0.00 (0.00)	3.33 (10.49)	8.00 (16.34)
T8	Deltamethrin 2.8 EC (0.04 ml/kg)	0.00 (0.00)	0.00 (0.00)	1.33 (6.53)	3.00 (9.88)
T9	Control	12.66 (20.78)	20.66 (27.00)	47.00 (43.26)	100.00 (100.00)
	S.Em±	0.940	1.238	1.391	1.877
	C.D.	2.793	3.680	4.133	5.578

Table 10.38c: Effect of insecticidal seed treatment on seed germination and damage 2013-14 (Centre-Durgapura)

S. No.	Treatments	Germination (%)	Damage (%)
		3 month	3 month
T1	Emamectin benzoate (Proclaim 40.0 mg/kg)	97.33(80.73)	0.00(0.00)
T2	Spinosad (Tracer 4.4 mg/kg)	97.33(80.11)	0.00(0.00)
T3	Indoxacarb (Avaut 13.8 mg/kg)	95.66(78.00)	2.33(8.74)
T4	Rynaxypyr (Coragen 99 mg/kg)	95.33(77.71)	3.00(9.88)
T5	Chlorfenapyr (Intrepid 0.02 ml/kg)	96.33(79.13)	2.00(7.94)
T6	Profenofos 50 EC (0.004 ml/kg)	96.66(79.59)	1.66(7.33)
T7	Novaluron (Rimon 0.05 ml/kg)	97.33(80.64)	0.00(0.00)
T8	Deltamethrin 2.8 EC (0.04 ml/kg)	98.00(82.05)	0.00(0.00)
T9	Control	62.00(52.04)	31.66(34.13)
S.Em±		1.602	1.138
C.D.		4.760	3.383

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RESULTS OF THE COORDINATED EXPERIMENTS
2013-14

CROP PROTECTION PROGRAMME (VOL.III, PART - C)
(NEMATOLOGY)

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PROGRAMME 11. WHEAT NEMATOLOGY

The action plan for the year 2013-14 in the Wheat Nematology sub programme under crop protection programme of AICW&BIP considered the aspects like evaluation of host resistance against Cereal Cyst Nematode (*Heterodera avenae* & *H. filipjevi*) and root knot nematode (RKN); pathotype study of *Heterodera avenae;* survey and surveillance for CCN, ECN and other plant parasitic nematodes found in wheat; population dynamics studies on major parasitic nematodes in wheat based different cropping systems, diversification in the prevailing system besides integrated and eco friendly approaches in management of CCN. The activities dealt in details with resultant outcomes are written hereunder.

11.1: HOST RESISTANCE

i) Response of CCNSN (AVT entries) against CCN, *Heterodera avenae* and *H. filipjevi* at multilocations:

Hisar

Nematode - infested soil was brought from village Kumhariya District Fatehabad. After diluting the soil with dune sand, the pots were filled with *H. avenae*- infested soil (Pi = 20 cysts/ 1 kg pot). Four seeds of each wheat var. were sown in three pots, and thinned to two plants after one week of germination. Numbers of white females/cysts were recorded in each pot after 110-120 days of sowing. Varieties/ lines were categorized as resistant (1-4 cysts), moderately resistant (5-9 cysts), susceptible (9 -20 cysts) and highly susceptible (>20cysts). 206 entries (AVT-I = 113, AVT-II = 93) were screened against *Heterodera avenae* under screen house conditions. All the entries were found highly susceptible. None of the entry showed resistant or moderately resistant reaction.

Durgapura

i. Screening of wheat germplasms AVT-I against cereal cyst nematode, *Heterodera avenae*:
   Out of 116 germplasms screened, none was found resistant. Only one genotype (K 1217) was moderately resistant. (Table 11.1)
ii. Screening of wheat germplasms AVT-II against cereal cyst nematode, *Heterodera avenae*:
   Out of 93 germplasms lines, none was found resistant. (Table 11.2.).

Table 11.1. Screening of AVT-I against cereal cyst nematode in wheat (Durgapura)

Number of germplasm lines	Reactions	Name of Germplasm
0	Resistant	Nil
1	Moderately Resistant	K 1217
99	Susceptible	HPW 373, HPW 400, HPW 401, HPW 410, HPW 411, HPW 412, HS 547, HS 562, HS 577, HS 590, HS 591, HS 594, HS 595, UP 2890, VL 976, VL 977, VL 1003, VL 1004, VL 3002, VL 3006, DBW 95, DBW 128, DBW 129, HD 3128, HD 3132, HD 3133, HD 3139, HD 4730, HUW 675, K 1204, MP 1277, PBW 677, PBW 692, PBW 695, PBW 697, PBW 698, PBW 702, PBW 703, TL 2995, UAS 356, WH 1154, WH 1156, WH 1157, WH

Number of germplasm lines	Reactions	Name of Germplasm
		1164, DBW 126, DBW 98, HD 3127, HUW 661, HUW 677, HUW 679, PBW 693, PBW 701, PBW 704, UP 2855, WH 1132, CG 1010, DDW 30 (D), GW 451, GW 455, HD 3146, HD 4728 (D), HI 8750 (D), HI 8755 (D), K 1215, MACS 3916 (D), MACS 3927 (D), MACS 6604, MP 1279, NIAW 2030, UAS 451 (D), DDW 27 (D), HI 8751 (D), HI 8754 (D), K 1213, UP 2864, DBW 155, MACS 5040, MACS 5031, MACS 5022*, DDK 1046, MACS 2971(C), DDK 1044, DDK 1029(C), HW 1099(C), MACS 2496(C), TL 2996, TL 2997, TL 2998,TL 2999, TL 3000, TL 2942 (C), TL 2969 (C), PBW 722, MMBL 283, HUW 234 (C), PBW 343 (C), FLW 32-1, FLW 32-2, FLW 32-3
14	Highly Susceptible	HS 558, HS 592, HS 593, UP 2891, VL 3004, VL 3005, PBW 706, PBW 723,MACS 6507,UAS 358, DBW 154 KB 2012-03, HD 2932+Sr26, HD 2932-Lr19/Sr2

Table 11.2. Screening of AVT-II against cereal cyst nematode in wheat(Durgapura)

Number of germplasm (Ninety one)	Reactions	Name of Germplasm
0	Resistant	Nil
0	Moderately Resistant	Nil
79	Susceptible	HPW 376, VL 967, HPW 251 (C), HS 277 (C), HS 375 (C), HS 490 (C), HS 507 (C), HS 542 (I) (C), VL 804 (C), VL 829 (C), VL 892 (C), VL 907 (C), HUW 666, PBW 681, WH 1129, WH 1138, WH 1142, DBW 90 (I) (C), DPW 621-50 (C), HD 2967 (C),HD 3043 (C), HD 3059 (C),HD 3086 (I) (C),PBW 590 (C),PBW 644 (C),PBW 660 (I) (C),PDW 233 (C),PDW 291 (C),PDW 314 (C),WH 1021 (C),WH 1080 (C),WH 1105 (C),BRW 3723,DBW 107,HD 3118, C 306 (C),DBW 39 (C),HD 2733 (C),HD 2888 (C),HD 2985 (C),HI 1563 (C), K0307 (C),K 1006 (I) (C),DBW 110,HI 8736 (D),HI 8737 (D),MP 3382,NIAW 1885, PBW689,A9-30-1 (D) (C),GW 322 (C),HI 1500 (C),HI 1544 (C),HI 8498 (D) (C),HI 8627 (D) (C),MP 3288 (C),MP 4010 (C),MPO 1215 (d) (C),NIAW 1994,UAS 347,UAS 446 (D), AKDW 2997-16(d)C, HD 3090 (I) (C),MACS 6222 (C), MACS 6478 (C),NI 5439 (C),NIAW 1415 (C),NIDW 295 (d) (C),Raj 4083 (C),UAS 428 (d) (C),HW 2044 (C),MACS 5022,DDK 1029 (C), Kharchia 65 (C),KRL 19 (C),MACS 2496 (C), MACS 2971 (C), DDK 1042 (SPL-DIC-07 AVT I), HW 1098 (SPL-DIC-09 AVT I)
14	Highly Susceptible	HPW 349 (C), DBW 88 (I) (C), WH 1124 (I) (C), K 1114, DBW 14 (C), K 8027 (C), NW 2036 (C), NW 5054 (I) (C), HD 2864 (C), HD 2932 (C), MP 3336 (C), CoW(W) 1 (C), HW 5216 (C), KRL 210 (C),

Ludhiana :
One hundred and eleven entries under AVT I and ninety three entries under AVT II were screened for resistance against *H. avenae* (CCN sick plot conditions). PBW 550, PBW 502 and PBW 343 were used as susceptible checks. Out of these none of the entry was found resistant. Only two genotypes HS 507 (C)and HD 3059 (C) in AVT II and eight in AVT I namely; HPW 400, DBW 98, UP 2855. HI 8755 (D), UP 2864, DDK 1042, HW 1098 (I) (C), and TL 2997 have shown moderately resistant reaction. Rest of the entries were either susceptible or highly susceptible to CCN.
Delhi : All the varieties screened under AVT I and AVT II were susceptible to highly susceptible.

ii. MULTIPLE DISEASE/ PEST SCREENING NURSERIS : NEMATODES (CCN) MDSN

Hisar : 49 entries (*Triticum aestivum* = 44, durum = 4, triticale = 1) were screened against *Heterodera avenae* under screen house conditions. All the entries gave highly susceptible reaction.

Ludhiana : Out of 49 genotypes evaluated for resistance to cereal cyst nematode, *H. avenae,* none was found resistant. Only seven genotypes namely HW1098, PBW 670, PDW 329(d), TL 2978(T), HD 3068, PBW 658 and HD 4725 were moderately resistant. Rest of the entries were susceptible or highly susceptible. Screening against cereal cyst nematode was done under pot culture conditions in the nematode infested soil.

Durgapura : Forty nine germplasms of wheat were screened against cereal cyst nematode, *Heterodera avenae* under infested field condition. None was found resistant or moderately resistant. Forty six lines were susceptible while three were found highly susceptible. (Table11.3).

Table 11.3. Multiple Disease Screening Nursery against cereal cyst nematode of wheat, 2013-14

Number of germplasm (Forty nine)	Reactions	Name of germplasm
0	Resistant	-
0	Moderately Resistant	-
46	Susceptible	HW 1098, HW 5216, GW 433, GW 1276(d), HD 3076, HD 3098, HPW 385, KRL 327, PBW 670, PDW 329 (d), TL 2978 (T), VL 971, MP 1259, Raj 4240, Raj 4270,UP 2825, UP 2852, Raj 4238, DDK 1042, GW 1280 (d),KLP 402, MP 3353, UP 2824, UP 2828, UAS 336, HS 526, HD 3065, HI 1579, WH 1105, MACS 3828, PBW 658, AKDW 4749, HD 3075, HD 3081 Q, HPW 368, HPW 376, HS 557, NIAW 1846, RW 3705, VL 972, PBW 661, HD 3077, HD 4725, HI 8626 (d) HUW 652, K 1016
3	Highly Susceptible	HI 1584, Raj 4245, Raj 4246,

COOPERATORS:

NAME	CENTRE
DAMAN JEET KAUR	LUDHIANA
RS KANWAR	HISAR
KN PATHAK	PUSA (BIHAR)
INDRA RAJVANSHI	DURGAPURA
PANKAJ	DELHI

ii) Screening against *M. graminicola*

Ludhiana

One hundred and thirteen entries under AVT I and ninety three entries under AVT II were screened for resistance against root knot nematode, *Meloidogyne graminicola* in the nematode infested soil under pot culture conditions. PBW 550, PBW 502 and PBW 343 were used as susceptible checks. All the entries showed susceptible to highly susceptible reaction .

Pusa Bihar

Ninety lines of AVT 1st year were screened against *Meloidogyne graminicola* in 15cm earthen pots containing nematode *M. graminicola* infested pot in 3 replications. The observations for root-knot index were recorded on at 1 - 5 scale. Out of 90 entries of AVT 1st year, none of the entry was found susceptible to *M. graminicola.* All entries appeared highly resistant against *M. graminicala.* For AVT IInd year also, none of the entry was reported susceptible.

COOPERATORS:

NAME	CENTRE
DAMAN JEET KAUR	LUDHIANA
KN PATHAK	PUSA (BIHAR)

iii) Studies on *Heterodera avenae* complex

Durgapura

The biotypes studies of cereal cyst nematode (Jaipur population) was carried out during the crop season 2013-14. Out of 24 differentials of wheat and barley, ten showed resistant reaction i.e. AUS-15854, Raj MR-1, AUS-7869,Capa, KVL-191, Dalmitsche, Harta, Martin, L-62 and Morocco (Table 11.4.).

Table 11.4. Reaction of *Heterodera avenae* of Jaipur population on International differentials

S.No.	International Differentials	Reactions
1	AUS-15854	R
2	Raj MR-1	R
3	AUS-7869	R
4	AUS-15895	MR
5	AUS-4930	S
6	AUS-498	S
7	Loros	S
8	IK2 Light	MR
9	Psathia	S
10	Capa	R
11	Ortalan	S
12	KVL-191	R

S.No.	International Differentials	Reactions
13	Ogrlitsche	S
14	Dalmitsche	R
15	Harta	R
16	Emir	S
17	Morocco	R
18	Gelliunepp	S
19	P-313221	S
20	Martin	R
21	Varda	S
22	Siri	S
23	La-estanzuella	S
24	L-62	R

COOPERATOR:

NAME	CENTRE
INDRA RAJVANSHI	DURGAPURA

11.2: SURVEY AND SURVEILLANCE

Crop health monitoring survey for nematodes

i) Post harvest survey for ear cockle nematode *Anguina tritici*

Durgapura

To find out the incidence of ear cockle disease, *Anguina tritici* grain samples were collected from various grain Mandies of five districts *viz.* Ajmer, Alwar, Dausa, Jaipur and Tonk. Out of 761 samples, 118 were found infected with ear cockle disease. Highest percentages of infestation (30.30) was recorded form Kishangarh of Ajmer District followed by Devli (24.00) of Tonk District. All the cultivars were infected with this disease. Highest percentages of infestation was recorded from mixture of cultivars (25.97) followed by local cultivar (23.91). (Table 11.7,11.8 & 11.9).

Table 11.7: Incidence of Ear cockle disease, *Anguina tritici*

S.N.	Districts	Places	Cultivars	No. of samples collected	No. of samples infested	No. of galls/1000 seed	% grain infestation
1.	Ajmer	Ajmer	Raj 1482	11	1.0	2.0	0.2
			Raj 3765	14	0.0	0.0	0.0
			Raj 3077	9	2.0	1.0	0.1
			Local	8	2.0	3.0	0.3
			Mixture	4	1.0	2.0	0.2
		Kishangarh	Raj 1482	16	7.0	3.0	0.3
			Raj 3765	21	3.0	2.0	0.2
			Raj 3077	16	3.0	1.0	0.1
			Local	8	4.0	6.0	0.6
			Mixture	5	3.0	2.0	0.2
2.	Alwar	Bansur	Raj 3765	12	2.0	1.0	0.1
			Raj 1482	9	2.0	1.0	0.1
			Raj 3077	11	0.0	0.0	0.0
3.	Dausa	Dausa	Raj 3077	16	2.0	1.0	0.1
			Raj 3765	15	2.0	1.0	0.1
			Raj 1482	11	5.0	3.0	0.3
		Lalsot	Raj3077	25	1.0	1.0	0.1

S.N.	Districts	Places	Cultivars	No. of samples collected	No. of samples infested	No. of galls/1000 seed	% grain infestation
			Raj 3765	10	1.0	1.0	0.1
			Raj1482	16	3.0	2.0	0.2
			Local	19	2.0	2.0	0.2
			Mixture	8	3.0	2.0	0.2
		Mandawri	Raj3077	11	0.0	0.0	0.0
			Raj 3765	14	2.0	1.0	0.1
			Raj1482	17	3.0	2.0	0.2
			Mixture	5	1.0	3.0	0.3
			Local	7	1.0	2.0	0.2
4.	Jaipur	Jaipur	Raj 3765	12	0.0	0.0	0.0
			Raj 3077	10	0.0	0.0	0.0
			Raj 1482	3	0.0	0.0	0.0
			Local	2	0.0	0.0	0.0
			Mixture	12	0.0	0.0	0.0
		Bassi	Raj 3765	16	1.0	1.0	0.1
			Raj 3077	12	2.0	1.0	0.1
			Raj 1482	15	4.0	2.0	0.2
			Mixture	13	3.0	1.0	0.1
			Local	7	2.0	1.0	0.1
		Chaksu	Raj 3765	9	1.0	1.0	0.1
			Raj 3077	11	0.0	0.0	0.0
			Raj 1482	9	1.0	1.0	0.1
			Local	15	4.0	2.0	0.2
		Chomu	Raj 3765	11	0.0	0.0	0.0
			Raj 3077	14	0.0	0.0	0.0
			Raj 1482	6	0.0	0.0	0.0
			Mixture	5	0.0	0.0	0.0
			Local	4	0.0	0.0	0.0
		Dudu	Raj 3765	5	2.0	2.0	0.2
			Raj 3077	3	1.0	1.0	0.1
			PBW343	15	2.0	3.0	0.3
			Raj 1482	7	2.0	2.0	0.2
			Local	6	1.0	4.0	0.4
		Kotputli	Raj 3765	15	2.0	2.0	0.2
			Raj 3077	13	1.0	1.0	0.1
			Raj 1482	19	2.0	3.0	0.3
			Mixture	7	2.0	2.0	0.2
			Local	6	1.0	4.0	0.4
		Renwal	Raj 3765	8	0.0	0.0	0.0
			Raj 3077	7	0.0	0.0	0.0
			Raj 1482	5	1.0	2.0	0.2
			Local	4	1.0	2.0	0.2
		Shahpura	Raj 3765	7	0.0	0.0	0.0
			Raj 3077	4	0.0	0.0	0.0
			Raj 1482	6	2.0	2.0	0.2
5	Tonk	Tonk	Raj 3765	19	1.0	1.0	0.1
			Raj 3077	12	2.0	3.0	0.3
			Raj 1482	10	1.0	0.0	0.0
			WH-147	11	2.0	1.0	0.1
			K-65	9	2.0	4.0	0.4
			Mixture	7	3.0	3.0	0.3

S.N.	Districts	Places	Cultivars	No. of samples collected	No. of samples infested	No. of galls/1000 seed	% grain infestation
			Local	2	1.0	4.0	0.4
		Devli	Raj 3765	18	2.0	2.0	0.2
			Raj 3077	14	1.0	1.0	0.1
			Raj 1482	3	2.0	1.0	0.1
			Mixture	11	4.0	3.0	0.3
			Local	4	3.0	3.0	0.3
		Total		761	118		

Table 11.8: Tehsil wise prevalence of ear cockle disease, *Anguina tritici*

S.NO.	Districts	Tehsil	No. of samples collected	No. of samples infested	% sample infestation
1	Ajmer	Ajmer	46	6	13.33
		Kishangarh	66	20	30.30
2	Alwar	Bansur	32	4	12.50
3.	Dausa	Dausa	42	9	21.42
		Lalsot	78	10	13.15
		Mandawri	54	7	12.96
4.	Jaipur	Jaipur	39	0.0	0.00
		Bassi	63	12	19.04
		Chaksu	44	6.0	13.63
		Chomu	40	0.0	0.00
		Dudu	36	8.0	22.22
		Kotputli	60	8.0	13.33
		Renwal	24	2.0	8.33
		Shahpura	17	2.0	11.76
5	Tonk	Tonk	70	12	17.14
		Devli	50	12	24.00
Total			761	118	15.50

Table 11.9: Cultivar wise prevalence of ear cockle disease, *Anguina tritici*

S.No.	Cultivar	No. of samples collected	No. of samples infested	% infestation
1	Raj 3765	206	19	9.22
2	Raj 1482	163	36	22.08
3	Raj 3077	188	15	7.97
4	PBW 343	15	2	13.33
5	WH 147	11	2	18.18
6	Local	92	22	23.91
7	Mixture	77	20	25.97
8	K 65	9	2	22.22
Total		761	118	15.50

Ludhiana :

A total of 1919 wheat grain samples collected from one 128 different grain markets of the Punjab in the months of April and May, 2014 were analyzed for ear cockle nematode. None of the samples showed incidence of ear cockle nematode.

Pusa Bihar

During 2013-14, a total of 150 samples of wheat from threshing floor/different mandies of Samastipur, Muzaffarpur and Vaishali were collected for examination for ECN (Table 11.10). However, ECN could not be found from any of the sample. There was no report for the occurrence of ECN, from other parts of Bihar also.

Table 11.10. Percentage of ear-cockle grains in wheat grain samples, collected from Bihar

S. No.	Villages (District)	Samples collected	Samples infested with ECN	% ECN galls in the sample
1	Harpur (Samastipur)	10	Nil	Nil
2	Thara gopalpur (Samastipur)	10	Nil	Nil
3	Ladaura (Samastipur)	10	Nil	Nil
4	Bala (Samastipur)	10	Nil	Nil
5	Karua (Samastipur)	10	Nil	Nil
6	Dighra (Samastipur)	10	Nil	Nil
7	Eteha (Muzaffarpur)	10	Nil	Nil
8	Dholi Farm (Muzaffarpur)	10	Nil	Nil
9	Pilkhi (Muzaffarpur)	10	Nil	Nil
10	Muzaul (Muzaffarpur)	10	Nil	Nil
11	Lautan (Muzaffarpur)	10	Nil	Nil
12	Hariharpur (Vaishali)	10	Nil	Nil
13	Mahua (Vaishali)	10	Nil	Nil
14	Ranipokhar (Vaishali)	10	Nil	Nil
15	Sarai (Vaishali)	10	Nil	Nil

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c) Other important Plant Parasitic Nematodes:

Cereal Cyst Nematode and other soil borne nematodes

Hisar

Crop health monitoring survey for nematodes was done in Sirsa, Hisar and Fatehabad districts. Cereal cyst nematode was reported in 41.4% (24/58) samples. It was found in samples collected from villages- Gangwa, Shahpur, Adampur, Juglan, Dhandur, Khoka, Hindwan of Hisar; in samples of villages Kukrawali, Chabla mori, Salam khera, Dhangar, Bun gaon, Chandrawal, Majra, Dhingsara, Dhani dhaka, Mochiwali and Mehuwala of Fatehabad; and in samples of Kotli, Begu, Kanwarpura, Kairanwali, Raipuria, Makhosarani of Sirsa.

Other soil borne plant parasitic nematodes present in these samples were *Hoplolaimus* (12 %), *Tylenchorhynchus* sp. (52%), *Helicotylenchus* sp (7%) and *Pratylenchus* sp. (24 %). Some non plant parasitic nematodes such as *Aphelenchus* sp. *Tripyla* sp. *Acrebeloides* sp., *Dorylaimus* sp. and *Mesodorylaimus* sp. were also reported in these soil samples. Apart from these, samples brought by farmers from Sasroli, Maaten hail, Birohar, (Jhajjar) and Baganwali (Bhiwani) also had cereal cyst nematode.

Ludhiana :

Eighty eight soil and root samples were collected from 18 locations for the plant parasitic nematode infestation on wheat crop the state (Table 11.11). Nematodes recorded were *H. avenae*, species of *Meloidogyne, Tylenchorhynchus, Hirschmanniella, Helicotylenchus and Hoploloaimus. H. avenae* cysts were recorded from Moga (District Moga), Kotkapoora (District Faridkot), Aulakh, Chibranwali (District Muktsar), Abohar and Fazilka (District Fazilka). The number of cysts recorded was 1-10 cysts/250 cc soil and highest number i.e 10 cysts was recorded from Fazilka (District Fazilka). Root knot nematode was also recorded up to 120 larvae/250cc soil and *Tylenchorhynchus* was recorded from all the collected samples

Table 11.11. Plant parasitic nematodes associated with wheat crop in Punjab (2013-2014)

Village/ Locality	No. of samples collected	Number of nematodes / 250 ml soil; Range (Frequency of occurrence, %)					
		H. avenae (cysts)	*Meloidogyne* (Larvae)	*Tylenchorhynchus*	*Hirschmanniella*	*Helicotylenchus*	*Hoplolaimus*
Behram	6	-	80-120 (100.00)	40-80 (100.00)	80-200 (100.00)	-	-
Bela	6	-	40 -80 (33.33)	40-160 (100.00)	40-240 (100.00)	-	-
Bahowal	4	-	80 (50.00)	40-240 (100.00)	40-120 (100.00)	40 (50.00)	-
Fatehgarh Vran	6	-	40-80 (100.00)	80-240 (100.00)	80-120 (100.00)	40-80 (50.00)	40 (33.33)
Mubarakpur (Nawashehr)	4	-	40 (50.00)	80-240 (100.00)	80-160 (100.00)	-	40 (50.00)
Moga	6	1-3 (50.00)	-	40-360 (100.00)	40-80 (50.00)	40 (16.66)	-
Punjgrahin	4	-	40-80 (50.00)	120-480 (100.00)	40-120 (100.00)	-	-
Kotkapoora	6	2 (50.00)	-	80-240 (100.00)	40-120 (100.00)	40 (50.00)	-
Aulakh	6	2-6 (50.00)	-	80-160 (100.00)	40-180 (100.00)	-	-
Muktsar	6	-	40-120 (50.00)	40-240 (100.00)	40 (33.33)	-	40 (50.00)
Chibranwali	4	8-10 (75.00)	-	120-280 (100.00)	-	-	-
Malout	4	-	-	80-480 (100.00)	40-80 (50.00)	40 (25.00)	-
Balluana	4	-	-	120-360 (100.00)	40-80 (50.00)	40 (50.00)	40 (25.00)

Village/ Locality	No. of samples collected	Number of nematodes / 250 ml soil; Range (Frequency of occurrence, %)					
		H. avenae (cysts)	*Meloidogyne* (Larvae)	*Tylenchorhynchus*	*Hirschmanniella*	*Helicotylenchus*	*Hoplolaimus*
Abohar	4	2 (25.00)	40 (25.00)	120-240 (100.00)	40-120 (50.00)	-	-
Fazilka	4	4-10 (100.00)	40-80 (50.00)	240-360 (100.00)	-	40 (50.00)	-
Faridkot	4	-	40 (25.00)	40-360 (100.00)	40-120 (75.00)	-	-
Mudaki	4	-	40 (25.00)	120-480 (100.00)	-	-	40 (50.00)
Bhai Talwandi	6	-	40 (16.66)	160-520 (100.00)	120-360 (100.00)	-	-
Total	88	1-10	40-120	40-520	40-360	40-80	40

Durgapura

Survey was conducted at different cultivator's fields of six districts of Rajasthan to find out the incidence of Cereal Cyst Nematode (CCN). Diseased fields were randomly selected on the basis of above ground symptoms of the crops. Stunting, yellowing and patchy growth were recorded during survey of each field. Roots samples were collected randomly from the rhizosphere of wheat and barley crops looking above ground symptoms. It was further confirmed by seeing the bushy roots adhered with white female on it.

Cereal cyst nematode infestation was recorded from 18 districts of Rajasthan causing losses of 15 crore rupees in 0.15 million hectare. A large number of infested fields were observed from Ajmer, Alwar, Bharatpur, Bikaner, Dausa, Hanumangarh, Jaipur, Jhunjhunu, Tonk, Sikar and Swaimadhopur districts. Heavy infested fields were observed in Amber, Bassi, Chomu Jamwa Ramgarh, Kotputli, Shamber, Sanganer, Sahapura and Viratnagar, tehsil of Jaipur district. About 700 hectares field of wheat was infested with CCN in various village of Bassi tehsil of Jaipur districts due to monoculture of wheat and mixture of seed of susceptible varieties. Sangaria, Tibbi, Rawatsar, Nohar and Bhadra Tehsil of Hanumangarh district known as grain bowl of state (adjourning to Haryana) were heavily infested with "Molya Disease".

Pusa Bihar :

Nematological survey of wheat field was conducted at 15 places in three districts namely Samastipur Muzaffarpur and vaishali, A Total of 150 samples were collected (10 samples/place). The perusal of data from Table 11.12 indicated that stunt nematode (*Tylenchorhynchus nudus* + *T. mashoodi*) was the predominant population (41.50%). This was followed by lesion nematode (*Pratylenchus* spp. 26.5%), lance nematode (*Helicotylenchus indicus* + *H. dihystera*, 6.5%) and root-knot nematode, 5.7%). The saprozoic or free living nematodes constituted 6.90% population of total nematode.

Table 11.12: Nematode survey in rhizosphere soil of the wheat field

Sl. No.	Places surveyed	Districts	Nematode Population in rhizosphere soil (200 g.)						
			A	B	C	D	E	F	G total
1	Ranitol	Samastipur	70(100)	50	30	15(10)	10(10)	25	200
2	Thahra	Samastipur	97 (100)	45	20	10(20)	20(10)	15	207
3	Kalwara	Samastipur	65 (90)	30	25	-	-	10	130
4	Mabbi	Samastipur	105 (100)	10	75	-	-	15	205
5	Birauli	Samastipur	95	90	60	20(20)	30 (30)	25	320
6	Dholi farm	Muzaffarpur	110	45	10	20	40 (40)	30	255
7	Eteha	Muzaffarpur	90	40	15	15	30 (40)	05	195
8	Raini	Muzaffarpur	125	95	20	10	10 (10)	10	270
9	Lautan	Muzaffarpur	100	40	20	10	15 (10)	05	190
10	Hariharpur	Hajipur	75	100	15	20	-	10	220
11	Ranipokhar	Vaishli	60	70	20	20	-	5	175
12	Mahua	Vaishli	65	60	20	15	-	20	180
	Total		1057	675	330	165	145	175	2547
	% Nematode density		41.50	26.50	13.00	6.65	5.20	6.90	-

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11.5. Integrated and ecofriendly management of *Heterodera avenae*

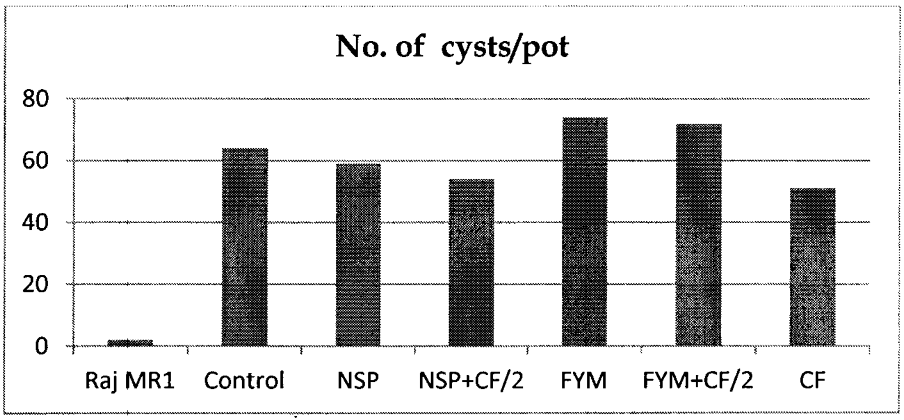
i) Evaluation of ecofriendly approaches for the management of cereal cyst nematode, *H. avenae*

Hisar

This experiment was done in screen house in earthen pots. Nematode - infested soil was brought from village Kumhariya, district Fatehabad. After diluting the soil with dune sand, the pots were filled with *H. avenae*- infested soil (Pi = 14 cysts/ 1 kg pot). Four seeds of wheat var. WH 1105 were sown on 29-11-2013 in each pot, except pots of resistant variety, where Raj MR 1 was sown. There were seven treatments; each replicated four times (Table 11.13). FYM and Neem seed powder was applied @ 5g per pot and carbofuran @ 1.5 kg a.i. /ha at sowing time. Ten days after sowing, two plants were maintained in each pot. Recommended dose of fertilizers and controlled amount of water were applied in pots. Observation on number of cysts (soil + roots) was recorded 110 days after sowing.

Results revealed that application of carbofuran, and resistant variety of wheat (Raj MR1) significantly reduced cyst population as compared to control (Table 11.13, Fig 11.1). On resistant variety of wheat, only two cysts were formed as compared to 64 in untreated control. Remaining treatments were at par with control in producing the number of cysts. Neem seed powder alone or with half dose of carbofuran reduced no. of cysts insignificantly in comparison to control.

Fig 11.1



NSP = neem seed powder, CF/2 = half dose of carbofuran i.e. 0.75 kg a.i./ha, CF= carbofuran 1.5 kg a.i./ha

Table 11.13. Effect of various treatments on cereal cyst nematode, *H.avenae* in wheat
(mean of four replications)

Treatment	**No. of cysts per pot**
T1. Raj MR1	2.0 (1.72)
T2. Untreated Control	63.5 (8.59)
T3. Neem seed powder@ 5g per pot	59. 3(7.71)
T4. Neem seed powder@ 5g per pot + carbofuran3G @ 0.75 kg a.i. /ha	54 .3(7.37)
T5. FYM@ 5g per pot	74.3 (8.79)
T6. FYM@ 5g per pot + carbofuran3G @ 0.75 kg a.i. /ha	71.5 (8.50)
T7. Carbofuran3G @ 1.5 kg a.i. /ha	50.0 (7.20)
C D at 5 %	- (1.37)

Figures in parentheses are square root transformations

Date of sowing: 29-11-2013; date of observations: 19-03.2014

Durgapura

Biofumigation as management tool for cereal cyst nematodes, *Heterodera*

i) Effect of different treatments on grain yield of wheat against cereal cyst nematode, *Heterodera avenae*

An experiment was conducted at Agricultural Research Station, Durgapura, Jaipur in naturally infested soil. Inoculum level was 13.9 larvae/g soil of cereal cyst nematode. The experiment consisted of seven treatments *viz* Nicoderma (10gm/kg seed), *P. fluorescence* (10gm/kg seed), Nemata 5 kg/ha, Samrat 10 g/1000ml (seed soaking), Dantotsu (2.0 g/kg seed) along with treated (Carbofuran 1.5 kg ai/ha) and untreated check (Raj 1482). The crop was examined after attaining the age of 75-90 days for the development of white cyst/plant in each treatment. The grain yield was taken at the time of harvesting of the crop in each treatment separately. The results revealed that all the treatments gave significantly higher grain yield and reduced number of cysts/plant over control. The maximum grain yield (37.83 q/ha) was recorded in carbofuran (CCN counts- 2.54 SQR) followed by Nemata (Grain yield - 34.44q/ha; CCN counts-3.67 SQR) followed by Samrat (Grain yield - 29.72 q/ha; CCN counts-4.22 SQR) over untreated control (Grain yield-13.33q/ha; CCN counts- 5.14 SQR). Nemata was effective in reducing the population of nematodes and increased grain yield over control and other treatments (Table 11.14).

Table 11.14. Biofumigation as management tool for cereal cyst nematodes, *Heterodera avenae* in wheat

S.NO.	Treatments	Grain Yield of Wheat		Cysts/ Plant (SQR)
		Yield q/ha	% Increase Over control	
1	Nicoderma (10gm/kg seed)	21.66	62.49	4.63
2	*P. fluorescence* (10gm/kg seed)	18.05	35.40	4.81
3	Nemata 5 kg/ha	34.44	158.36	3.67
4	Samrat (10gm/1000ml) (seed	29.72	122.95	4.22
5	soaking)	26.94	102.10	4.29
6	Dantotsu (2gm/kg seed)	37.83	183.79	2.54
7	Carbofuran 1.5 kg ai/ha	13.33	-	5.14
	Untreated check (Raj 1482)			
	CD5%	4.44		0.25
	CV%	9.61		3.39

ii). Effect of different treatments on grain yield of wheat against cereal cyst nematode, *Heterodera avenae*

An experiment was conducted at Agricultural Research Station, Durgapura Jaipur in naturally infested soil. Inoculums level was 10 to 12 larvae/g soil of cereal cyst nematode. The experiment consisted of eight treatments *viz* Neem cake (10q/ha), Neem oil (10 ml /kg seed), Neem gold (10ml/kg seed), Nimicidine (10ml/kg seed),Carbosulfan 25 EC 2%(Seed treatment) Raj MR-1(Resistant variety) along with treated (Carbofuran 1.5kg ai/ha) and untreated check (Raj 1482). Completely randomized block design were used and replicated thrice. The crop was examined after attaining the age of 75-90 days for the development of white cyst/plant in each treatment. The grain yield was taken at the time of harvesting of the crop in each treatment separately. The results revealed that all the treatments gave significantly higher grain yield and reduced number of cysts/plant over control. The maximum grain yield in three year (38.04 q/ha) was recorded in Raj MR-1 (CCN counts- 0.88 cyst/ plant) followed by carbofuran (Grain yield - 34.17q/ha; CCN counts-2.33 cysts/plant), carbosulfan 2% (Grain yield - 31.77 q/ha; CCN counts-2.98 cysts/plant) and neem gold 10ml/kg seed (Grain yield - 30.44 q/ha; CCN counts-3.24 cysts/plant over untreated control (Grain yield-14.00 q/ha; CCN counts- 4.77 cysts/plant).

Carbosulfan 2% 25 EC was effective in reducing the cyst population of nematode and increased grain yield over control (Table 11.15). All the neem based formulations was also found effective in reducing the population of nematodes and increased grain yield over control. Neem gold 10% showed its overall superiority and better plant growth response may be due to the fact that besides having nematicidal potential and might have increased the tolerance level of plant and develop potential to resist the nematode attack.

Table 11.15. Effect of different treatments on grain yield of wheat against cereal cyst nematode, *Heterodera avenae*

S.No.	Treatments	Grain Yield of Wheat		Cysts/ Plant (SQR)
		Yield q/ha	% Increase over control	
1	Neem cake (10 q/ha soil application)	23.56	68.28	3.81
2	Neem oil (10 ml /kg seed)	27.24	94.57	3.39
3	Neem gold (10 ml/kg seed)	30.44	117.42	3.24
4	Nimicidine (10ml/kg seed)	21.11	50.78	4.18
5	Carbosulfan 25 EC(2% seed treatment)	31.77	126.92	2.98
6	Carbofuran 1.5 kg ai/ha	34.17	144.07	2.33
7	Raj MR -1(Resistant variety)	38.04	171.71	0.88
8	Untreated check (Raj 1482)	14.00	--	4.77
	CD5%	**2.30**		**0.33**
	CV%	**4.78**		**5.82**

iii). Diversification in existing wheat based systems for CCN management

This experiment was conducted at Agricultural Research Station, Durgapura, Jaipur in naturally infested soil. The experiment consisted of eight treatments *viz* Mustard, Pea, Gram, Fenugreek, Cabbage, Raj MR 1 (Resistant variety) along with treated check (Carbofuran @ 1.5 kg ai/ha) and untreated check (Raj 1482) in a completely randomized block design. Soil samples were taken from each treatment before the sowing and recorded population of cyst. Each treatment was replicated thrice. Soil samples were taken from each treatment and recorded the number of cyst after the harvest. The results revealed that all the treatments gave significantly reduced the cyst in the soil as compared the control (Higher cyst). Carbofuran @ 1.5 kg ai/ha reduces the nematode population followed by cabbage, mustard, resistant variety, fenugreek, gram and Pea also reduces as compared to the control. Population were recorded in Carbofuran (Initial 4.13cyst in 100ml soil and final 2.11 cyst in 100ml soil) followed by cabbage (Initial 3.96 cyst in 100ml soil and final 2.19 cyst in 100ml soil) and mustard (Initial 3.07 cyst in 100ml soil and final 2.73 cyst in 100ml soil), fenugreek (Initial 3.28 cyst in 100ml soil and final 3.02 cyst in 100ml soil). Final population was recorded in control (Initial 3.75 cyst in 100ml soil and final 4.73 cysts in 100ml soil). (Table 11.16).

Table 11.16. Diversification in existing wheat based systems for *H. avenae* management

S.NO.	Treatments	Pi (100 ml soil)	Pf (100 ml soil)	Difference	%age	Increase/ Decrease
1	Mustard	3.07	2.73	0.34	11.07	Decrease
2	Pea	3.47	3.23	0.24	6.91	Decrease
3	Gram	3.18	3.02	0.16	5.03	Decrease
4	Fenugreek	3.28	3.02	0.26	7.92	Decrease
5	Cabbage	3.96	2.19	1.77	44.69	Decrease
6	Raj MR 1	3.80	3.01	0.79	20.78	Decrease
7	Carbofuran @1.5 kg ai/ha	4.13	2.11	2.02	48.91	Decrease
8	Control (Raj1482)	3.75	4.73	0.98	26.13	Increase
	CD5%	0.39	0.29			
	CV%	6.41	5.45			

No of cyst in soil
Pi = Population at the time of sowing / 100 ml soil (Initial Population)
Pf = Population at the time of harvesting (Final Population)

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11.6 SYSTEM BASED RESEARCH

Population dynamics of major plant parasitic nematodes in cotton -wheat system

Hisar :

Five fields (Fatehabad and Hisar) were selected for this study. Soil samples from cotton and wheat crops were taken in Sept. 2013 and April, 2014 respectively. These samples were examined for the population behaviour of plant parasitic nematodes and data are presented in Table 11.17. It is revealed from the data that cyst nematode was present in four fields and its population increased in all fields on wheat. Stunt and lance nematodes were present in four and three fields, respectively; and their populations increased on wheat. Root lesion nematode was present in three fields; and in wheat season its population increased in two fields but reduced in one field. This species was not *P. thornei*, and probably it did not multiply on wheat. Reniform and spiral nematodes were found in two fields in cotton season but they were not recorded in wheat crop.

Table 11.17. Population dynamics of major plant parasitic nematodes in cotton - wheat system

Field no.		Crop / Rotation	Nematodes /200 cc soil						
			HA	HL	TR	PL	HT	RR	other
I	Dharnia (Fatehabad)	Cotton	13	24	15	20	-	40	-
		Wheat	40	4	44	53	-	-	-
II	Dharnia	Cotton	7	56	15	-	8		-

Field no.		Crop / Rotation	Nematodes /200 cc soil						
			HA	HL	TR	PL	HT	RR	other
	(Fatehabad)	Wheat	22	7	20	-	-	-	-
III	Khairampur	Cotton	-	80	-	120	-	300	-
	(Fatehabad)	Wheat	-	5	-	10	-	-	-
IV	Kumhariya	Cotton	15	-	10	14	4	-	-
	(Fatehabad)	Wheat	46	-	18	20	-	-	-
V	Agroha	Cotton	6	-	40	-	-	-	4 LD
	(Hisar)	Wheat	30	-	50	-	-	-	-

Fields I, II, in Dharnia; III= in Khairampur, IV = in Agroha, V= in Kumhariya villages

HA = cysts of *Heterodera avenae* ; HL = *Hoplolaimus* sp., TR = *Tylenchorynchus* sp., PL = *Pratylenchus* sp., HT = *Helicotylenchus* sp. , RR = *Rotylenchulus reniformis*, LD = *Longidorus* sp. , - = not detected

Ludhiana:

Two cropping systems, rice - wheat and cotton - wheat were studied for population dynamics of nematodes. Ten (soil and root) samples were collected during the mid season of the crop from the same field and the data recorded is presented in Table 11.18.

Table 11.18. Plant parasitic nematodes in different cropping systems

Nematode	Nematode Pop./ 250 cc soil & Roots (Frequency of occurrence %)	
	Rice	Wheat
Heterodera avenae cysts	1-2 (20.00)	2-6 (50.00)
Meloidogyne sp. Larvae	40-240 (60.00)	40-120 (50.00)
Hirschmanniella oryzae	40-360 (100.00)	40-80 (80.00)
Tylenchorhynchus sp.	40 – 80 (40.00)	40-520 (100.00)
Hoploloaimus sp.	40 (10.00)	-
	Cotton	Wheat
Heterodera cysts	1-3 (40.00)	2-5 (60.00)
Meloidogyne sp. Larvae	40-240 (60.00)	40-80 (50.00)
Tylenchorhynchus sp.	40-160 (100.00)	40-480 (100.00)
Helicotylenchus sp.	40 (20.00)	40-80 (40.00)
Hoplolaimus sp.	40 (10.00)	40-160 (40.00)

Rice-Wheat: *Heterodera avenae, Meloidogyne spp. Hirschmanniella oryzae, Hoploloaimus* and *Tylenchorhynchus* sp. were recorded in rice - wheat cropping system. The highest population was recorded of *Tylenchorhynchus* sp in wheat crop. In rice, *H. oryzae* was higher as compared to wheat crop. The frequency of occurrence was 100 per cent of *Tylenchorhynchus* spp. in wheat and number was 520 nematodes / 250 cc soil. During wheat season the cysts of *H. avenae* were extracted from the roots. Besides larvae of root knot nematodes, galling was also observed on wheat roots of some samples.

Cotton-Wheat: In cotton- wheat cropping system, *Heterodera avenae,* species of *Meloidogyne, Tylenchorhynchus. Helicotylenchus,* and *Hoplolaimus* were important plant parasitic nematodes recorded. During cotton season, the highest number of nematodes recorded was of *Meloidogyne sp.* (240 nematodes/250cc soil) and *Tylenchorhynchus sp* in wheat season (480/250cc soil) with highest (100%) frequency of occurrence.

Durgapura

Impact of different cropping system on nematode populations

An experiment was planned to find out the impact of various cropping pattern (Millet-wheat, Groundnut- wheat, Cowpea-wheat and Moong -wheat) on population dynamics of various plant parasitic nematode inhibit in soil. Population of *Hoplolaimus spp, Helechorhynchus spp., Tylenchorhynchus spp. Xiphenema* and *Helicotylenchus* was declined in groundnut-wheat pattern and millet -wheat pattern whereas the population of *H. avenae, Meloidogyne spp., Pratylenchus spp.* were increased when millet was preceded with wheat. Population of *Hoplolaimus spp, Helechorhynchus spp.* and *Tylenchorhynchus spp.* were declined in cowpea and moong but *H. avenae* and *Meloidogyne spp.* were also increased in wheat season (Table- 11.19 & 11.20)

Table 11.19. Impact of different cropping system on nematode populations

Millet - wheat Patterns					
S.No.	**Nematode**	**Initial Population (J2/ 100ml soil)**	**Final Population (J2/100ml soil)**	**Increase/ Decrease (Percent)**	**Increase/ Decrease**
1	*H .avenae*	132	770	583.33	Increase
2	*Meloidogyne graminicola*	23	130	565.21	Increase
3	*Pratylenchus spp.*	45	564	1253.33	Increase
4	*Hoplolaimus indicus*	165	80	48.48	Decrease
5	*Helechorhynchus spp.*	145	65	44.82	Decrease
6	*Tylenchorhynchus spp.*	63	42	66.66	Decrease
7	Other nematodes*	76	35	46.05	Decrease

Other nematodes* *Xiphenema, Helicotylenchus , Helicotylenchus*

Groundnut -wheat Patterns					
S.No.	**Nematode**	**Initial Population (J2/ 100ml soil)**	**Final Population (J2/100ml soil)**	**Increase/ Decrease (Percent)**	**Increase/ Decrease**
1	*H .avenae*	317	945	298.11	Increase
2	*Meloidogyne spp.*	135	57	42.22	Decrease
3	*Pratylenchus penetrans*	39	67	171.79	Increase
4	*Hoplolaimus spp.*	86	39	45.35	Decrease
5	*Helechorhynchus spp.*	89	57	64.04	Decrease
6	*Tylenchorhynchus spp.*	82	49	59.76	Decrease
7	Other nematodes*	167	87	52.09	Decrease

Other nematodes* ***Xiphenema, Helicotylenchus***

Table 11.20. Impact of different cropping system on nematode populations

Cowpea - wheat Patterns					
S.No.	**Nematode**	**Initial Population (J2/ 100ml soil)**	**Final Population (J2/100ml soil)**	**Increase/ Decrease (Percent)**	**Increase/ Decrease**
1	*H .avenae*	257	1075	418.29	Increase
2	*Meloidogyne graminicola*	66	177	268.18	Increase
3	*Pratylenchus spp.*	117	393	335.90	Increase
4	*Hoplolaimus indicus*	108	188	174.07	Decrease
5	*Helechorhynchus spp.*	86	47	54.65	Decrease
6	*Tylenchorhynchus spp.*	64	39	60.93	Decrease
7	Other nematodes*	140	87	62.14	Decrease
Other nematodes * *Xiphenema , Helicotylenchus sp*					
Moong -Wheat Patterns					
S.No.	**Nematode**	**Initial Population (J2/ 100ml soil) pp**	**Final Population (J2/100ml soil)**	**Increase/ Decrease (Percent)**	**Increase/ Decrease**
1	*H .avenae*	185	1021	551.89	Increase
2	*Meloidogyne spp.*	139	55	39.57	Decrease

3	*Pratylenchus penetrans*	26	96	369.23	Increase
4	*Hoplolaimus spp.*	75	36	48.00	Decrease
5	*Helechorhynchus spp.*	83	49	59.04	Decrease
6	*Tylenchorhynchus spp.*	83	40	48.19	Decrease
7	Other nematodes*	128	55	42.97	Decrease
Other nematodes* *Xiphenema, Helicotylenchus*					

Pusa Bihar

Rice-wheat:

The result of rice-wheat system on occurnce of population of nematode is depicted in Table 11.21. Under rice-wheat system, there was increase of 146.46% in total nematode population over initial population when paddy was cultivated. When we look for individual nematode, the higher increase was recorded in *Hirshmaniella oryzae* (400%) followed by *Meloidogyne* and *Tylenchorhynchus, Hoploloinus* and *Helicotylenchus*. There was Decrease of 20% in Pratylenchus population.
When wheat was cultivated after paddy in the same field, there was further increase of 28.48% total nematode population over paddy nematodes.

There was Decrease in *Hirshmaniella oryzae* and *Meloidogyne* nematode in the population to the tune of 40%. However, the *Pratylechus* increased up to 650% followed by *Hoplolaimus, Helicotylenchuls* and *Tylenchus.*

Table 11.21. Occurrence of population of nematodes in rice-wheat system.

S. No.	Nematodes	Initial Population	Nematode population in 200 g soct			
			Paddy	Wheat	% (+) or (-) over initial population in paddy	% (+) or (-) population in wheat
1	*Helicotylenchus (H. dihystera + H. indicus)*	15	25	40	66.67	66.68
2	*Hirschmaniella Oryzae*	25	125	75	400.00	(-) 40.06
3	*Tylenchoshynchus*	30	65	95	116.67	46.15
4	*Meloidagyne sp*	10	25	15	150.00	(-) 40.00
5	*Pratylonchus sp.*	10	08	60	(-) 20.00	650.00
6	*Tylenchus* sp.	15	25	25	66.67	-
7	*Hoplolimus indicus*	22	40	95	81.82	137.5
8	Total nematodes (Phytophagus)	127	313	405	146.46	28.48
9	Saprozoic nematode	15	25	20	-	-
10	Grand Total (8+9)	142	338	425	-	-

(+) = increase (-) = Decrease

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Three Years (2011-12, 2012-13, 2013-14) Pooled data for Recommendation (Durgapura)

1. Effect of different treatments on grain yield of wheat against cereal cyst nematode, *Heterodera avenae* (Durgapura)

An experiment was conducted from 2011-12 to 2013-14 at Agricultural Research Station, Durgapura Jaipur in naturally infested soil. Inoculums level was 10 to 12 larvae/g soil of cereal cyst nematode. The experiment consisted of eight treatments *viz* Neem cake (10q/ha), Neem oil (10 ml /kg seed), Neem gold (10ml/kg seed), Nimicidine (10ml/kg seed),Carbosulfan 25 EC 2%(Seed treatment) Raj MR-1(Resistant variety) along with treated (Carbofuran 1.5kg ai/ha) and untreated check (Raj 1482). Completely randomized block design were used and replicated thrice. The crop was examined after attaining the age of 75-90 days for the development of white cyst/plant in each treatment. The grain yield was taken at the time of harvesting of the crop in each treatment separately. The results revealed that all the treatments gave significantly higher grain yield and reduced number of cysts/plant over control. The maximum grain yield in three year (38.59 q/ha) was recorded in Raj MR-1 (CCN counts- 0.87 cyst/ plant) followed by carbofuran (Grain yield - 35.46q/ha; CCN counts-2.52 cysts/plant), carbosulfan 2% (Grain yield - 32.47 q/ha; CCN counts-3.17cysts/plant) and neem gold 10ml/kg seed (Grain yield - 31.31 q/ha; CCN counts-3.36 cysts/plant over untreated control (Grain yield-13.84q/ha; CCN counts- 4.85 cysts/plant) (Table 11.22).

Carbosulfan 2% 25 EC was effective in reducing the cyst population of nematode and increased grain yield over control. All the neem based formulations was also found effective in reducing the population of nematodes and increased grain yield over control. Neem gold 10ml/kg seed showed its overall superiority and better plant growth response may be due to the fact that besides having nematicidal potential and might have increased the tolerance level of plant and develop potential to resist the nematode attack.

Recommendation :

Carbosulfan 2% 25 EC (seed treatment) was effective in reducing the cyst population of nematode and increased grain yield over control. **Neem gold** 10ml/kg seed (Seed treatment) also showed its overall superiority and better plant growth response may be due to the fact that besides having nematicidal potential and might have increased the tolerance level of plant and develop potential to resist the nematode attack.

2. Diversification in existing wheat based systems for CCN management

The three years (2011-14) experiment was conducted at Agricultural Research Station, Durgapura, Jaipur in naturally infested soil. Soil samples were taken from each treatment before the sowing and recorded initial population of cyst. The experiment consisted of seven treatments *viz* Mustard, Pea, Gram, Fenugreek, Cabbage, Raj MR 1 (Resistant variety) along with treated check (Carbofuran @ 1.5 kg ai/ha) and untreated check (Raj 1482) in a completely randomized block design. Each treatment was replicated thrice. Soil samples were taken from each treatment after the harvest and recorded the number of cyst. The results revealed that all the treatments significantly reduced the cyst in the soil from initial population as compared the control (Higher cyst). Carbofuran @ 1.5 kg ai/ha reduces the nematode population followed by cabbage, mustard, fenugreek and resistant variety. Pea and gram also reduces as compared to the control. Population were recorded in Carbofuran (Initial 4.12cyst in 100ml soil and final 2.31 cyst in 100ml soil) followed by cabbage (Initial 3.96 cyst in 100ml soil and final 2.31 cyst in 100ml soil) and mustard (Initial 3.52 cyst in 100ml soil and final 2.62 cyst in 100ml soil), fenugreek (Initial 3.50 cyst in 100ml soil and final 3.00 cyst in 100ml soil). Final population was recorded in control (Initial 3.75 cyst in 100ml soil and final 5.09 cysts in 100ml soil). (Table 11.23).

Recommendation:

Cabbage is effective control to reduce cyst of *Heterodera avenae* after carbofuran treatment while carbofuran is costly treatment and also caused health and environment hazards. After cabbage mustard also reduces significantly cyst population, it is second alternate crop for farmers for management of cereal cyst nematode simply replacing crop in crop rotation.

Table 11.22. Effect of different treatments on grain yield of wheat against cereal cyst nematode, *H. avenae*

S. No.	Treatments	Grain yield Q/ha			Pooled Data	B: C Ratio	Cyst /Plant SQR			Pooled Data
		2011-12	2012-13	2013-14	Three Yrs.		2011-12	2012-13	2013-14	Three Yrs.
1	Neem cake 10 q/ha	24.00	23.56	23.56	23.70	1.89	4.10	4.01	3.80	3.97
2	Neem oil 10ml /kg seed	28.00	27.77	27.24	27.67	3.86	3.84	3.84	3.38	3.68
3	Neem gold 10ml/kg seed	31.44	32.11	30.44	31.31	4.36	3.38	3.48	3.23	3.36
4	Nimicidine 10 ml/kg seed	22.56	22.55	21.11	22.08	3.08	4.33	4.25	4.17	4.25
5	Carbosulfan 25 EC 2%	32.22	33.44	31.77	32.47	4.53	3.28	3.28	2.97	3.17
6	Carbofuran 1.5 kg ai/ha	37.22	35.00	34.17	35.46	4.31	2.33	2.91	2.33	2.52
7	Raj MR-1 (Resistant variety)	39.33	38.44	38.04	38.59	5.55	0.87	0.87	0.87	0.87
8	Untreated Check	13.22	14.33	14.00	13.84	-	4.88	4.91	4.77	4.85
	CD 5%	1.46	1.93	2.30	1.66		0.37	0.43	0.32	0.32
	CV %	2.92	3.89	4.78	2.47		6.32	7.12	5.81	4.05

Table 11.23. Diversification in existing wheat based systems for Cereal Cyst Nematode, management, *Heterodera avenae*

S. No.	Treatments	2011-12		2012-13		2013-14		Pooled data Three yrs.		Difference	% age
		Pi (100 soil ml)	Pf (100 soil ml)	Pi (100 soil ml)	Pf (100 soil ml)	Pi (100 soil ml)	Pf (100 soil ml)	Pi (100 soil ml)	Pf (100 soil ml)		
1	Mustard	4.21	2.41	3.29	2.73	3.07	2.73	3.52	2.62	0.90	25.5
2	Pea	3.71	3.13	3.38	3.08	3.47	3.23	3.44	3.22	0.22	6
3	Gram	4.01	3.29	3.13	2.84	3.18	3.02	3.44	3.05	0.39	6.39
4	Fenugreek	4.13	2.79	3.33	2.94	3.28	3.02	3.50	3.00	0.50	11.3
5	Cabbage	3.97	1.89	3.93	2.54	3.96	2.19	3.96	2.31	1.65	3
6	Raj MR-1	4.09	2.54	3.81	2.91	3.80	3.01	3.90	2.82	1.08	14.2
7	Carbofuran	4.17	2.48	4.06	2.33	4.13	2.11	4.12	2.31	1.81	8
	@ 1.0 kg										41.6
8	ai/ha	3.89	6.21	3.62	4.44		4.73	3.75	5.09	1.34	6
	Untreated					3.75					27.6
	Check										9
											43.9
											3
											35.7
											3
	CD5%	0.44	0.29	0.27	0.34	0.39	0.29	0.36	0.69		
	CV%	6.24	5.35	4.29	6.55	6.41	5.45		12.20		

ANNEXURES

Annexure I: Performance of AVT II year material against different diseases under multilocational testing during 2013-14

S. No.	Variety	LB (dd)		PM (0-9)		LS%		KB		FHB		FR%	FS		HB %	
		HS	AV	HS	AV	HS	AV	HS	AV	HS	AV		HS	AV	HS	AV
Source: AVT IInd Year 2013-14																
I. NORTH HILL ZONE																
1	HPW 376	69	36	6	3	50.0	27.5	12.5	3.1	3	3	5	7.1	2.4	22.9	14.00
2	VL 967	78	35	7	4	60.2	31.1	26.4	6.3	5	4.5	20	0.0	0.0	46	21.52
3	HPW 251 (C)	78	36	5	4	44.3	31.1	6.7	1.9	4	4	5	0.0	0.0	9.7	3.97
4	HPW 349 (C)	67	35	5	3	50	31.1	35.9	14.6	5	4	0	25.0	10.4	15.4	12.70
5	HS 277 (C)	67	35	7	4	5.4	1.8	10.3	5.2	5	4	35	0.0	0.0	5.3	2.68
6	HS 375 (C)	68	35	9	5	-	-	8.2	2.9	5	4	20	6.3	2.3	6.34	3.51
7	HS 490 (C)	58	36	7	5	50	35	4.3	2.6	5	4	55	16.7	7.4	10.37	5.96
8	HS 507 (C)	69	35	9	6	-	-	13.4	4.1	5	4	20	4.0	1.3	45.7	22.86
9	HS 542 (I) (C)	67	36	7	5	12.3	4.1	46.6	12.3	5	4	5	0.0	0.0	27.97	13.26
10	VL 804 (C)	79	46	9	5	61.5	26.9	25.5	9.9	5	4.5	25	0.0	0.0	22.09	7.70
11	VL 829 (C)	78	36	9	5	50.3	16.8	16.1	6.1	5	4	15	0.0	0.0	40	16.48
12	VL 892 (C)	99	46	7	3	53.2	27.8	21.0	11.5	5	5	55	26.7	9.2	14.6	9.77
13	VL 907 (C)	67	35	7	5	58.3	27.6	19.8	5.6	5	4	5	0.0	0.0	46.8	28.08
II. NORTH WESTERN PLAIN ZONE																
14	HUW 666	78	35	8	5	60.3	41.0	67.9	17.9	4	3.5	35	6.9	2.3	-	-
15	PBW 681	89	36	9	4	71.2	47.6	41.0	20.9	5	4	10	27.8	12.3	-	-
16	WH 1129	67	46	7	4	80.0	43.4	23.9	7.2	3	3	5	5.3	1.8	-	-
17	WH 1138	78	35	9	5	10.3	3.4	68.9	25.3	5	4.5	15	16.7	5.6	-	-
18	WH 1142	78	46	7	5	90.0	41.3	33.4	15.2	5	4	15	4.3	2.6	-	-
19	DBW 88 (I) (C)	68	36	9	6	80	54	29.1	9.2	5	4	15	3.8	1.3	-	-
20	DBW 90 (I) (C)	89	46	9	6	30.2	10.1	25.2	7.7	5	4	0	14.3	5.4	-	-
21	DPW 621-50 (C)	78	46	9	7	80	38.4	61.3	17.2	3	3	5	5.9	2.0	-	-
22	HD 2967 (C)	67	35	7	5	66	52.9	27.3	11.3	3	3	25	15.8	9.6	-	-
23	HD 3043 (C)	79	35	6	4	80	26.7	52.1	18.0	5	4	15	0.0	0.0	-	-
24	HD 3059 (C)	79	46	8	5	85.7	59.8	29.9	10.0	5	4	25	5.3	1.8	-	-
25	HD 3086 (I) (C)	89	46	7	5	12.6	4.2	56.1	14.8	5	4.5	15	7.1	2.7	-	-
26	PBW 590 (C)	89	46	9	6	78.6	52.2	30.3	13.7	5	4.5	35	15.4	6.5	-	-
27	PBW 644 (C)	89	45	7	5	60	35.8	39.2	13.0	3	3	20	27.8	11.5	-	-
28	PBW 660 (I) (C)	79	35	7	5	57.3	40.2	17.0	6.0	5	4	15	19.0	6.9	-	-
29	PDW 233 (C)	89	46	7	5	-	-	5.1	1.1	5	4	25	0.0	0.0	-	-
30	PDW 291 (C)	69	35	6	4	0	0	10.7	2.4	5	4	45	0.0	0.0	-	-
31	PDW 314 (C)	89	35	7	5	60.1	23.7	6.0	1.3	4	3.5	30	0.0	0.0	-	-
32	WH 1021 (C)	78	46	7	5	64.5	46.3	15.6	4.7	5	4.5	35	13.6	4.5	-	-

S. No.	Variety	LB (dd)		PM (0-9)		LS%		KB		FHB		FR%	FS		HB %	
		HS	AV	HS	AV	HS	AV	HS	AV	HS	AV		HS	AV	HS	AV
33	WH 1080 (C)	89	45	6	5	50.2	42.4	8.5	4.4	5	4	15	0.0	0.0	-	-
34	WH 1105 (C)	89	46	9	5	80	60	72.9	19.0	5	4	35	0.0	0.0	-	-
35	WH 1124 (I) (C)	78	46	9	5	50	16.7	23.8	8.2	5	4.5	25	11.1	4.0	-	-
III. NORTH EASTERN PLAIN ZONE																
36	BRW 3723	69	35	7	5	33.3	29.6	25.7	5.1	3	1.5	25	15.8	5.3	-	-
37	DBW 107	78	36	7	4	84.1	43.2	39.7	16.4	5	3.5	5	27.8	14.6	-	-
38	HD 3118	77	46	7	4	47.2	32.9	25.4	12.9	5	5	20	11.8	3.9	-	-
39	K 1114	89	46	7	5	-	-	31.1	14.7	5	4	20	31.3	15.7	-	-
40	C 306 (C)	79	46	7	5	80	44.3	40.4	18.4	5	4	35	71.4	30.3	-	-
41	DBW 14 (C)	99	57	9	5	40	23.1	15.0	6.8	5	4.5	30	4.4	1.5	-	-
42	DBW 39 (C)	79	46	9	6	40	19.2	47.7	15.9	5	4	25	0.0	0.0	-	-
43	HD 2733 (C)	99	46	9	6	70.2	42.8	18.6	7.4	5	4	30	1.7	0.6	-	-
44	HD 2888 (C)	78	46	7	5	30.1	18.2	29.2	12.0	5	5	55	13.6	9.0	-	-
45	HD 2985 (C)	99	46	9	6	40.4	34.7	45.5	17.6	5	4.5	20	6.3	2.4	-	-
46	HI 1563 (C)	89	47	9	6	35.1	27.9	19.4	9.5	5	4.5	20	33.3	22.2	-	-
47	K 0307 (C)	79	46	7	4	40.2	24.1	7.3	3.3	5	4.5	20	0.0	0.0	-	-
48	K 1006 (I) (C)	99	46	9	5	5.2	1.7	22.8	7.0	5	4	10	0.0	0.0	-	-
49	K 8027 (C)	89	36	7	5	54.4	43.5	24.6	11.3	5	4	5	8.3	2.8	-	-
50	NW 2036 (C)	99	57	8	4	60	45.6	11.8	4.7	5	5	5	0.0	0.0	-	-
51	NW 5054 (I) (C)	99	56	7	5	60	32.1	45.3	17.3	5	4	10	6.3	2.9	-	-
IV. CENTRAL ZONE																
52	DBW 110	99	46	7	3	-	-	9.4	2.0	3	2.5	15	0.0	0.0	-	-
53	HI 8736 (D)	99	46	7	3	-	-	39.1	14.3	4	2	25	0.0	0.0	-	-
54	HI 8737 (D)	99	46	9	5	80.0	26.7	12.2	5.5	3	1.5	15	0.0	0.0	-	-
55	MP 3382	99	46	7	3	26.7	8.9	20.5	9.2	5	4	10	0.0	0.0	-	-
56	NIAW 1885	99	47	7	3	80.1	46.1	11.2	7.7	4	2	5	0.0	0.0	-	-
57	PBW 689	68	35	7	3	-	-	23.9	8.8	5	4	5	0.0	0.0	-	-
58	A 9-30-1 (D) (C)	99	67	9	6	0	0	7.8	5.5	5	5	20	0.0	0.0	-	-
59	GW 322 (C)	68	46	8	5	39.6	26.2	32.5	15.6	5	4.5	25	1.1	0.4	-	-
60	HD 2864 (C)	99	56	8	4	68	49.9	12.1	4.7	5	4.5	15	29.4	9.8	-	-
61	HD 2932 (C)	99	46	9	5	61.3	49.9	18.3	7.0	5	4	5	0.0	0.0	-	-
62	HI 1500 (C)	89	46	7	5	60.3	37.5	69.2	23.9	5	5	45	35.3	16.4	-	-
63	HI 1544 (C)	99	46	9	5	22.5	20.4	27.7	16.1	5	4	15	71.4	26.1	-	-
64	HI 8498 (D) (C)	79	36	9	5	0	0	25.0	9.6	5	4	45	0.0	0.0	-	-
65	HI 8627 (D) (C)	79	46	9	5	0	0	20.0	10.2	5	4	25	0.0	0.0	-	-
66	MP 3288 (C)	79	57	9	5	40	33.9	13.0	6.2	5	4	20	16.7	7.9	-	-

S. No.	Variety	LB (dd)		PM (0-9)		LS%		KB		FHB		FR%	FS		HB %	
		HS	AV	HS	AV	HS	AV	HS	AV	HS	AV		HS	AV	HS	AV
67	MP 3336 (C)	99	57	9	5	40.1	29.9	7.8	4.2	5	4.5	25	5.9	2.7	-	-
68	MP 4010 (C)	99	56	9	5	50	42.2	22.2	10.8	5	4.5	10	13.6	4.8	-	-
69	MPO 1215 (d) (C)	79	46	8	5	10	3.3	46.7	9.3	5	4	35	7.1	2.4	-	-
V. PENINSULAR ZONE																
70	NIAW 1994	99	57	7	4	53.1	28.9	33.8	10.8	5	4	5	0.0	0.0	-	-
71	UAS 347	78	35	9	5	-	-	39.3	11.7	3	3	10	5.9	2.0	-	-
72	UAS 446 (D)	89	35	9	4	20.0	6.7	7.5	2.9	5	4	15	0.0	0.0	-	-
73	AKDW 2997-16(d) (C)	99	57	9	5	50	17.5	3.3	1.0	5	4	15	0.0	0.0	-	-
74	HD 3090 (I) (C)	99	56	9	5	40.3	26.6	100.0	33.0	5	4	0	20.0	7.0	-	-
75	MACS 6222 (C)	89	46	9	5	32.1	18.3	32.8	11.3	5	4	10	8.0	2.7	-	-
76	MACS 6478 (C)	79	35	9	5	64.6	37.1	32.9	8.8	5	5	5	28.6	9.5	-	-
77	NI 5439 (C)	99	57	9	3	84.9	44.1	40.8	16.3	5	4.5	35	40.0	15.6	-	-
78	NIAW 1415 (C)	78	46	9	5	40.3	34.9	34.5	10.8	5	5	30	5.3	1.8	-	-
79	NIDW 295 (d) (C)	68	46	9	3	0	0	8.2	1.9	5	4.5	5	0.0	0.0	-	-
80	Raj 4083 (C)	99	57	9	5	76.3	45.4	25.2	9.2	5	4	40	12.5	6.6	-	-
81	UAS 428 (d) (C)	79	46	9	6	50	16.7	9.8	4.7	5	4.5	40	0.0	0.0	-	-
VI. SOUTHERN HILLS ZONE																
82	CoW(W) 1 (C)	89	46	8	5	34.7	34.3	29.3	9.0	4	3.5	35	0.0	0.0	-	-
83	HW 2044 (C)	99	56	8	5	44.4	34.9	19.5	8.9	5	4.5	65	37.5	16.5	-	-
84	HW 5216 (C)	99	57	8	5	20.3	10.9	44.8	13.4	5	4	25	61.1	27.9	-	-
VII. SPECIAL TRIAL																
85	DDK 1042	99	46	5	2	0.0	0.0	20.8	4.3	5	4	30	0.0	0.0	-	-
86	MACS 5022	79	46	5	1	0.0	0.0	33.7	5.6	5	4.5	0	0.0	0.0	-	-
87	DDK 1029 (C)	89	56	5	3	40.2	15.9	27.6	6.1	5	4.5	15	0.0	0.0	-	-
88	HW 1098 (I) (C)	99	46	7	4	-	-	30.4	6.4	4	3.5	25	0.0	0.0	-	-
89	Kharchia 65 (C)	99	57	9	6	60	33.3	35.2	15.3	5	4.5	15	33.3	16.5	-	-
90	KRL 19 (C)	99	46	7	5	-	-	10.2	5.1	5	4.5	15	0.0	0.0	-	-
91	KRL 210 (C)	78	46	8	5	50.6	16.9	16.3	4.0	5	4.5	15	0.0	0.0	-	-
92	MACS 2496 (C)	78	46	7	5	66.4	26.8	22.9	7.5	5	4.5	40	10.0	3.3	-	-
93	MACS 2971 (C)	99	46	6	4	-	-	47.9	10.5	5	4	0	16.0	5.3	-	-

Annexure II: Seedling Resistance Test of AVTII against pathotypes of brown rust (*Puccinia triticina*) at Shimla during 2013-14

S. No.	Variety	Pathotypes																							GENES
		11	12-2	12-3	12-5	12-7	77	77-1	77-2	77-5	77-7	77-8	77-9	77-10	77A-1	104-2	104-3	104-4	104B	106	108-1	162-1	162-3	162A	
I. NORTHERN HILL ZONE																									
1	HPW 376	R	S	R	R	S	R	R	S	MS	MS	R	MS	R	R	MS	S	R	R	R	R	R	R	R	*Lr*10+13+23+
2	VL 967	R	S	R	MS	M	S	R	R	M	R	R	S	R	R	MS	MX	R	S	R	R	NG	R	R	*Lr*13+
3	HPW 251 (C)	R	R	R	R	MS	R	R	R	MS	S	R	S	S	R	S	R	R	R	R	R	R	R	R	*Lr*23+26+
4	HPW 349 (C)	R	R	R	S	MS	S	MS	S	S	S	R	R	R	R	MS	MS	S	R	R	R	R	R	R	*Lr*13+
5	HS 277 (C)	R	R	NG	MR	MS	R	S	NG	S	S	R	S	R	R	R	R	S	R	R	R	R	NG	NG	*Lr*26+34+
6	HS 375 (C)	R	R	R	R	R	R	MS	R	MS	S	R	S	R	R	R	R	R	NG	R	R	R	R	NG	*Lr*26+34+
7	HS 490 (C)	R	S	R	MS	R	R	S	S	S	S	R	R	S	R	NG	S	S	NG	R	R	R	R	NG	*Lr*23+
8	HS 507 (C)	R	R	R	R	R	R	R	NG	MS	S	R	MS	R	R	S	R	S	R	R	R	R	R	R	*Lr*1+26+
9	HS 542 (I) (C)	R	R	R	R	R	R	S	S	S	R	R	S	S	R	R	R	S	R	R	R	R	R	R	*Lr*10+13+
10	VL 804 (C)	R	R	R	R	S	R	S	R	S	S	R	S	R	R	S	S	MX	R	R	NG	S	R	R	*Lr*10+26+34+
11	VL 829 (C)	R	R	R	MS	MS	R	S	R	S	MS	R	S	R	R	MS	R	S	R	R	R	R	R	R	*Lr*26+34+
12	VL 892 (C)	R	R	R	R	S	R	R	R	MS	S	R	MS	R	R	S	R	MS	S	R	R	R	R	R	*Lr*10+13+23+
13	VL 907 (C)	R	R	R	R	R	R	R	R	R	R	R	R	R	R	MS	R	S	R	R	R	R	R	R	*Lr*1+26+
II. NORTH WESTERN PLAIN ZONE																									
14	HUW 666	R	R	R	R	R	R	S	S	R	NG	R	S	S	R	R	R	R	R	R	R	R	R	R	*Lr*10+13+
15	PBW 681	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R
16	WH 1129	R	R	R	R	R	R	R	R	R	R	R	S	R	R	R	R	R	R	R	R	R	R	R	*Lr*10+13+
17	WH 1138	R	R	R	R	S	R	S	S	S	S	R	S	S	R	S	S	R	S	R	R	R	R	S	*Lr*3+10+13+
18	WH 1142	R	R	R	R	MS	R	S	R	S	S	R	S	R	R	S	S	R	R	R	R	R	R	R	*Lr*1+3+26+
19	DBW 88 (I) (C)	R	R	R	R	S	R	R	S	MS	MS	R	S	S	R	R	R	R	R	R	R	R	R	R	*Lr*10+13+
20	DBW 90 (I) (C)	R	S	R	R	S	R	S	S	S	S	R	S	S	R	S	S	R	S	R	R	R	R	S	*Lr*3+10+13+
21	DPW 621-50 (C)	R	R	R	R	MS	R	MS	S	S	S	S	S	S	R	MR	R	MS	R	R	NG	R	R	R	*Lr*10+13+
22	HD 2967 (C)	R	R	R	R	S	R	R	R	R	R	R	S	S	R	R	R	R	R	R	R	R	R	R	*Lr*23+
23	HD 3043 (C)	R	R	R	R	MS	R	S	S	R	MX	S	S	S	R	R	R	R	R	R	R	R	R	R	*Lr*10+13+
24	HD 3059 (C)	N	N	NG	NG	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	-

S. No.	Variety	11	12-2	12-3	12-5	12-7	77	77-1	77-2	77-5	77-7	77-8	77-9	77-10	77A-1	104-2	104-3	104-4	104B	106	108-1	162-1	162-3	162A	GENES
		Pathotypes																							
		G	G			G	G	G	G	G	G	G	G	G	G	G	G	G	G	G	G	G	G	G	
25	HD 3086 (I) (C)	R	S	MX	R	S	R	S	S	S	S	S	S	S	R	S	S	R	R	R	R	R	R	MS	*Lr*3+10+13+
26	PBW 590 (C)	R	R	R	R	R	R	R	R	R	NG	R	R	R	R	MS	R	MX	R	R	NG	R	R	R	*Lr*1+23+26+
27	PBW 644 (C)	R	R	R	R	R	S	S	S	S	S	R	S	R	R	S	R	S	S	R	MS	R	R	R	*Lr*1+13+
28	PBW 660 (I) (C)	R	R	R	MR	MS	R	R	R	S	R	R	MS	R	R	R	S	R	R	R	R	R	R	R	*Lr*3+26+
29	PDW 233 (C)	R	S	R	S	S	R	NG	R	NG	R	R	R	MS	R	S	R	MS	S	R	R	R	R	R	*Lr*23+
30	PDW 291 (C)	R	R	R	S	R	R	R	R	NG	NG	R	R	R	R	MR	S	R	S	R	R	R	R	R	*Lr*23+
31	PDW 314 (C)	R	R	R	S	R	R	NG	R	R	R	R	R	R	R	MR	R	R	MS	S	NG	R	R	R	*Lr*23+
32	WH 1021 (C)	R	R	R	R	R	R	NG	R	M	S	R	MS	R	R	S	MS	R	R	MS	NG	R	R	R	*Lr*1+26+
33	WH 1080 (C)	R	S	MS	S	S	S	S	S	MS	MS	R	S	S	S	S	S	R	S	R	R	R	R	S	*Lr*13+
34	WH 1105 (C)	R	R	R	S	R	S	S	MS	R	S	S	S	S	NG	S	S	R	R	R	R	S	R	R	*Lr*13+
35	WH 1124 (I) (C)	R	S	R	R	S	R	R	S	S	S	R	S	R	R	S	R	S	S	R	R	MS	R	S	*Lr*10+13+
III. NORTH EASTERN PLAIN ZONE																									
36	BRW 3723	R	S	R	S	S	S	S	S	S	S	R	S	S	R	S	S	S	S	R	R	R	R	NG	*Lr*13+
37	DBW 107	R	R	S	S	S	R	S	R	S	S	R	S	R	R	S	S	S	R	R	MX	R	R	R	*Lr*3+26+
38	HD 3118	R	S	R	S	S	S	S	MS	R	R	R	S	R	R	S	S	S	S	R	R	M	R	R	*Lr*13+
39	K 1114	R	S	MS	S	S	S	R	S	S	S	S	S	R	R	S	S	S	S	R	R	S	R	R	*Lr*13+
40	C 306 (C)	R	S	MX	S	S	S	S	S	S	S	S	S	R	S	S	S	S	S	R	R	R	MX	S	-
41	DBW 14 (C)	R	S	R	R	S	R	NG	R	R	S	R	S	R	R	MS	S	MS	S	R	R	MS	R	R	*Lr*23+
42	DBW 39 (C)	R	R	R	R	R	R	R	R	R	R	R	MS	R	R	S	R	R	R	R	R	S	R	R	*Lr*1+23+26+
43	HD 2733 (C)	R	R	R	S	S	R	R	R	R	S	R	S	R	R	S	S	S	R	R	R	S	R	R	*Lr*26+34+
44	HD 2888 (C)	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	S	R	R	R	R	R	R	R	*Lr*24+
45	HD 2985 (C)	R	S	R	R	S	R	R	S	S	S	S	S	S	R	S	MS	S	S	R	R	S	R	R	*Lr*10+13+
46	HI 1563 (C)	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R
47	K 0307 (C)	R	R	R	R	R	R	R	S	MS	S	R	S	R	R	S	S	S	R	R	R	R	R	R	*Lr*1+23+
48	K 1006 (I) (C)	R	R	R	R	R	R	MS	S	R	S	R	S	S	R	S	S	S	MS	R	R	R	R	R	*Lr*10+23
49	K 8027 (C)	S	S	S	S	S	S	R	S	S	MS	R	S	S	R	S	S	S	S	S	R	R	R	S	*Lr*13+

S. No .	Variety	Pathotypes																							GENES
		11	12-2	12-3	12-5	12-7	77	77-1	77-2	77-5	77-7	77-8	77-9	77-10	77A-1	104-2	104-3	104-4	104B	106	108-1	162-1	162-3	162A	
50	NW 2036 (C)	R	R	R	S	MS	R	R	R	S	S	R	S	R	R	S	S	S	R	R	R	R	R	R	*Lr*23+26+
51	NW 5054 (I) (C)	R	S	R	S	S	R	R	S	R	R	R	MS	R	R	S	S	R	S	R	R	MS	R	R	*Lr*23+
IV. CENTRAL ZONE																									
52	DBW 110	R	R	R	R	R	R	R	S	S	S	R	S	S	R	S	S	S	MS	R	R	R	R	S	*Lr*10+13+
53	HI 8736 (D)	R	S	R	S	S	R	S	R	M	S	R	R	MS	R	S	S	S	S	S	R	R	R	R	*Lr*23+
54	HI 8737 (D)	R	R	R	MS	R	R	R	R	R	R	R	R	R	R	S	S	R	R	R	R	R	R	R	*Lr*23+
55	MP 3382	R	S	R	S	R	S	MS	S	S	S	R	S	S	R	S	S	S	R	R	R	S	R	R	*Lr*3+13+
56	NIAW 1885	R	S	R	R	R	R	R	S	R	R	R	S	S	R	S	S	S	S	R	R	R	R	R	*Lr*10+23+
57	PBW 689	R	R	R	R	R	R	R	S	R	S	R	S	S	R	R	S	MS	R	R	R	R	R	R	*Lr*10+13+
58	A 9-30-1 (D) (C)	R	R	R	S	MS	R	R	S	S	S	R	S	S	R	S	S	MS	MS	R	R	MS	R	R	*Lr*23+
59	GW 322 (C)	R	R	R	R	R	S	R	S	S	S	R	MS	MS	MS	MS	R	S	R	R	R	R	R	R	*Lr*13+
60	HD 2864 (C)	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R
61	HD 2932 (C)	R	S	R	R	R	S	S	S	S	S	R	S	R	S	S	S	R	S	R	R	R	MS	R	*Lr*13+
62	HI 1500 (C)	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	*Lr*24+
63	HI 1544 (C)	R	R	MS	S	S	S	R	S	R	S	S	S	S	R	S	R	S	R	R	R	S	R	R	*Lr*24+
64	HI 8498 (D) (C)	R	R	R	S	R	R	R	R	R	R	R	R	R	R	S	S	R	MS	R	R	R	R	R	*Lr*23+
65	HI 8627 (D) (C)	R	S	R	S	R	R	R	S	M	S	R	S	S	R	S	S	S	MS	R	R	S	R	R	*Lr*13+
66	MP 3288 (C)	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	*Lr*24+
67	MP 3336 (C)	R	S	MS	S	S	S	S	S	S	S	R	S	S	R	MS	S	S	S	R	R	R	R	R	-
68	MP 4010 (C)	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	*Lr*24+
69	MPO 1215 (d) (C)	R	S	R	MS	R	R	R	R	R	NG	R	R	R	R	R	MS	R	MS	R	R	R	R	R	*Lr*23+
V. PENINSULAR ZONE																									
70	NIAW 1994	R	R	R	R	R	R	R	R	R	S	R	S	MS	R	R	R	MS	R	R	R	R	R	R	*Lr*1+23+
71	UAS 347	R	S	R	S	S	S	R	S	R	R	R	S	R	R	S	S	S	S	R	R	S	R	R	*Lr*23+
72	UAS 446 (D)	R	R	R	S	R	R	R	R	R	S	R	R	R	R	R	R	R	R	R	R	R	R	R	*Lr*23+
73	AKDW 2997-16(d) (C)	R	R	MS	S	R	R	R	S	R	MS	R	R	R	R	S	R	R	R	R	R	R	R	R	-
74	HD 3090 (I) (C)	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	*Lr*1+26+
75	MACS 6222 (C)	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	*Lr*1+26+
76	MACS 6478 (C)	R	R	R	R	R	R	R	S	R	S	S	S	S	R	R	S	R	R	R	R	R	R	R	*Lr*23+
77	NI 5439 (C)	R	S	R	R	S	R	S	S	R	S	S	S	S	R	S	S	S	S	R	R	S	R	S	-
78	NIAW 1415 (C)	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	*Lr*26+
79	NIDW 295 (d) (C)	R	R	R	S	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	*Lr*18+

Annexure III: Seedling Resistance Test of AVT II against pathotypes of black rust (*Puccinia graminis tritici*) at Shimla during 2013-14

S. No.	Variety	Pathotypes																
		11	15-1	21	21A-2	24A	34-1	40A	40-1	40-2	40-3	42	117-4	117-6	184	184-1	295	GENES
I. NORTHERN HILL ZONE																		
1	HPW 376	R	R	R	MX	R	MX	S	MX	R	S	R	R	R	R	R	S	*Sr*5+
2	VL 967	R	S	R	MR	R	R	MS	R	R	S	R	R	R	R	R	R	*Sr*8a+9 b+11+
3	HPW 251 (C)	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	*Sr*2+31+
4	HPW 349 (C)	R	S	MR	R	R	R	S	R	S	MS	R	R	MR	R	S	S	*Sr*2
5	HS 277 (C)	R	NG	NG	R	R	NG	R	R	R	R	R	R	R	NG	R	R	*Sr*31+
6	HS 375 (C)	R	NG	R	R	R	NG	R	R	R	R	R	R	R	R	R	R	*Sr*5+31+
7	HS 490 (C)	R	NG	NG	R	NG	NG	NG	R	R	R	R	NG	NG	R	R	R	*Sr*2+9b+
8	HS 507 (C)	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	*Sr*31+
9	HS 542 (I) (C)	R	R	R	R	R	R	S	R	R	R	R	R	R	R	R	R	*Sr*5+8a+9b+11+
10	VL 804 (C)	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	*Sr*5+31+
11	VL 829 (C)	R	NG	R	R	R	R	R	R	R	R	R	R	R	R	R	R	*Sr*2+5+31+
12	VL 892 (C)	R	R	R	MS	R	R	MR	R	R	R	R	R	R	R	R	MS	*Sr*2+
13	VL 907 (C)	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	*Sr*31+
II. NORTH WESTERN PLAIN ZONE																		
14	HUW 666	S	R	R	R	R	R	MR	R	R	MS	S	R	R	R	R	R	*Sr*9b+11+
15	PBW 681	R	R	R	R	R	R	R	R	R	R	S	R	R	R	R	R	*Sr*2+11+
16	WH 1129	S	R	R	R	R	R	R	R	R	S	S	R	R	R	R	R	*Sr*9b+11+
17	WH 1138	R	MX	MS	R	MS	MX	R	MR	R	R	S	R	R	R	R	MX	*Sr*7b+
18	WH 1142	R	R	R	R	R	R	R	R	R	S	R	R	R	R	R	R	*Sr*2+31+
19	DBW 88 (I) (C)	MX	R	R	R	R	R	R	R	R	S	R	R	R	R	R	R	*Sr*11+
20	DBW 90 (I) (C)	S	R	MS	MS	R	R	R	MX	MX	MS	R	MX	R	R	R	MX	*Sr*13+
21	DPW 621-50 (C)	S	R	R	MS	MX	R	R	R	R	R	MX	R	R	R	R	R	-
22	HD 2967 (C)	R	S	R	R	R	R	MS	MX	MX	MS	S	R	R	R	R	R	*Sr*8a+11+
23	HD 3043 (C)	S	R	R	MS	R	MR	R	R	R	S	S	R	R	R	R	R	-
24	HD 3059 (C)	NG	NG	NG	NG	NG	NG	NG	NG	NG	NG	NG	NG	NG	NG	NG	NG	-
25	HD 3086 (I) (C)	S	MX	S	R	MS	MX	R	MS	R	MS	R	MR	R	MS	R	S	*Sr*2+7b+
26	PBW 590 (C)	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	*Sr*5+31+
27	PBW 644 (C)	MR	R	R	MX	R	R	S	S	R	R	S	R	R	R	R	R	*Sr*2+
28	PBW 660 (I) (C)	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	*Sr*5+31+
29	PDW 233 (C)	R	MX	R	R	R	R	R	MX	R	R	R	R	MX	S	MS	R	*Sr*2+9e+
30	PDW 291 (C)	R	MX	R	R	MX	R	R	MR	R	R	R	R	R	R	MR	R	*Sr*9e+
31	PDW 314 (C)	R	R	R	R	R	R	S	S	MX	S	S	MX	R	S	MS	R	*Sr*9e+
32	WH 1021 (C)	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	*Sr*2+31+

S. No.	Variety	Pathotypes																						
		11	12-2	12-3	12-5	12-7	77	77-1	77-2	77-5	77-7	77-8	77-9	77-10	77A-1	104-2	104-3	104-4	104B	106	108-1	162-1	162-3	162A	GENES
80	Raj 4083 (C)	R	S	R	R	R	R	S	R	S	S	R	S	S	R	MS	MS	S	R	R	R	R	R	R	*Lr*23+
81	UAS 428 (d) (C)	R	R	R	S	R	R	R	R	M	R	R	R	R	R	S	R	S	MS	R	R	R	R	R	*Lr*23+
VI. SOUTHERN HILLS ZONE																									
82	CoW (W) 1 (C)	R	R	R	R	R	R	R	R	R	R	R	R	R	R	NG	R	R	R	R	R	R	R	R	*Lr*26+
83	HW 2044 (C)	R	NG	NG	R	NG	R	NG	NG	NG	NG	R	R	R	R	R	R	R	R	NG	R	R	R	NG	*Lr*24+
84	HW 5216 (C)	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	*Lr*26+
VII. SPECIAL TRIAL																									
85	DDK 1042	R	R	R	R	R	R	R	R	R	R	NG	R	NG	R	S	R	R	R	R	-	MS	R	R	*Lr*23+
86	MACS 5022	S	R	R	R	R	R	R	R	R	R	R	R	R	S	MS	MS	R	R	S	R	S	R	R	-
87	DDK 1029 (C)	S	S	R	R	R	R	R	R	R	R	R	R	R	R	S	S	R	R	S	R	MS	R	R	-
88	HW 1098 (I) (C)	S	S	S	R	R	R	R	R	R	R	R	R	R	R	R	S	R	R	S	-	S	R	R	-
89	Kharchia 65 (C)	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	MS	S	S	S	S	S	-
90	KRL 19 (C)	R	S	R	S	MS	S	S	S	S	S	R	S	MS	MS	S	MS	S	MS	R	R	R	R	R	-
91	KRL 210 (C)	R	R	R	R	MS	R	S	MS	S	S	R	S	R	R	S	S	R	S	R	R	R	R	R	*Lr*10+13+
92	MACS 2496 (C)	R	R	NG	S	R	R	S	S	S	S	R	S	MS	R	S	S	S	R	R	R	R	R	R	*Lr*23+26+
93	MACS 2971 (C)	S	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	MR	S	R	MS	R	S	-

S. No.	Variety	Pathotypes															
		11	15-1	21	21A-2	24A	34-1	40A	40-1	40-2	40-3	42	117-4	117-6	184	184-1	295	GENES
33	WH 1080 (C)	R	R	R	S	R	R	S	MS	R	MR	R	R	MS	R	MX	MX	*Sr*2+9e+
34	WH 1105 (C)	R	R	R	R	R	R	S	R	R	NG	S	R	R	R	R	R	*Sr*11+
35	WH 1124 (I) (C)	S	R	S	R	MR	R	R	S	MX	MR	S	MX	R	MR	MR	S	*Sr*2+7b+
III. NORTH EASTERN PLAIN ZONE																		
36	BRW 3723	MS	R	R	R	R	R	S	R	R	S	NG	R	R	S	R	S	*Sr*9b+11+
37	DBW 107	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	*Sr*31+
38	HD 3118	MS	MX	R	R	R	S	MS	R	R	R	S	R	MS	R	R	MR	*Sr*9b+11+
39	K 1114	MR	R	R	R	R	R	S	MX	R	MR	MS	R	MS	R	R	R	*Sr*2+11+
40	C 306 (C)	S	S	MX	S	NG	S	S	S	R	S	S	MX	MX	S	S	S	-
41	DBW 14 (C)	MR	R	R	MS	R	R	S	MR	R	S	S	R	R	R	MR	S	*Sr*2+
42	DBW 39 (C)	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	*Sr*31+
43	HD 2733 (C)	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	*Sr*31+
44	HD 2888 (C)	R	NG	NG	R	R	R	R	S	R	R	R	NG	R	R	R	NG	*Sr*24+
45	HD 2985 (C)	S	R	R	MX	R	R	R	MX	R	MR	S	MX	R	R	S	R	*Sr*7b+
46	HI 1563 (C)	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	*Sr*2+R
47	K 0307 (C)	R	R	R	R	R	R	S	R	R	R	R	R	R	R	MS	MR	*Sr*2+
48	K 1006 (I) (C)	R	R	R	R	R	R	S	MX	R	R	R	R	R	R	R	R	*Sr*8a+9b+11+
49	K 8027 (C)	S	R	R	R	S	S	S	MX	R	MS	S	R	S	S	S	S	*Sr*2+11+
50	NW 2036 (C)	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	*Sr*31+
51	NW 5054 (I) (C)	S	R	R	S	R	S	R	MX	MX	R	S	R	R	R	MR	R	*Sr*7b+
IV. CENTRAL ZONE																		
52	DBW 110	MX	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R
53	HI 8736 (D)	R	S	R	R	MR	R	MR	R	R	R	S	R	MR	R	R	R	*Sr*11+
54	HI 8737 (D)	MR	MX	R	R	R	R	R	R	R	MR	R	R	R	MX	R	R	*Sr*9e+
55	MP 3382	R	MX	R	R	R	R	MR	R	R	R	R	R	R	R	MR	MR	*Sr*9b+11+
56	NIAW 1885	R	MX	R	R	R	R	S	R	MX	S	S	R	R	R	R	S	*Sr*7b+
57	PBW 689	MX	R	R	R	R	R	R	MX	R	MX	S	R	R	R	MS	R	*Sr*9b+11+
58	A- 9-30-1 (D) (C)	S	R	R	MX	MR	S	MS	MX	R	S	S	R	MS	R	MX	S	*Sr*11+
59	GW 322 (C)	MS	R	R	R	R	MX	MS	R	R	R	S	R	R	R	NG	R	*Sr*2+11+
60	HD 2864 (C)	R	R	R	R	R	R	R	R	R	MR	R	R	R	R	R	R	*Sr*8a+11+
61	HD 2932 (C)	R	R	R	S	R	R	R	R	R	MS	MX	R	R	R	R	R	-
62	HI 1500 (C)	R	R	R	R	R	R	R	S	R	R	NG	R	R	R	R	R	*Sr*24+
63	HI 1544 (C)	R	R	R	R	R	R	R	MX	R	R	R	R	R	R	R	R	*Sr*2+Sr24+ R
64	HI 8498 (D) (C)	R	R	R	R	NG	R	R	R	R	MR	MR	R	MR	R	R	MX	*Sr*2+11+
65	HI 8627 (D) (C)	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	-

S. No.	Variety	Pathotypes																GENES
		11	15-1	21	21A-2	24A	34-1	40A	40-1	40-2	40-3	42	117-4	117-6	184	184-1	295	
66	MP 3288 (C)	R	R	R	R	R	R	R	S	R	R	R	R	R	R	R	R	*Sr*24+
67	MP 3336 (C)	S	R	R	R	R	NG	R	MR	R	MS	MS	R	R	R	R	R	-
68	MP 4010 (C)	R	R	R	R	R	R	R	S	R	R	R	R	R	R	R	R	*Sr*2+24+
69	MPO 1215 (d) (C)	MR	NG	R	R	S	R	R	R	R	MS	R	R	R	R	R	MX	*Sr*11+
V. PENINSULAR ZONE																		
70	NIAW 1994	R	MX	R	MX	R	R	R	MX	R	MS	S	R	R	R	S	MS	*Sr*9b+11+
71	UAS 347	MS	R	R	R	R	R	MR	R	MX	S	R	R	R	R	MR	R	*Sr*2+7b+11+
72	UAS 446 (D)	R	R	R	R	MS	R	R	R	MR	R	R	R	R	MR	R	R	*Sr*2+11+
73	AKDW 2997-16(d) (C)	MX	R	S	R	S	S	MS	MX	MX	MR	S	R	MS	MX	R	MR	*Sr*7b+
74	HD 3090 (I) (C)	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	*Sr*2+31+
75	MACS 6222 (C)	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	*Sr*31+
76	MACS 6478 (C)	S	R	R	S	R	R	S	R	S	MS	MS	R	R	R	R	R	-
77	NI 5439 (C)	S	R	R	R	MX	R	S	MX	MX	MR	S	R	MX	R	R	R	*Sr*11+
78	NIAW 1415 (C)	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	*Sr*31+
79	NIDW 295 (d) (C)	R	MX	R	R	R	R	MS	R	R	R	R	R	S	S	R	R	*Sr*2+9e+12
80	Raj 4083 (C)	MS	R	R	R	S	R	R	R	R	MS	S	R	R	R	MS	MR	*Sr*11+
81	UAS 428 (d) (C)	MR	R	R	R	NG	R	MR	R	R	R	S	R	R	MS	R	MX	*Sr*11+
VI. SOUTHERN HILLS ZONE																		
82	CoW (W) 1 (C)	R	NG	R	R	NG	R	R	R	R	R	R	R	R	R	R	NG	*Sr*31+
83	HW 2044 (C)	R	NG	NG	NG	R	NG	R	MS	R	R	NG	NG	NG	NG	NG	R	*Sr*2+24+
84	HW 5216 (C)	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	*Sr*31+
VII. SPECIAL TRIAL																		
85	DDK 1042	R	R	R	-	MR	R	MR	NG	-	R	NG	-	S	MR	-	MX	*Sr*11+
86	MACS 5022	S	R	R	R	R	MX	MR	R	S	R	R	R	R	S	MS	MX	*Sr*11+
87	DDK 1029 (C)	R	R	R	R	NG	R	MS	R	R	MR	R	R	R	R	R	S	*Sr*11+
88	HW 1098 (I) (C)	R	R	R	-	S	MR	R	R	-	MS	NG	-	MS	R	-	R	*Sr*11+
89	Kharchia 65 (C)	S	R	S	S	R	MX	S	S	S	S	S	S	MR	S	S	S	
90	KRL 19 (C)	R	R	R	R	R	MX	MR	R	R	R	R	R	R	R	R	MX	*Sr*8b+9b+11+
91	KRL 210 (C)	MX	S	MS	R	MR	S	R	MR	S	MS	MX	MX	S	MR	R	MX	*Sr*7b+
92	MACS 2496 (C)	R	R	R	R	R	R	R	R	R	R	R	R	MR	R	R	R	*Sr*2+31+
93	MACS 2971 (C)	MR	R	R	R	MR	R	MR	R	R	R	R	R	MR	MR	R	MX	*Sr*11+

Annexure IV: Seedling Resistance Test of AVT II against pathotypes of yellow rust (*Puccinia striiformis*) at Shimla during 2013-14

S. No.	Variety	Pathotypes													
		78S84	P	46S119	K	T	31	I	38A	A	L	20A	14A	N	GENES
I. NORTHERN HILL ZONE															
1	HPW 376	R	S	S	R	R	R	R	MX	R	S	R	R	R	*Yr*2+
2	VL 967	S	S	S	R	R	R	R	R	R	R	R	R	R	*Yr*2+
3	HPW 251 (C)	S	R	S	R	R	R	R	R	R	R	R	R	R	*Yr*9+
4	HPW 349 (C)	R	S	S	R	R	R	R	R	R	R	R	R	R	*Yr*2+
5	HS 277 (C)	S	R	S	R	R	R	R	R	NG	R	R	R	R	*Yr*9+18+
6	HS 375 (C)	S	R	S	R	R	R	R	R	R	R	R	R	R	*Yr*9+18+
7	HS 490 (C)	R	R	S	R	R	R	R	R	R	R	R	R	R	-
8	HS 507 (C)	R	R	R	R	R	R	R	R	R	R	R	R	R	*Yr*9+
9	HS 542 (I) (C)	R	S	S	R	S	R	R	R	R	R	R	R	R	*Yr*2+
10	VL 804 (C)	S	R	S	R	R	R	R	R	R	R	R	R	R	*Yr*9+18+
11	VL 829 (C)	S	R	S	R	R	R	R	R	R	R	R	NG	R	*Yr*9+18+
12	VL 892 (C)	R	R	S	R	R	R	R	R	R	R	R	R	R	*Yr*A+
13	VL 907 (C)	S	R	R	R	R	R	R	R	R	R	R	R	R	*Yr*9+27+
II. NORTH WESTERN PLAIN ZONE															
14	HUW 666	R	R	MS	R	R	R	R	R	R	R	R	R	R	*Yr*A+
15	PBW 681	R	R	R	R	R	R	R	R	R	R	R	R	R	R
16	WH 1129	R	MS	MS	R	R	R	R	R	R	R	R	R	R	*Yr*2+
17	WH 1138	R	S	S	MX	R	R	R	MS	R	R	R	R	R	*Yr*2+
18	WH 1142	R	R	S	R	R	R	R	R	R	R	R	R	R	*Yr*9+
19	DBW 88 (I) (C)	R	R	R	R	R	R	R	R	R	R	R	R	R	-
20	DBW 90 (I) (C)	R	MS	S	R	S	S	R	R	R	R	R	R	R	*Yr*2+
21	DPW 621-50 (C)	MR	R	R	R	R	R	R	R	R	R	R	R	R	-
22	HD 2967 (C)	R	S	S	R	S	R	R	R	R	R	R	R	R	*Yr*2+
23	HD 3043 (C)	R	R	R	R	MS	R	R	R	R	R	R	R	R	*Yr*2+
24	HD 3059 (C)	NG	NG	NG	NG	NG	NG	NG	NG	NG	NG	NG	NG	NG	-
25	HD 3086 (I) (C)	R	S	S	R	S	R	R	R	R	MR	R	R	R	*Yr*2+
26	PBW 590 (C)	S	R	S	R	R	R	R	R	R	R	R	R	R	*Yr*9+
27	PBW 644 (C)	S	MR	S	R	R	R	R	R	R	R	R	R	R	*Yr*2+
28	PBW 660 (I) (C)	R	R	R	R	R	R	R	R	R	R	R	R	R	*Yr*9+, R
29	PDW 233 (C)	S	S	S	MX	R	S	R	S	R	MX	R	R	R	-
30	PDW 291 (C)	S	S	S	MS	MS	S	MS	S	R	R	R	S	MX	-
31	PDW 314 (C)	R	S	S	R	R	MS	S	MS	R	R	R	S	R	*Yr*2+
32	WH 1021 (C)	R	R	MS	R	R	R	R	R	R	R	R	R	R	*Yr*9+

S. No.	Variety	Pathotypes													
		78S84	P	46S119	K	T	31	I	38A	A	L	20A	14A	N	GENES
33	WH 1080 (C)	S	S	S	S	R	S	MS	S	R	S	R	S	R	*Yr2+*
34	WH 1105 (C)	R	R	R	R	R	R	R	R	R	R	R	R	R	*Yr2+*
35	WH 1124 (I) (C)	R	MR	S	R	R	R	R	R	R	MX	R	R	R	*Yr2+*
III. NORTH EASTERN PLAIN ZONE															
36	BRW 3723	MS	MS	S	R	R	R	R	R	R	R	R	R	R	*Yr2+*
37	DBW 107	S	R	S	R	R	R	R	R	R	R	R	R	R	*Yr9+*
38	HD 3118	S	S	S	MR	S	MS	MS	R	R	MS	R	MS	R	*Yr2+*
39	K 1114	S	S	S	MS	S	S	MS	MS	R	S	R	S	R	*Yr2+*
40	C 306 (C)	NG	S	S	R	S	R	R	R	R	R	R	R	NG	-
41	DBW 14 (C)	S	R	MR	S	R	S	R	R	R	R	R	R	R	-
42	DBW 39 (C)	S	R	S	R	R	R	R	R	R	R	R	R	R	*Yr9+*
43	HD 2733 (C)	R	R	S	R	NG	R	R·	R	R	R	R	R	R	*Yr9+18+*
44	HD 2888 (C)	R	S	S	R	NG	R	R	R	R	R	R	R	R	*Yr2+*
45	HD 2985 (C)	S	S	S	S	MS	MR	R	R	R	R	R	R	MS	*Yr2+*
46	HI 1563 (C)	R	R	MR	R	R	R	R	R	R	R	R	R	R	*Yr2+*
47	K 0307 (C)	S	S	S	MS	R	S	R	S	R	R	R	S	R	*Yr2+*
48	K 1006 (I) (C)	S	S	S	S	R	S	S	S	R	S	R	R	S	*Yr2+*
49	K 8027 (C)	S	S	S	MS	MS	R	R	R	R	R	R	R	MS	*Yr2+*
50	NW 2036 (C)	R	R	S	R	R	R	R	R	R	R	R	R	R	*Yr9+*
51	NW 5054 (I) (C)	S	S	S	MS	S	MS	S	MS	R	MS	S	S	S	*Yr2+*
IV. CENTRAL ZONE															
52	DBW 110	S	S	S	R	R	R	R	R	R	R	R	R	R	*Yr2+*
53	HI 8736 (D)	MS	R	MS	R	R	MS	S	MR	R	R	R	S	R	*Yr2+*
54	HI 8737 (D)	MS	MR	S	S	R	MS	S	R	R	S	R	S	R	*Yr2+*
55	MP 3382	MS	R	MS	R	R	R	R	R	R	R	R	R	R	*YrA+*
56	NIAW 1885	S	S	S	S	S	R	R	R	R	R	R	R	R	*Yr2+*
57	PBW 689	S	S	S	MR	S	MR	R	R	R	R	R	R	R	*Yr2+*
58	A -9-30-1 (D) (C)	S	S	S	S	S	S	S	S	NG	S	MX	S	S	-
59	GW 322 (C)	S	S	S	MS	MS	S	R	MR	R	MS	R	R	R	*Yr2+*
60	HD 2864 (C)	S	S	S	R	MS	R	R	R	R	R	R	R	R	*Yr2+*
61	HD 2932 (C)	S	S	S	MS	R	MS	S	S	R	MS	R	R	R	-
62	HI 1500 (C)	S	S	S	R	R	R	R	R	R	R	R	R	R	*Yr2+*
63	HI 1544 (C)	S	MS	S	MS	R	S	MS	MS	R	MS	NG	MS	R	*Yr2+*
64	HI 8498 (D) (C)	MS	S	S	MS	R	MX	S	MX	NG	R	R	S	R	*Yr2+*
65	HI 8627 (D) (C)	S	MS	S	R	R	MR	R	MR	R	R	R	S	R	-

S. No.	Variety	Pathotypes													
		78S84	P	46S119	K	T	31	I	38A	A	L	20A	14A	N	GENES
66	MP 3288 (C)	S	S	S	R	R	MR	R	MS	R	R	R	R	R	*Yr2+*
67	MP 3336 (C)	S	MS	S	MS	R	R	MS	MS	R	R	R	R	R	*Yr2+*
68	MP 4010 (C)	S	S	S	MS	R	R	R	R	R	R	R	R	MS	*Yr2+*
69	MPO 1215 (d) (C)	MS	R	MS	MS	R	S	S	S	R	R	R	S	R	
V. PENINSULAR ZONE															
70	NIAW 1994	MS	MX	S	MX	R	R	MR	R	R	S	R	S	R	*YrA+*
71	UAS 347	S	S	S	MS	S	R	R	R	NG	MS	R	R	S	*Yr2+*
72	UAS 446 (D)	MR	MS	MS	R	R	S	S	S	NG	R	NG	S	R	*Yr2+*
73	AKDW 2997-16(d) (C)	S	S	S	MS	R	S	S	S	R	S	R	S	R	-
74	HD 3090 (I) (C)	S	R	S	R	R	R	R	R	R	R	R	NG	R	*Yr9+*
75	MACS 6222 (C)	S	R	S	R	R	R	R	R	R	R	R	R	R	*Yr9+27+*
76	MACS 6478 (C)	S	R	R	R	S	MR	R	R	R	R	R	R	R	*Yr2+*
77	NI 5439 (C)	S	S	S	R	R	R	R	R	R	R	R	R	S	*Yr2+*
78	NIAW 1415 (C)	S	R	S	R	R	R	R	R	R	R	R	R	R	*Yr9+*
79	NIDW 295 (d) (C)	S	R	S	MX	R	R	R	MS	R	MX	R	R	R	-
80	Raj 4083 (C)	S	S	S	R	R	R	R	R	R	R	S	MR	R	*Yr2+*
81	UAS 428 (d) (C)	S	S	S	MS	MX	S	S	S	R	S	R	S	R	-
VI. SOUTHERN HILLS ZONE															
82	CoW (W) 1 (C)	S	R	S	R	R	R	R	R	R	R	R	R	R	*Yr9+*
83	HW 2044 (C)	BG	R	R	R	R	R	R	R	R	R	R	NG	R	*Yr2+*
84	HW 5216 (C)	S	R	S	R	R	R	R	R	R	R	R	R	R	*Yr9+*
VII. SPECIAL TRIAL															
85	DDK 1042	R	MS	R	R	R	R	NG	R	R	R	R	R	R	-
86	MACS 5022	S	MS	S	MS	MS	S	S	MR	R	MS	MR	MS	S	*Yr2+*
87	DDK 1029 (C)	S	S	MS	R	MR	R	R	R	R	R	R	R	MS	-
88	HW 1098 (I) (C)	R	MS	R	R	R	R	R	R	R	R	R	R	R	-
89	Kharchia 65 (C)	S	S	S	S	R	S	S	S	R	S	R	S	S	-
90	KRL 19 (C)	S	MS	S	S	R	MS	R	R	R	S	R	R	R	-
91	KRL 210 (C)	R	S	S	R	R	MS	R	R	R	R	R	R	R	-
92	MACS 2496 (C)	S	R	S	R	R	R	R	R	R	R	R	R	R	*Yr9+*
93	MACS 2971 (C)	S	MS	MS	R	MS	R	R	R	R	R	R	R	R	*Yr2+*

Annexure V: Seedling Resistance Test of AVT I against pathotypes of brown rust (*Puccinia triticina*) at Shimla during 2013-14

S.No.	Variety	Pathotypes: 11	12	12-2	12-3	12-5	12-7	12-9	77	77-1	77-2	77-5	77-7	77-8	77-9	77-10	77A-1	104-2	104-3	104-4	104B	106	107-1	162-1	162-3	162A	GENES
1	HPW 373	R	R	R	R	R	R	R	R	R	S	R	R	R	MS	S	R	R	R	R	R	R	R	R	R	R	*Lr1*+10+23+
2	HPW 400	R	R	MS	R	S	S	S	MS	S	S	MS	R	R	S	S	NG	S	MS	R	S	R	R	MS	R	S	*Lr13*+
3	HPW 401	R	R	R	R	R	R	R	R	R	R	MS	R	MS	S	R	R	MS	R	R	R	R	R	R	R	R	*Lr13*+
4	HPW 410	R	S	S	S	S	MX	MS	R	R	NG	S	R	R	S	NG	S	S	S	R	R	R	R	R	S	S	*Lr13*+
5	HPW 411	R	R	NG	R	R	R	R	MS	R	S	S	R	M	S	S	NG	S	S	R	R	R	R	R	R	R	*Lr1*+13+
6	HPW 412	R	R	R	R	R	R	R	R	S	R	MS	S	R	S	R	NG	MS	S	R	R	R	R	R	R	R	*Lr1*+26+
7	HS 547	R	R	R	R	R	R	R	R	R	S	S	S	R	S	R	R	S	S	R	R	R	R	R	R	S	*Lr1*+10+13
8	HS 558	R	R	S	R	S	S	S	S	S	S	S	R	S	S	S	R	S	S	R	S	R	MS	S	R	R	*Lr13*+
9	HS 562	R	R	S	R	R	R	S	R	R	S	S	R	R	MS	S	S	S	S	R	S	R	R	R	R	R	*Lr23*+
10	HS 577	R	R	R	R	S	MS	R	R	MS	S	R	S	R	M	S	R	S	MS	S	S	R	R	R	R	R	*Lr3*+23+
11	HS 590	R	R	R	R	S	R	R	S	S	S	S	R	S	S	S	R	S	R	R	MS	R	R	S	R	R	*Lr13*+
12	HS 591	R	R	R	R	R	S	R	R	R	R	R	S	R	R	R	R	R	R	R	R	R	R	R	R	R	*Lr10*+13+
13	HS 592	R	R	R	R	R	R	R	R	MS	R	S	R	S	S	S	R	M	R	R	R	R	R	R	R	R	*Lr1*+10+13+
14	HS 593	R	MS	R	R	S	R	R	S	R	S	R	R	R	S	S	R	S	R	R	S	R	R	R	S	R	*Lr13*+
15	HS 594	R	R	R	R	S	R	R	R	R	MX	R	R	S	S	S	S	R	R	R	R	R	R	R	R	R	*Lr13*+
16	HS 595	R	R	R	R	R	R	R	R	S	S	R	R	R	S	R	R	S	R	R	R	R	R	R	R	R	*Lr1*+10+13+
17	UP 2890	R	S	S	R	S	MS	R	S	R	S	S	S	R	S	R	R	S	S	S	S	R	MS	S	R	MS	*Lr13*+
18	UP 2891	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R
19	VL 976	R	R	R	R	R	R	R	R	R	R	MS	R	R	MS	R	R	S	R	R	R	R	R	R	R	R	*Lr1*+23+26+
20	VL 977	R	R	R	R	S	S	R	R	R	R	R	S	R	R	R	R	S	S	MS	R	R	R	R	R	R	*Lr23*+26+
21	VL 1003	R	R	R	R	MS	MS	R	R	R	R	R	R	R	R	S	R	R	R	R	R	R	R	R	R	R	*Lr23*+26+
22	VL 1004	R	R	S	R	R	S	S	R	R	S	MS	S	R	S	S	R	S	S	S	R	R	R	R	R	R	*Lr10*+23+
23	VL 3002	R	R	R	R	R	R	R	M	S	S	R	R	MS	S	R	R	S	S	R	R	R	R	R	**M**	**R**	*Lr13*+
24	VL 3004	R	R	R	R	R	R	R	R	R	R	S	R	R	S	S	R	R	R	R	R	R	R	R	R	R	*Lr1*+26+
25	VL 3005	R	R	R	R	R	NG	R	R	R	R	R	S	R	S	R	R	R	S	R	R	R	R	R	R	R	*Lr23*+
26	VL 3006	R	R	R	R	R	R	R	R	MS	R	MS	S	R	MS	R	R	S	S	R	M	R	R	R	R	R	*Lr10*+13+
II. NORTH WESTERN PLAIN ZONE																											
27	DBW 95	R	R	R	R	R	R	R	S	S	S	S	R	S	S	R	R	S	S	R	R	R	R	M	R	R	*Lr13*+
28	DBW 128	R	R	R	R	R	MS	S	S	R	S	MS	S	S	S	S	R	S	S	R	S	R	R	MS	MS	R	*Lr13*+

S.No.	Variety	11	12	12-2	12-3	12-5	12-7	12-9	77	77-1	77-2	77-5	77-7	77-8	77-9	77-10	77A-1	104-2	104-3	104-4	104B	106	107-1	162-1	162-3	162A	GENES
		Pathotypes																									
29	DBW 129	R	R	R	R	R	R	R	R	R	S	R	R	R	S	R	MX	R	R	R	R	R	R	R	R	R	*Lr*10+23+
30	HD 3128	R	R	R	R	S	R	R	R	MS	R	R	R	R	S	MS	R	S	S	R	R	R	R	S	R	R	*Lr*26+
31	HD 3132	R	R	R	R	R	R	R	R	R	S	MS	S	S	S	R	R	M	MS	R	R	R	R	S	R	R	*Lr*10+13+
32	HD 3133	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	*Lr*26+R
33	HD 3139	R	R	R	R	R	R	MS	R	R	S	R	R	R	S	S	R	S	MS	R	R	R	R	R	R	R	*Lr*23+
34	HD 4730	R	R	R	R	R	R	R	R	R	R	R	R	R	R	S	R	S	S	R	R	R	R	R	R	R	*Lr*23+
35	HUW 675	R	R	R	R	R	R	R	R	R	S	R	S	R	S	S	R	S	R	R	R	R	R	S	R	R	*Lr*10+23+
36	K 1204	R	R	R	R	R	R	R	R	R	S	R	R	R	S	S	R	S	S	R	R	R	R	R	R	R	*Lr*1+23+
37	MP 1277	R	R	S	R	R	S	S	R	R	S	MS	R	R	S	R	R	S	S	S	S	R	R	R	R	R	*Lr*10+23+
38	PBW 677	R	R	R	R	S	R	R	R	R	S	M	R	R	S	R	R	R	S	R	R	R	R	R	R	R	*Lr*23+
39	PBW 692	R	R	R	R	R	R	R	S	R	S	S	S	R	S	R	R	S	MS	S	R	R	R	R	R	R	*Lr*13+
40	PBW 695	R	R	R	R	R	R	R	R	R	S	MS	R	R	R	S	R	S	R	R	MS	R	R	R	R	R	*Lr*23+
41	PBW 697	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R
42	PBW 698	R	R	R	R	R	R	R	R	R	R	R	R	R	S	R	R	R	R	R	R	R	R	R	R	R	R
43	PBW 702	R	R	R	R	R	R	R	R	R	S	MS	R	R	S	S	R	S	S	MS	MS	R	R	R	R	R	*Lr*10+23+
44	PBW 703	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R
45	PBW 706	R	R	R	R	S	R	R	S	MS	S	R	R	R	S	S	R	S	S	R	MS	R	R	R	R	R	*Lr*13+
46	TL 2995	R	R	R	R	R	R	R	R	R	R	R	R	MS	R	R	R	R	R	R	R	R	R	R	R	R	*Lr*9+
47	UAS 356	R	R	S	R	S	R	S	R	R	S	R	R	R	R	R	R	M	MS	NG	MS	R	R	R	R	R	*Lr*23+
48	WH 1154	R	R	S	R	R	S	S	R	MS	S	S	R	R	S	R	R	S	S	R	S	R	R	MS	R	R	*Lr*13+
49	WH 1156	R	R	R	R	S	R	S	S	S	S	S	R	S	S	S	R	S	R	R	S	R	R	R	R	R	*Lr*13+
50	WH 1157	R	R	R	R	R	R	R	R	R	S	R	R	R	R	MS	S	M	R	R	R	R	R	R	R	R	*Lr*10+13+
51	WH 1164	R	R	R	R	S	R	MS	S	MS	S	R	R	S	S	R	MS	S	M	R	S	R	R	R	R	R	*Lr*13+
III. NORTH EASTERN PLAIN ZONE																											
52	DBW 126	R	R	R	R	S	MS	S	S	S	S	S	R	S	S	R	S	S	S	R	S	R	R	S	R	R	*Lr*13+
53	DBW 98	R	R	S	R	R	S	S	R	S	S	S	R	R	S	S	S	S	S	R	S	R	R	S	R	MS	*Lr*10+13+
54	HD 3127	R	R	R	R	S	MS	R	MS	R	MS	S	R	S	S	MS	R	S	MS	R	R	R	R	MS	R	R	*Lr*13+
55	HUW 661	R	NG	R	R	R	R	R	R	R	S	NG	R	R	R	S	R	R	S	R	R	R	R	R	R	-	*Lr*1+2a+10+23+
56	HUW 677	R	NG	R	R	R	R	R	R	R	R	R	R	R	R	R	NG	R	R	R	R	R	R	R	R	-	R
57	HUW 679	R	R	R	R	R	R	R	R	R	R	R	R	R	M	S	R	R	MS	R	R	R	R	R	R	R	*Lr*1+10+26+
58	PBW 693	R	R	R	R	R	R	R	R	S	R	R	R	R	R	R	N	R	R	R	R	R	R	R	R	R	*Lr*10+26+

S.No .	Variety	11	12	12-2	12-3	12-5	12-7	12-9	77	77-1	77-2	77-5	77-7	77-8	77-9	77-10	77A-1	104-2	104-3	104-4	104B	106	107-1	162-1	162-3	162A	GENES
																	G										
59	PBW 701	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	S	R	R	R	R	R	R	R	R	*Lr*23+26+
60	PBW 704	R	R	R	R	R	R	R	R	R	R	R	R	R	R	MS	R	M	R	R	R	R	R	R	R	R	
61	UP 2855	R	R	R	R	R	R	R	R	R	R	R	M R	R	R	R	R	R	R	R	R	R	R	R	R	R	*Lr*1+23+26+
62	WH 1132	R	R	S	R	R	S	S	R	M S	S	S	R	S	S	R	R	S	S	R	S	R	R	R	R	M R	*Lr*10+13+
IV. CENTRAL ZONE																											
63	CG 1010	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R
64	DDW 30 (D)	R	R	R	R	S	R	R	R	R	R	R	R	R	R	R	R	R	M S	R	S	R	R	R	R	R	*Lr*23+
65	GW 451	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R
66	GW 455	R	R	R	N G	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R
67	HD 3146	R	R	R	R	S	R	R	R	R	R	MS	R	R	R	S	N G	S	S	S	R	R	R	R	R	R	*Lr*23+26+
68	HD 4728 (D)	R	M R	R	R	R	R	R	R	R	S	R	R	R	R	R	R	M	R	R	R	R	R	R	R	R	*Lr*23+
69	HI 8750 (D)	R	R	R	R	S	S	R	R	R	R	MS	R	R	R	R	N G	S	S	MS	S	R	R	S	R	R	*Lr*18+
70	HI 8755 (D)	R	R	R	R	M S	R	R	R	R	M	R	R	R	R	R	R	S	S	R	S	R	R	R	R	N G	*Lr*18+
71	K 1215	R	R	MS	R	S	R	S	M S	S	MS	R	MS	R	S	R	R	S	S	S	S	R	R	R	R	R	*Lr*23+
72	K 1217	R	R	R	R	S	S	R	R	R	R	S	R	R	S	R	R	S	S	S	R	R	R	R	R	R	*Lr*23+26+
73	MACS 3916 (D)	R	R	R	R	S	R	R	R	R	MS	R	R	R	R	R	R	S	R	R	S	S	R	M S	R	R	*Lr*23+
74	MACS 3927 (D)	R	S	S	S	S	S	S	M	R	S	S	S	R	S	S	R	S	S	R	S	S	R	R	M S	R	*Lr*18+
75	MACS 6604	R	R	S	R	S	R	S	R	R	MS	MS	R	R	S	S	R	S	M S	S	R	R	R	R	R	R	*Lr*23+
76	MP 1279	R	R	R	R	S	R	R	R	R	S	S	R	R	S	S	R	S	R	R	R	R	R	R	R	R	*Lr*23+
77	NIAW 2030	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	*Lr*23+
78	UAS 451 (D)	M X	R	R	R	M S	R	R	R	R	MS	R	R	R	R	R	R	M S	S	R	R	M	R	R	R	R	
V. PENINSULAR ZONES																											
79	DDW 27 (D)	R	R	R	R	S	S	M S	R	R	R	R	S	R	R	R	R	S	S	R	M S	M	R	R	R	R	*Lr*18+23+
80	HI 8751 (D)	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	S	R	R	R	R	R	R	R	R	*Lr*23+
81	HI 8754 (D)	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	S	R	R	R	R	R	R	R	Lr23+
82	K 1213	S	MS	S	MS	S	R	S	S	S	S	S	R	S	M S	S	R	S	S	MS	S	R	R	S	M S	S	
83	UP 2864	R	R	R	R	S	R	R	R	R	R	R	MS	R	R	R	R	M S	R	R	R	R	R	R	R	R	*Lr*23+26+
VI. SOUTHERN HILLS ZONE																											
84	MACS 6507	R	R	S	R	S	S	S	S	R	M	MS	R	R	S	S	R	S	S	S	S	R	R	S	R	S	*Lr*13+
85	UAS 358	R	R	R	R	R	R	R	R	M S	R	MS	R	R	M S	R	R	S	S	R	R	R	R	M S	R	R	*Lr*10+26+

S.No .	Variety	Pathotypes																								GENES
		11	12	12-2	12-3	12-5	12-7	12-9	77	77-1	77-2	77-5	77-7	77-8	77-9	77-10	77A-1	104-2	104-3	104-4	104B	106	107-1	162-1	162-3	162A	
VII. SPECIAL TRIAL (Dicoccum and Sailinity and Alkalinity																										
86	DBW 154	R	R	R	R	S	R	R	R	MS	R	MS	R	R	R	MS	R	S	S	S	R	R	R	MS	R	R	*Lr26+*
87	DBW 155	R	R	MS	R	R	R	S	R	R	MS	R	R	R	S	R	R	S	S	S	S	R	R	R	R	R	*Lr23+*
88	MACS 5040	MS	R	R	R	R	R	R	R	R	R	R	R	R	R	S	R	R	M	R	R	S	R	S	R	R	*Lr20+*
89	MACS 5031	S	MS	R	R	R	R	R	R	R	R	R	R	R	R	S	R	R	S	R	R	S	R	S	R	R	
90	DDK 1046	S	R	R	R	MS	R	R	R	R	R	R	R	R	R	R	R	R	S	MS	R	S	R	S	R	R	*Lr20+*
91	DDK 1044	S	R	R	R	MS	R	R	R	R	R	R	R	R	R	R	R	R	S	R	R	R	R	S	R	R	
92	HW 1099	R	R	R	R	R	R	R	R	R	R	R	R	R	R	MS	R	R	S	MS	R	R	R	S	R	R	*Lr13+10+*
VIII. SPECIAL TRIAL (TRITICALE)																										
93	TL 2996	R	MS	R	R	S	MS	S	S	R	S	R	S	R	S	S	S	S	S	R	R	R	S	R	S	MS	
94	TL 2997	R	R	R	R	S	S	S	S	R	S	S	NG	MS	S	R	R	S	S	R	S	R	MX	R	S	NG	*Lr13+*
95	TL 2998	R	R	R	R	MS	MS	R	S	R	R	R	R	R	R	S	R	MS	R	R	R	R	R	R	MS	R	*Lr13+*
96	TL 2999	R	R	R	R	R	R	R	R	R	R	R	MS	R	R	MS	R	S	R	R	R	MS	R	R	S	R	
97	TL 3000	R	R	R	R	R	NG	R	R	R	R	R	S	R	R	R	R	R	R	R	R	R	R	R	R	R	-
98	TL 2942 (C)	R	R	R	R	R	R	R	S	R	MS	R	S	R	MS	R	R	R	R	R	R	R	R	R	R	R	
99	TL 2969 (C)	R	R	R	R	R	R	R	R	R	MS	R	S	R	R	R	R	S	R	R	R	R	R	R	R	R	*Lr23+*
IV. SPECIAL TRIAL (MABB/NIL ENTRIES)																										
100	PBW 722	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R
101	PBW 723	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R
102	KB 2012-03	R	R	R	R	S	S	S	R	R	S	MS	R	R	S	S	R	S	MS	S	S	R	R	R	R	R	*Lr23+*
103	HD 2932+Sr26	R	R	S	S	S	MS	S	S	S	S	S	S	S	S	S	S	S	S	S	S	M	S	R	S	R	*Lr3+*
104	HD 2932-Lr19/Sr25	R	R	R	R	R	R	R	R	R	R	R	R	S	R	R	R	R	R	R	R	R	R	R	R	R	*Lr19+*
105	MMBL 283	R	R	S	S	S	S	S	R	R	S	S	S	M	S	S	MS	S	S	S	S	R	R	R	MS	R	*Lr13+*
106	HUW 234 (C)	R	R	S	S	S	S	S	R	S	S	S	S	R	S	S	S	S	S	S	S	R	R	MS	S	R	*Lr14a+*
107	PBW 343 (C)	R	R	R	R	R	MS	R	M	R	R	MS	R	R	S	S	R	S	S	S	S	R	R	R	R	R	*Lr26+*

Annexure VI : Seedling Resistance Test of AVT I against pathotypes of black rust (*Puccinia graminis tritici*) at Shimla during 2013-14

S. No.	Variety	Pathotypes														GENES
		11	11A	24A	34-1	40A	40-1	40-3	117-1	117-2	117-3	117-5	117-6	184	295	
1	HPW 373	R	R	R	R	S	R	S	R	R	R	R	R	R	S	*Sr*11+
2	HPW 400	R	R	R	R	MS	R	S	R	R	R	R	R	R	R	*Sr*9b+11+
3	HPW 401	R	R	R	R	R	-	R	R	R	R	R	R	R	R	R
4	HPW 410	R	R	R	R	R	NG	R	R	R	R	R	R	R	R	R
5	HPW 411	R	S	NG	R	MR	-	R	-	R	R	R	R	R	S	*Sr*2+13++
6	HPW 412	R	R	R	R	R	R	R	R	R	R	R	R	R	R	*Sr*31+
7	HS 547	R	R	R	R	R	-	R	R	R	R	R	R	R	R	R
8	HS 558	R	R	R	R	MR	MX	S	R	R	R	R	R	R	S	*Sr*9b+11+
9	HS 562	R	MX	R	R	S	R	S	R	S	R	R	R	R	S	*Sr*5+8a+9b+11+
10	HS 577	MS	R	R	R	S	-	MR	R	R	R	R	R	R	MX	*Sr*2+7b+11+
11	HS 590	S	S	R	MR	S	-	S	R	MX	R	R	R	R	S	*Sr*7b+
12	HS 591	S	R	R	R	S	-	S	R	MX	R	R	R	R	R	*Sr*2+7b+11+
13	HS 592	R	R	R	R	S	-	S	R	MX	R	R	R	R	S	*Sr*9b+11+
14	HS 593	R	MR	R	MX	MS	-	MS	R	R	R	R	R	R	R	*Sr*7b+
15	HS 594	S	MS	R	R	S	-	S	R	MX	R	R	R	MX	S	*Sr*2+7b+
16	HS 595	S	R	NG	R	MS	-	S	R	R	R	R	R	R	S	*Sr*2+9b+11+
17	UP 2890	S	S	R	MX	MX	MX	R	R	R	MX	R	R	R	MX	*Sr*7b+
18	UP 2891	R	R	R	R	R	-	R	R	R	R	R	R	R	R	*Sr*2+R
19	VL 976	R	NG	R	NG	R	-	R	R	R	R	R	R	R	R	*Sr*2+31+
20	VL 977	R	R	R	R	R	-	R	R	R	R	R	R	R	R	*Sr*31+
21	VL 1003	R	R	R	R	R	R	R	R	R	R	R	R	R	R	*Sr*31+
22	VL 1004	R	R	R	R	S	-	S	R	R	MX	R	R	R	S	*Sr*2+9b+11+
23	VL 3002	S	MR	R	R	R	-	R	R	R	R	R	R	R	R	*Sr*2+13+
24	VL 3004	R	R	R	R	R	-	R	R	R	R	R	R	R	R	*Sr*31+
25	VL 3005	R	MX	R	R	MS	R	MS	R	R	R	R	R	R	S	*Sr*2+9b+11+
26	**VL 3006**	S	MX	R	R	MS	-	S	R	R	R	R	R	R	MX	*Sr*2+7b+
II. NORTH WESTERN PLAIN ZONE																
27	DBW 95	MR	R	R	R	S	-	S	R	MX	R	R	R	R	S	*Sr*2+9b+11+
28	DBW 128	S	R	R	R	S	R	S	R	R	R	R	R	R	S	*Sr*9b+11+
29	DBW 129	MR	MX	R	R	S	-	S	R	MX	R	R	R	R	S	*Sr*2+7b
30	HD 3128	R	R	R	R	R	-	R	R	R	R	R	R	R	R	*Sr*2+31+
31	HD 3132	S	MR	R	R	MR	-	MS	R	R	R	R	R	R	S	*Sr*7b+
32	HD 3133	R	R	R	R	R	R	R	R	R	R	R	R	R	R	*Sr*2+31
33	HD 3139	S	MS	R	MX	S	-	S	R	R	R	R	R	R	S	*Sr*2+7b
34	HD 4730	R	R	S	R	MX	R	R	R	R	S	R	MX	R	R	*Sr*2+11+
35	HUW 675	S	R	R	R	R	-	MX	R	R	R	R	R	R	R	*S*11+13+
36	K 1204	MR	R	R	R	R	R	R	R	MX	R	R	R	R	R	*Sr*2+11+
37	MP 1277	R	R	R	R	S	R	S	R	R	MS	R	MR	R	S	*Sr*7b+11+
38	PBW 677	R	R	R	R	S	R	S	R	S	R	R	R	R	S	*Sr*9b+11+

S. No.	Variety	Pathotypes														GENES
		11	11A	24A	34-1	40A	40-1	40-3	117-1	117-2	117-3	117-5	117-6	184	295	
39	PBW 692	S	R	R	R	R	R	S	R	R	MX	R	R	R	MS	*Sr*2+9b+11
40	PBW 695	MS	R	R	R	MS	R	S	R	MX	R	R	R	R	S	*Sr*2+9b+11+
41	PBW 697	S	MX	R	R	MR	-	S	R	R	R	R	R	R	S	*Sr*2+9b+11+
42	PBW 698	R	MX	R	R	R	R	S	R	R	R	R	R	R	MS	*Sr*2+9b+11+
43	PBW 702	MX	R	R	R	MR	R	MX	R	R	R	R	R	R	MR	*Sr*9b+11+
44	PBW 703	R	R	R	R	R	R	MX	R	R	R	R	R	R	R	R
45	PBW 706	R	R	R	R	S	-	MS	R	R	R	R	R	R	MS	*Sr*9b+11+
46	TL 2995	R	R	R	NG	R	R	R	R	R	R	R	R	R	R	-
47	UAS 356	MR	R	R	R	S	-	S	R	R	R	R	R	R	MS	*Sr*9b+11+
48	WH 1154	MX	R	R	R	MX	-	MS	R	S	MS	R	S	R	S	*Sr*2+11+13+
49	WH 1156	S	MX	R	R	S	-	S	R	MS	R	R	R	R	S	*Sr*9b+11+
50	WH 1157	S	R	R	R	S	R	S	R	MX	R	R	R	R	S	*Sr*2+9b+11+
51	WH 1164	R	R	R	R	R	-	S	R	R	R	R	R	R	R	*Sr*2+8a+13
III. NORTH EASTERN PLAIN ZONE																
52	DBW 126	R	MR	R	R	MR	-	S	R	S	R	R	R	R	MR	*Sr*7b+5
53	DBW 98	MX	MX	R	R	MS	-	S	R	S	MS	MS	S	R	S	*Sr*7b+
54	HD 3127	MR	S	R	R	S	-	S	R	R	R	R	R	MX	S	*Sr*7b+
55	HUW 661	S	R	R	R	R	-	R	R	R	R	R	NG	R	R	*Sr*30+
56	HUW 677	R	R	R	R	R	-	R	R	R	R	R	NG	R	R	*Sr*2+
57	HUW 679	R	R	R	R	R	MX	R	R	R	R	R	NG	R	R	*Sr*31+
58	PBW 693	R	R	R	R	R	-	R	R	R	R	R	NG	R	R	*Sr*31+
59	PBW 701	R	R	R	R	R	-	R	R	R	R	R	R	R	R	*Sr*31+
60	PBW 704	R	R	R	R	R	-	R	R	R	R	R	R	R	R	-
61	UP 2855	R	R	R	R	R	-	R	R	R	R	R	R	R	R	*Sr*31+
62	WH 1132	S	MX	R	R	MR	-	R	R	S	S	R	MX	R	S	*Sr*7b+
IV. CENTRAL ZONE																
63	CG 1010	R	R	R	R	R	R	R	R	R	R	R	R	R	S	*Sr*2+
64	DDW 30 (D)	R	R	S	NG	R	-	MS	S	R	MS	R	R	S	R	*Sr*2+11+
65	GW 451	R	MR	R	R	R	-	R	R	R	R	R	R	R	S	*Sr*2+7b
66	GW 455	R	R	R	MR	MS	-	R	R	R	R	R	R	R	R	*Sr*7b+
67	HD 3146	R	R	R	R	R	-	R	R	R	R	R	R	R	R	*Sr*31+
68	HD 4728 (D)	R	R	S	R	R	-	R	S	R	MX	R	NG	MS	MX	*Sr*11+
69	HI 8750 (D)	S	R	S	R	R	-	R	MR	R	S	R	R	R	R	*Sr*11+
70	HI 8755 (D)	MS	S	S	R	R	-	MS	MX	R	R	R	S	MR	R	*Sr*2+13+
71	K 1215	MS	R	R	R	R	-	S	R	R	MR	R	R	R	MX	*Sr*13+
72	K 1217	R	R	R	R	R	-	R	R	R	R	R	R	MR	R	*Sr*5+31+
73	MACS 3916 (D)	R	NG	MS	R	R	-	MS	S	R	MX	R	R	MX	R	*Sr*11+
74	MACS 3927 (D)	S	R	S	R	S	-	MR	S	MX	MR	R	MX	MX	MX	*Sr*11+
75	MACS 6604	MR	R	R	R	R	-	R	R	R	R	R	R	R	MX	*Sr*5+8a+13+
76	MP 1279	S	R	R	R	R	R	R	R	R	R	R	R	R	MX	*Sr*11+13+

S. No.	Variety	Pathotypes														GENES
		11	11A	24A	34-1	40A	40-1	40-3	117-1	117-2	117-3	117-5	117-6	184	295	
77	NIAW 2030	R	R	R	R	R	S	R	R	R	R	S	R	R	R	*Sr*11+
78	UAS 451 (D)	R	R	MR	R	R	R	R	S	R	S	R	MX	S	R	*Sr*11+
V. PENINSULAR ZONE																
79	DDW 27 (D)	R	R	S	R	MR	R	R	S	R	MS	R	R	MR	MS	*Sr*2+11+
80	HI 8751 (D)	R	R	MS	R	R	R	R	S	R	R	R	MS	MX	R	*Sr*2+11+
81	HI 8754 (D)	R	R	MR	R	MS	R	S	S	R	R	R	R	S	R	*Sr*2+11+
82	K 1213	R	R	R	R	R	R	S	R	R	R	R	R	MR	R	*Sr*8a+11+13+
83	UP 2864	R	R	R	R	R	-	R	R	R	R	R	R	R	R	*Sr*2+5+8a+31+
VI. SOUTHERN HILLS ZONE																
84	MACS 6507	R	R	R	R	R	R	MR	R	R	R	R	R	R	R	*Sr*8a+11+
85	UAS 358	R	R	R	R	MR	R	R	R	R	R	R	R	R	R	*Sr*31+
VII. SPECIAL TRIAL (Dicoccum and Sailinity and Alkalinity)																
86	DBW 154	R	R	R	R	MX	R	R	R	R	R	R	R	R	R	*Sr*31+
87	DBW 155	MR	R	R	R	S	R	S	R	R	R	R	NG	R	S	*Sr*11+
88	MACS 5040	MR	R	S	R	R	R	MS	MS	R	R	R	R	MR	R	*Sr*11+
89	MACS 5031	S	MX	S	R	R	R	MS	MR	R	R	R	S	R	R	*Sr*11+
90	DDK 1046	R	R	MS	R	MS	R	MR	R	R	R	R	S	R	R	*Sr*11+
91	DDK 1044	R	R	R	R	MR	-	R	R	R	R	R	MR	MS	R	*Sr*9e+
92	HW 1099	R	R	MS	MX	R	R	MS	R	R	R	R	R	S	R	*Sr*11+
VIII. SPECIAL TRIAL (TRITICALE)																
93	TL 2996	R	R	R	NG	MR	-	R	R	R	MX	R	R	R	MS	*Sr*11+
94	TL 2997	R	R	R	R	R	R	R	R	S	R	R	R	R	R	-
95	TL 2998	R	MX	R	R	R	-	R	R	R	R	R	R	R	R	R
96	TL 2999	R	MX	R	R	R	-	R	R	R	R	R	R	R	R	*Sr*2+R
97	TL 3000	R	MX	R	R	R	-	R	R	R	R	R	R	NG	R	*Sr*2+R
98	TL 2942 (C)	R	R	R	R	R	R	R	R	R	R	R	R	R	MR	*Sr*2+R
99	TL 2969 (C)	R	R	R	R	R	R	R	R	R	R	R	R	MX	R	*Sr*2+R
IV. SPECIAL TRIAL (MABB/NIL ENTRIES)																
100	PBW 722	MR	MX	R	R	MS	-	S	R	R	R	R	R	R	MX	*Sr*2+11+13+
101	PBW 723	R	R	R	R	R	-	R	R	R	R	R	R	R	R	*Sr*2+R
102	KB 2012-03	S	R	R	R	MR	-	MR	R	R	MX	R	R	R	S	*Sr*11+13+
103	HD 2932+Sr26	R	R	R	R	R	-	R	R	R	R	R	R	R	R	*Sr*26+
104	HD 2932-Lr19/Sr25	R	NG	R	R	R	R	R	R	R	R	R	R	R	R	*Sr*2+25+
105	MMBL 283	S	MX	R	MX	MS	-	S	MR	MX	MR	R	S	MR	S	*Sr*11+
106	HUW 234 (C)	S	MX	R	MX	MR	S	MS	MR	R	MX	R	S	R	S	*Sr*11+
107	PBW 343 (C)	R	R	R	R	R	R	R	R	R	R	R	R	R	R	*Sr*2+31+

Annexure VII: Seedling Resistance Test of AVT I against pathotypes of yellow rust (*Puccinia striiformis*) at Shimla during 2013-14

S. No.	Variety	Pathotypes														
		78S84	46S119	K	T	P	31	38A	L	14A	I	A	20A	N	13	GENES
1	HPW 373	R	S	R	MS	MX	R	R	R	R	R	R	R	R	R	*Yr*A+
2	HPW 400	S	S	S	S	R	R	R	R	S	R	R	R	R	MS	*Yr*2+
3	HPW 401	S	S	R	S	MR	R	R	R	R	R	R	R	R	R	*Yr*2+
4	HPW 410	S	MS	NG	R	R	R	NG	R	R	R	R	R	R	R	*Yr*2+
5	HPW 411	R	R	R	R	R	NG	R	R	R	R	R	R	R	R	R
6	HPW 412	R	S	R	R	R	R	R	R	R	R	R	R	R	R	*Yr*9+A+
7	HS 547	S	S	R	R	R	R	R	R	R	R	R	R	R	R	*Yr*2+
8	HS 558	R	S	MS	MS	S	S	R	MX	S	R	R	MS	R	S	*Yr*2+
9	HS 562	R	S	R	S	S	R	R	R	R	R	R	R	R	S	*Yr*A+
10	HS 577	MS	MS	R	R	R	R	R	R	S	R	R	R	S	R	*Yr*2+
11	HS 590	R	MS	R	R	R	R	R	R	R	R	R	R	R	R	*Yr*A+
12	HS 591	R	R	R	R	R	R	R	R	R	R	R	R	R	R	-
13	HS 592	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R
14	HS 593	R	R	R	R	R	R	R	R	R	R	R	R	R	MS	R
15	HS 594	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R
16	HS 595	R	R	R	R	R	R	R	R	R	R	R	R	MR	R	*Yr*2+
17	UP 2890	S	MS	R	S	S	R	R	R	R	R	R	S	R	S	*Yr*2+
18	UP 2891	R	MS	R	S	S	MS	R	R	S	R	R	R	R	R	*Yr*A+
19	VL 976	S	S	R	R	R	R	R	R	R	R	R	R	R	NG	*Yr*9+
20	VL 977	R	R	R	R	R	R	R	R	R	R	R	R	R	R	*Yr*9+R
21	VL 1003	R	R	R	R	R	R	R	R	R	R	R	R	R	R	*Yr*9+R
22	VL 1004	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R
23	VL 3002	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R
24	VL 3004	R	S	R	R	R	R	R	R	R	R	R	R	R	R	*Yr*9+A+
25	VL 3005	R	MS	R	MR	R	R	R	R	R	R	R	R	R	R	*Yr*A+
26	VL 3006	S	MS	R	R	R	R	R	R	R	R	R	R	R	NG	*Yr*2+
II. NORTH WESTERN PLAIN ZONE																
27	DBW 95	MS	R	R	R	R	R	R	R	R	R	R	S	R	R	*Yr*2+
28	DBW 128	S	S	S	R	S	S	S	S	S	R	S	S	S	R	*Yr*2+
29	DBW 129	R	S	R	R	S	R	R	R	R	R	R	R	R	R	*Yr*A+
30	HD 3128	R	R	R	R	R	R	R	R	R	R	R	R	R	R	*Yr*9+R
31	HD 3132	R	MS	R	R	R	R	R	R	R	R	R	R	R	R	*Yr*A+
32	HD 3133	S	S	R	R	R	R	R	R	R	R	R	R	R	R	*Yr*9+
33	HD 3139	S	S	R	MS	S	R	R	R	R	R	R	R	R	MS	*Yr*2+
34	HD 4730	S	MS	R	MS	MS	R	R	R	R	R	R	R	MS	R	*Yr*2+
35	HUW 675	R	R	R	R	R	R	R	R	R	R	R	R	R	NG	R
36	K 1204	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R
37	MP 1277	S	S	S	R	S	R	S	R	S	R	R	S	R	R	*Yr*2+
38	PBW 677	S	S	R	R	S	R	R	R	MS	R	R	S	R	R	*Yr*2+
39	PBW 692	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R

S. No.	Variety	Pathotypes														
		78S84	46S119	K	T	P	31	38A	L	14A	I	A	20A	N	13	GENES
40	PBW 695	S	S	R	R	S	R	R	R	S	R	R	S	R	R	Yr2+
41	PBW 697	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R
42	PBW 698	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R
43	PBW 702	R	R	R	NG	R	R	R	R	R	R	NG	R	R	R	R
44	PBW 703	R	R	R	R	R	R	NG	R	R	R	NG	R	R	R	R
45	PBW 706	R	R	R	R	S	R	R	R	R	R	R	R	R	R	-
46	TL 2995	R	S	R	R	R	R	R	R	R	R	R	R	R	R	YrA+
47	UAS 356	MS	MS	R	R	R	R	R	R	R	R	R	R	R	R	Yr2+
48	WH 1154	S	S	R	R	S	R	R	R	S	R	R	R	R	R	Yr2+
49	WH 1156	R	S	R	MS	S	R	R	R	R	R	MS	MS	R	R	YrA+
50	WH 1157	MS	S	R	S	S	R	NG	R	R	NG	R	MS	R	R	Yr2+
51	WH 1164	MR	S	R	R	S	R	R	R	R	R	R	NG	R	NG	Yr2+
III. NORTH EASTERN PLAIN ZONE																
52	DBW 126	R	MS	R	R	R	R	R	R	R	R	R	R	R	R	YrA+
53	DBW 98	R	S	R	R	S	R	R	R	MS	R	NG	R	R	R	YrA+
54	HD 3127	S	R	R	S	R	R	R	R	R	R	R	MS	S	R	Yr2+
55	HUW 661	S	S	R	R	S	R	NG	MS	MS	NG	R	R	NG	R	Yr2+
56	HUW 677	R	R	R	R	S	R	R	R	S	R	R	MS	R	NG	Yr2+
57	HUW 679	S	S	R	R	R	R	NG	R	R	R	R	NG	R	NG	Yr9+
58	PBW 693	R	R	R	R	R	R	R	R	R	NG	R	R	R	R	Yr9+R
59	PBW 701	R	R	R	R	R	R	R	R	R	R	R	R	R	R	Yr9+R
60	PBW 704	S	R	R	R	R	R	R	R	R	R	R	R	R	R	Yr2+27+
61	UP 2855	S	S	R	R	R	R	R	R	R	R	R	R	R	R	Yr9+
62	WH 1132	MS	S	R	R	S	R	R	R	R	R	R	R	R	R	Yr2+
IV. CENTRAL ZONE																
63	CG 1010	S	S	R	R	S	R	R	R	R	R	R	R	R	S	Yr2+
64	DDW 30 (D)	MS	R	S	R	MS	R	S	MS	MS	R	R	R	R	R	Yr2+
65	GW 451	MS	S	R	S	R	R	MS	R	S	R	NG	R	R	MS	Yr2+
66	GW 455	R	MS	R	R	MS	R	R	R	R	R	R	R	R	R	Yr2+
67	HD 3146	S	R	R	R	R	R	R	R	R	R	R	R	R	R	Yr9+
68	HD 4728 (D)	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R
69	HI 8750 (D)	S	S	S	R	S	S	S	S	S	S	NG	R	S	MS	-
70	HI 8755 (D)	MR	R	R	R	MS	R	R	R	S	S	R	S	R	MS	Yr2+
71	K 1215	S	S	R	R	S	R	R	R	R	R	NG	S	MS	S	Yr2+
72	K 1217	MS	R	R	R	R	R	R	R	R	R	R	R	R	R	Yr9+
73	MACS 3916 (D)	R	S	R	R	R	R	R	R	MS	NG	R	R	R	R	Yr2+
74	MACS 3927 (D)	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R
75	MACS 6604	S	S	R	R	S	R	R	S	R	R	R	MS	R	MR	Yr2+
76	MP 1279	S	S	MS	R	S	R	R	R	R	R	R	R	MS	S	Yr2+
77	NIAW 2030	S	S	R	S	S	R	R	R	R	R	R	S	S	S	Yr2+
78	UAS 451 (D)	R	S	S	R	S	R	R	R	S	R	NG	R	R	MS	YrA+
V. PENINSULAR ZONE																

S. No.	Variety	Pathotypes														
		78S84	46S119	K	T	P	31	38A	L	14A	I	A	20A	N	13	GENES
79	DDW 27 (D)	MS	R	MS	R	R	R	R	R	S	R	R	R	R	R	*Yr2+*
80	HI 8751 (D)	MR	R	MS	R	MX	S	R	MS	S	R	R	R	R	R	-
81	HI 8754 (D)	S	S	S	S	S	S	R	S	S	S	R	R	S	R	*Yr2+*
82	K 1213	S	S	MS	R	S	MS	MS	S	S	MS	NG	S	R	MS	*Yr2+*
83	UP 2864	MS	S	R	R	R	R	R	R	R	NG	R	R	R	R	*Yr9+*
VI. SOUTHERN HILLS ZONE																
84	MACS 6507	R	S	R	R	R	R	R	R	R	R	R	R	R	MS	*Yr2+*
85	UAS 358	R	S	R	R	R	R	R	R	R	R	R	R	R	R	*Yr9+A+*
VII. SPECIAL TRIAL (Dicoccum and Sailinity and Alkalinity)																
86	DBW 154	MS	MS	R	R	R	R	R	R	R	R	R	R	R	R	*Yr9+*
87	DBW 155	S	R	S	R	R	S	R	R	R	R	R	R	R	R	*Yr2+*
88	MACS 5040	S	S	R	S	S	R	R	R	R	R	R	MS	R	S	*Yr2+*
89	MACS 5031	MS	R	S	S	S	MR	R	S	S	S	S	S	MS	R	-
90	DDK 1046	S	MR	R	R	MS	R	MS	S	S	R	R	R	S	MS	*Yr2+*
91	DDK 1044	S	MS	MS	S	S	S	S	S	S	S	S	S	S	S	-
92	HW 1099	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R
VIII. SPECIAL TRIAL (TRITICALE)																
93	TL 2996	MS	S	R	NG	R	R	R	R	R	R	R	R	R	NG	-
94	TL 2997	MS	S	S	R	R	MS	MS	MS	S	MS	R	S	R	NG	-
95	TL 2998	R	S	R	R	S	R	R	R	R	R	R	R	R	R	-
96	TL 2999	S	S	R	R	R	R	R	R	R	R	R	R	R	R	-
97	TL 3000	MS	S	R	R	S	R	R	R	R	R	R	R	R	MR	-
98	TL 2942 (C)	R	S	MS	S	R	R	R	R	R	R	R	R	R	R	-
99	TL 2969 (C)	MR	S	R	R	S	R	R	R	S	R	S	R	R	R	-
IV. SPECIAL TRIAL (MABB/NIL ENTRIES)																
100	PBW 722	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R
101	PBW 723	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R
102	KB 2012-03	S	S	R	R	R	R	R	R	R	R	R	R	R	R	*Yr2+*
103	HD 2932+Sr26	S	S	R	S	S	R	S	R	S	R	R	R	R	S	*Yr2+*
104	HD 2932-Lr19/Sr25	S	MR	R	NG	R	R	R	R	R	R	R	R	R	R	*Yr2+*
105	MMBL 283	S	S	MS	S	R	MS	MR	MX	S	MS	R	S	R	NG	*Yr2+*
106	HUW 234 (C)	S	S	S	S	S	R	S	MS	S	S	R	S	R	R	*Yr2+*
107	PBW 343 (C)	S	R	R	R	R	R	R	R	R	R	R	R	R	R	*Yr9+27+*

Annexure VIII: Seedling Resistance Test of AVTII against pathotypes of brown rust (*Puccinia triticina*) at Mahabaleshwar during 2013-14

Sr. No.	AVT II Genotypes	Reaction again Stem rust pathotypes of leaf rust											
		77-2	77-3	77-4	77-5	104-1	104-3	104A	104B	12-1	12-2	12-4	162-1
CENTRAL ZONE													
1	DBW 110	R	R	R	R	R	R	R	R	R	R	R	R
2	HI 8736(D)	S	S	S	S	R	S	R	R	R	S	R	R
3	HI 8737(D)	S	R	R	S	R	R	R	R	R	R	R	S
4	MP 3382	R	R	R	R	R	R	R	R	R	R	R	S
5	NIAW 1885	R	R	R	R	R	R	R	R	R	R	R	R
6	PBW 689	R	R	R	R	R	R	R	R	R	R	R	R
7	A 9-30-1(D) (C)	S	S	S	S	R	S	R	R	R	S	R	R
8	GW 322(C)	R	R	R	R	R	R	R	S	R	R	R	R
9	HD 2864(C)	R	R	R	R	R	R	R	R	R	R	R	R
10	HD 2932(C)	S	R	R	R	R	S	R	R	R	R	R	S
11	HI 1500(C)	R	R	R	R	R	R	R	R	R	R	R	R
12	HI 1544(C)	R	R	R	R	R	R	R	R	R	R	R	R
13	HI 8498(D) (C)	R	R	R	R	R	R	R	R	R	S	R	R
14	HI 8627 (D) (C)	S	R	S	S	R	R	R	R	R	S	R	R
15	MP 3288(C)	R	R	R	R	R	R	R	R	R	R	R	R
16	MP 3336(C)	S	R	R	R	R	R	R	R	R	R	R	S
17	MP 4010(C)	R	R	R	R	R	R	R	R	R	R	R	R
18	MPO 1215(d) (C)	R	R	R	R	R	R	R	R	R	R	R	R
PENINSULAR ZONE													
19	NIAW 1994	R	R	R	R	R	R	R	R	R	R	R	R
20	UAS 347	R	R	R	R	R	R	R	R	R	R	R	R
21	UAS 446(D)	R	R	R	R	R	R	R	R	R	R	R	R
22	AKDW 2997-16 (d) (C)	S	R	R	R	R	R	R	R	R	R	R	R
23	HD 3090(1) (C)	R	R	R	R	R	R	R	R	R	R	R	R
24	MACS 6222(C)	R	R	R	R	R	R	R	R	R	R	R	R
25	MACS 6478(C)	R	R	R	R	R	R	R	R	R	R	R	R
26	NI 5439(C)	S	S	S	S	R	S	R	R	R	S	R	R
27	NIAW 1415(C)	R	R	R	R	R	R	R	R	R	R	R	R
28	NIDW 295(d) (C)	R	R	R	R	R	R	R	R	R	R	R	R
29	Raj 4083(C)	R	R	R	R	R	R	R	R	R	R	R	R
30	UAS 428 (d) (c)	R	R	R	R	R	S	R	R	R	R	R	R

Annexure IX: Seedling Resistance Test of AVT II against pathotypes of black rust (*Puccinia graminis tritici*) at Mahabaleshwar during 2013-14

Sr. No.	AVT II genotypes	Reaction against pathotypes of Stem rust							
		R 11	R 117-6	R 40A	R 122	R 117	R 117-1	R 117-3	R 117-4
Central Zone									
1	DBW 110	R	R	R	R	R	R	R	R
2	HI 8736(D)	R	NG	NG	NG	NG	NG	NG	NG
3	HI 8737(D)	R	R	R	R	R	R	R	R
4	MP 3382	R	R	R	R	R	R	R	R
5	NIAW 1885	R	R	R	R	R	R	R	R
6	PBW 689	R	S	R	S	S	R	S	R
7	A 9-30-1(D) (C)	S	R	S	S	R	S	S	R
8	GW 322(C)	R	R	R	R	R	R	R	R
9	HD 2864(C)	R	R	R	R	R	R	R	R
10	HD 2932(C)	R	S	S	S	S	S	S	S
11	HI 1500(C)	R	R	R	R	R	R	R	R
12	HI 1544(C)	R	R	R	R	R	R	R	R
13	HI 8498(D) (C)	R	R	R	R	R	R	R	R
14	HI 8627 (D) (C)	R	R	R	R	R	R	R	R
15	MP 3288(C)	R	R	R	R	R	R	R	R
16	MP 3336(C)	R	R	R	R	R	R	R	R
17	MP 4010(C)	R	R	R	R	R	R	R	R
18	MPO 1215(d) (C)	R	R	R	R	R	R	R	R
Peninsular Zone									
19	NIAW 1994	R	R	R	R	R	R	R	R
20	UAS 347	S	S	R	R	S	R	R	R
21	UAS 446(D)	NG	NG	NG	NG	NG	NG	NG	NG
22	AKDW 2997 16 (d) (c)	R	R	R	R	R	R	R	R
23	HD 3090(1) (C)	R	S	S	S	S	S	S	S
24	MACS 6222(C)	R	R	R	R	R	R	R	R
25	MACS 6478(C)	R	R	R	R	R	R	R	R
26	NI 5439(C)	S	S	S	S	S	R	R	R
27	NIAW 1415(C)	R	R	R	R	R	R	R	R
28	NIDW 295(d) (C)	R	R	R	R	R	R	R	R
29	Raj 4083(C)	R		R	R	R	R	R	R
30	UAS 428(d) (C)	NG	NG	NG	NG	NG	NG	NG	NG

R : Resistant; S : Susceptible; NG : Not Germinated

Pathotypes : R 11 (79G31); R 117-6 (37G19); R 40A (62G29); R 122 (7G11); R 117 (37G3); R 117-1 (166G2); R 117-3 (167G3); R 177-4 (166G3)

Annexure X: Seedling Resistance Test of AVT I against pathotypes of brown rust (*Puccinia triticina*) at Mahabaleshwar during 2013-14

Sr. No.	AVT I Genotypes	Reaction against pathotypes of leaf rust											
		77-2	77-3	77-4	77-5	104-1	104-3	104A	104B	12-1	12-2	12-4	162-1
CENTRAL ZONE													
1	CG 1010	R	R	R	S	R	S	R	R	R	R	R	S
2	DDW 30(D)	R	R	R	R	R	R	R	R	R	R	R	R
3	GW 451	S	S	S	S	R	S	R	R	R	S	R	S
4	GW 455	R	R	R	R	R	R	R	R	R	R	R	R
5	HD 3146	R	R	R	R	R	R	R	R	R	R	R	R
6	HD 4728(D)	S	S	R	S	R	S	R	S	R	R	R	R
7	HI 8750(D)	R	R	R	R	R	R	R	R	R	R	R	R
8	HI 8755(D)	S	R	R	S	R	S	R	R	R	R	R	S
9	K 1215	S	R	S	S	R	S	R	R	R	S	R	S
10	K 1217	R	R	R	R	R	R	R	R	R	R	R	S
11	MACS 3916(D)	S	R	S	S	R	S	R	R	R	S	R	S
12	MACS 3927(D)	S	R	S	R	R	S	R	R	R	S	R	R
13	MACS 6604	R	R	R	R	R	R	R	R	R	R	R	R
14	MP 1279	S	R	S	S	R	S	R	R	R	S	R	S
15	NIAW 2030	R	R	R	S	R	R	R	R	R	S	R	R
16	UAS 451 (D)	S	R	R	R	R	R	R	R	R	R	R	S
PENINSULAR ZONE													
17	DDW 27(D)	S	S	S	S	R	S	R	R	R	S	R	S
18	HI 8751(D)	R	R	R	R	R	R	R	R	R	R	R	R
19	HI 8754(D)	S	S	R	S	R	S	R	S	R	R	R	S
20	K 1213	R	R	R	S	R	S	R	R	R	R	R	R
21	UP 2864	R	R	R	R	R	S	R	R	R	R	R	R

Annexure XI : Seedling Resistance Test of AVT I against pathotypes of black rust (*Puccinia graminis tritici*) at Mahabaleshwar during 2013-14

Sr. No.	AVT I genotypes	Reaction against pathotypes of Stem rust							
		R 11	R 117-6	R 40A	R 122	R 117	R 117-1	R 117-3	R 117-4
Central Zone									
1	CG 1010	R	R	S	R	S	S	R	R
2	DDW 30(D)	R	R	R	R	R	R	R	R
3	GW 451	R	R	R	R	R	R	R	R
4	GW 455	R	S	R	R	S	S	S	S
5	HD 3146	R	R	R	R	R	R	R	R
6	HD 4728(D)	R	R	R	R	R	R	R	R
7	HI 8750(D)	S	R	R	R	R	R	R	R
8	HI 8755(D)	S	R	S	S	R	S	S	S
9	K 1215	R	S	S	R	S	S	S	S
10	K 1217	R	R	R	R	R	R	R	R
11	MACS 3916(D)	R	R	R	R	R	R	R	R
12	MACS 3927(D)	S	R	S	S	R	S	S	S
13	MACS 6604	R	R	R	R	R	R	R	R
14	MP 1279	R	R	R	R	R	R	R	R
15	NIAW 2030	R	S	S	R	S	S	S	S
16	UAS 451 (D)	S	S	S	R	S	S	S	R
Peninsular zone									
17	DDW 27(D)	R	S	S	R	S	S	S	S
18	HI 8751(D)	R	R	R	R	R	R	R	R
19	HI 8754(D)	S	S	R	S	R	S	S	S
20	K 1213	R	S	S	S	S	S	S	S
21	UP 2864	R	R	R	R	R	R	R	R

R : Resistant; S : Susceptible

Pathotypes : R 11 (79G31); R 117-6 (37G19); R 40A (62G29); R 122 (7G11); R 117 (37G3); R 117-1 (166G2); R 117-3 (167G3); R 177-4 (166G3)

Annexure XII: Seedling Resistance Test of NIVT against pathotypes of brown rust (*Puccinia triticina*) at Mahabaleshwar during 2013-14

Sr. No.	NIVT Genotypes	Reaction against pathotypes of leaf rust											
		77-2	77-3	77-4	77-5	104-1	104-3	104A	104B	12-1	12-2	12-4	162-1
1	PDW 341	S	S	R	S	R	S	R	R	R	S	R	S
2	WHD 955	S	R	R	S	R	S	R	R	R	S	R	S
3	PDW 339	S	R	R	S	R	S	R	R	R	S	R	R
4	GW 1310	R	R	R	S	R	S	R	R	R	R	S	R
5	HI 8759	S	R	R	S	R	S	R	R	R	S	R	S
6	PDW 340	S	S	R	S	R	S	S	S	R	S	R	NG
7	HI 8761	S	R	R	R	R	S	R	R	R	S	R	R
8	UAS 452	S	R	R	S	R	R	R	R	R	R	R	R
9	RKD 280	S	R	R	S	R	S	R	S	R	S	R	S
10	HI 8757	S	R	R	S	R	S	R	R	R	S	R	R
11	MPO 1302	R	R	R	R	R	R	R	R	R	R	R	R
12	UAS 453	R	R	R	R	R	R	R	R	R	R	R	R
13	HI 8758	S	R	R	R	R	R	R	R	R	S	R	R
14	RKD 279	S	S	R	R	R	R	R	R	R	S	R	R
15	PBND 5128	S	R	R	S	R	S	R	R	R	S	R	S
16	NIDW 841	S	R	R	S	R	S	S	S	R	S	R	R
17	NIDW 842	R	R	R	R	R	R	R	R	R	R	R	R
18	HI 8760	S	R	R	R	R	S	R	R	R	S	R	R
19	HD 4732	R	R	R	R	R	R	R	R	R	R	R	R
20	UPD 96	S	R	R	R	R	R	R	R	R	S	R	R
21	PDW 342	S	R	R	R	R	R	R	R	R	S	R	S
22	HD 4731	S	R	R	R	R	S	R	R	R	S	R	R
23	GW 1311	R	R	R	R	R	R	R	R	R	R	R	R
24	HI 8498 (c)	S	R	R	R	R	S	R	R	R	R	R	R
25	hd 2967 (c)	R	R	R	R	R	R	R	R	R	R	R	R
26	MACS 4024	R	R	R	R	R	R	R	R	R	R	R	R
27	DDW 31	S	R	S	R	R	S	R	S	R	R	R	R
28	GW 1308	S	R	R	R	R	S	R	R	R	R	R	S
29	MACS 3949	R	R	R	R	R	S	R	R	R	R	R	S
30	WHD 956	S	R	R	S	R	R	R	R	R	R	R	R
31	NIDW 295 (c)	S	R	R	S	R	S	R	R	R	S	R	R
32	DDW 32	R	R	R	R	R	R	R	R	R	S	R	R
33	GW 1309	S	R	R	R	R	S	R	R	R	R	R	R
34	PBW 314 (c)	S	R	R	R	R	S	R	R	R	R	R	R
35	MPO 1301	S	R	R	R	R	S	R	R	R	R	R	R
36	MACS 4023	S	R	R	R	R	S	R	R	R	R	R	R

R: Resistant; S: Susceptible; NG: Not Germinated

Pathotypes : 77-2= 109R31-1, 77-3 = 125R55, 77-4=125R23-1, 104A=21R31, 77-5= 121R63-1, 104-1=21R31-1, 104-3 = 21R 63, 104B=29R23, 12-1 = 5R37, 12-2 = 1R5, 12-4 = 69R 13, 162-1 = 93R 47

Annexure X III: Seedling Resistance Test of NIVT against pathotypes of black rust (*Puccinia graminis tritici*) at Mahabaleshwar during 2013-14

Sr. No.	NIVT 4 genotypes	Reaction against pathotypes of Stem rust							
		R 11	R 117-6	R 40A	R 122	R 117	R 117-2	R 117-3	R 117-4
1	PDW 341	R	R	R	R	R	R	R	R
2	WHD 955	R	R	R	R	R	R	R	R
3	PDW 339	R	R	R	R	R	NG	R	R
4	GW 1310	R	R	R	R	R	R	R	R
5	HI 8759	R	R	NG	R	R	R	R	R
6	PDW 340	R	R	R	R	R	R	R	R
7	HI 8761	R	R	R	R	R	R	R	R
8	UAS 452	R	R	R	R	R	R	R	R
9	RKD 280	R	R	R	R	R	R	R	R
10	HI 8757	NG	R	R	R	NG	R	R	R
11	MPO 1302	R	R	R	R	R	R	R	R
12	UAS 453	R	R	R	R	R	R	R	R
13	HI 8758	R	R	R	R	R	R	R	R
14	RKD 279	R	R	R	R	NG	R	R	R
15	PBND 5128	S	R	R	S	R	R	R	R
16	NIDW 841	NG	R	R	S	R	R	R	R
17	NIDW 842	R	R	R	R	R	R	S	NG
18	HI 8760	R	S	NG	R	R	R	R	NG
19	HD 4732	R	R	R	R	R	R	R	R
20	UPD 96	R	R	R	R	NG	R	R	R
21	PDW 342	S	R	S	S	R	R	NG	R
22	HD 4731	NG	R	R	R	R	R	R	R
23	GW 1311	NG	NG	R	NG	R	R	R	NG
24	HI 8498 (c)	R	R	R	R	R	R	R	R
25	hd 2967 (c)	NG	R	NG	R	R	R	R	R
26	MACS 4024	R	R	NG	R	R	NG	R	NG
27	DDW 31	R	R	R	S	R	NG	R	R
28	GW 1308	R	R	R	NG	R	R	R	R
29	MACS 3949	R	R	R	NG	NG	R	R	R
30	WHD 956	NG	R	R	R	R	R	S	NG
31	NIDW 295 (c)	R	R	R	R	R	R	R	R
32	DDW 32	S	R	S	S	R	S	R	R
33	GW 1309	R	R	R	R	R	R	R	R
34	PBW 314 (c)	S	R	S	S	R	S	R	S
35	MPO 1301	R	R	R	NG	R	R	R	R
36	MACS 4023	R	R	R	R	R	NG	R	R

R : Resistant; S : Susceptible; NG : Not Germinated

Pathotypes : R 11 (79G31); R 117-6 (37G19); R 40A (62G29); R 122 (7G11); R 117 (37G3); R 117-1 (166G2); R 117-3 (167G3); R 177-4 (166G3)

Annexure XIV: AVTs entries evaluated under natural conditions for stripe rust at Yamunanagar (Haryana) and Langroya (Punjab) during 2013-14

S.No.	Variety	Langroya	Yamunanagar
AVT IInd Year 2013-14			
I. NORTHERN HILL ZONE			
1	HPW 376	10S	5S
2	VL 967	10S	0
3	HPW 251 (C)	60MS	5S
4	HPW 349 (C)	5MR	5S
5	HS 277 (C)	60S	5S
6	HS 375 (C)	40S	10S
7	HS 490 (C)	10S	5S
8	HS 507 (C)	5S	5S
9	HS 542 (I) (C)	10S	5S
10	VL 804 (C)	40MS	5S
11	VL 829 (C)	20S	5S
12	VL 892 (C)	40S	5S
13	VL 907 (C)	10S	5S
II. NORTH WESTERN PLAIN ZONE			
14	HUW 666	20S	10S
15	PBW 681	0	5S
16	WH 1129	20S	5S
17	WH 1138	5MS	5S
18	WH 1142	5MS	5S
19	DBW 88 (I) (C)	10S	5S
20	DBW 90 (I) (C)	TR	5S
20. A	INFECTOR	80S	40S
21	DPW 621-50 (C)	20MS	5S
22	HD 2967 (C)	-	20S
23	HD 3043 (C)	5S	5S
24	HD 3059 (C)	20S	0
25	HD 3086 (I) (C)	5S	5S
26	PBW 590 (C)	60S	5S
27	PBW 644 (C)	10S	5S
28	PBW 660 (I) (C)	TS	0
29	PDW 233 (C)	10MS	0
30	PDW 291 (C)	TR	0
31	PDW 314 (C)	5MR	5S
32	WH 1021 (C)	40S	5S
33	WH 1080 (C)	TS	5S
34	WH 1105 (C)	5S	5S
35	WH 1124 (I) (C)	0	10S
III. NORTH EASTERN PLAIN ZONE			
36	BRW 3723	60S	0
37	DBW 107	10S	5S
38	HD 3118	TS	10S
39	K 1114	60S	10S
40	C 306 (C)	40S	5S
40. A	INFECTOR	80S	20S
41	DBW 14 (C)	40MS	5S
42	DBW 39 (C)	60S	10S
43	HD 2733 (C)	80S	20S
44	HD 2888 (C)	20S	10S
45	HD 2985 (C)	40S	5S
46	HI 1563 (C)	40MS	5S
47	K 0307 (C)	40S	5S
48	K 1006 (I) (C)	40S	5S
49	K 8027 (C)	60S	10S
50	NW 2036 (C)	60S	10S
51	NW 5054 (I) (C)	10S	5S
IV. CENTRAL ZONE			
52	DBW 110	20S	5S
53	HI 8736 (D)	5MR	5S
54	HI 8737 (D)	10S	5S
55	MP 3382	40S	5S
56	NIAW 1885	60S	20S
57	PBW 689	20S	5S
58	A 9-30-1 (D) (C)	80S	60S
59	GW 322 (C)	60S	40S
60	HD 2864 (C)	60S	20S
60. A	INFECTOR	80S	20S
61	HD 2932 (C)	80S	5S
62	HI 1500 (C)	60S	5S
63	HI 1544 (C)	80S	5S
64	HI 8498 (D) (C)	10MS	5S
65	HI 8627 (D) (C)	10MS	5S
66	MP 3288 (C)	5MS	20S
67	MP 3336 (C)	40S	5S
68	MP 4010 (C)	80S	10S
69	MPO 1215 (d) (C)	10MS	5S
V. PENINSULAR ZONE			
70	NIAW 1994	60S	5S
71	UAS 347	20S	5S
72	UAS 446 (D)	0	0
73	AKDW 2997-16(d) (C)	0	20S
74	HD 3090 (I) (C)	60S	5S
75	MACS 6222 (C)	10S	5S
76	MACS 6478 (C)	40S	5S
77	NI 5439 (C)	80S	60S
78	NIAW 1415 (C)	60S	20S
79	NIDW 295 (d) (C)	5MS	5S
80	Raj 4083 (C)	20MS	5S
80. A	INFECTOR	80S	10S
81	UAS 428 (d) (C)	TS	5S
VI. SOUTHERN HILLS ZONE			
82	CoW(W) 1 (C)	60S	20S
83	HW 2044 (C)	40S	5S
84	HW 5216 (C)	60S	5S
VII. SPECIAL TRIAL			
85	DDK 1042	40S	20S
86	MACS 5022	60S	20S
87	DDK 1029 (C)	-	10S
88	HW 1098 (I) (C)	60S	10S
89	Kharchia 65 (C)	80S	60S
90	KRL 19 (C)	60S	20S
91	KRL 210 (C)	5MS	5S
92	MACS 2496 (C)	60S	20S
93	MACS 2971 (C)	60MS	20S
93. A	INFECTOR	80S	60S
AVT Ist Year 2013-14			
I. NORTHERN HILL ZONE			
1	HPW 373	0	5S
2	HPW 400	10MS	5S
3	HPW 401	10S	0
4	HPW 410	5MS	0
5	HPW 411	5MS	0
6	HPW 412	40MS	0
7	HS 547	20S	5S
8	HS 558	20S	0
9	HS 562	5MS	0
10	HS 577	20S	0
11	HS 590	5S	0
12	HS 591	10S	5S
13	HS 592	5S	0

S.No.	Variety	Langroya	Yamunanagar
14	HS 593	10MS	0
15	HS 594	10S	0
16	HS 595	20MS	0
17	UP 2890	60S	40S
18	UP 2891	60S	5S
19	VL 976	10S	5S
20	VL 977	20S	0
20. A	INFECTOR	80S	40S
21	VL 1003	10S	0
22	VL 1004	10S	0
23	VL 3002	5S	5S
24	VL 3004	40S	0
25	VL 3005	10MS	5S
26	VL 3006	10MS	5S
II. NORTH WESTERN PLAIN ZONE			
27	DBW 95	10S	0
28	DBW 128	5MS	0
29	DBW 129	5MS	0
30	HD 3128	20MS	0
31	HD 3132	20MS	0
32	HD 3133	60S	10S
33	HD 3139	40S	5S
34	HD 4730	10MS	10S
35	HUW 675	20MS	10S
36	K 1204	0	10S
37	MP 1277	10S	10S
38	PBW 677	5MS	10S
39	PBW 692	5S	5S
40	PBW 695	0	0
40. A	INFECTOR	80S	60S
41	PBW 697	10MS	0
42	PBW 698	0	10S
43	PBW 702	5MS	0
44	PBW 703	0	5S
45	PBW 706	5MS	0
46	TL 2995	0	10S
47	UAS 356	10S	5S
48	WH 1154	5MS	5S
49	WH 1156	0	5S
50	WH 1157	0	0
51	WH 1164	TS	0
III. NORTH EASTERN PLAIN ZONE			
52	DBW 126	60S	10S
53	DBW 98	TS	5S
54	HD 3127	40S	5S
55	HUW 661	TS	0
56	HUW 677	20MS	10S
57	HUW 679	10MS	10S
58	PBW 693	40S	10S
59	PBW 701	60S	10S
60	PBW 704	40MS	5S
60. A	INFECTOR	80S	60S
61	UP 2855	40MS	20S
62	WH 1132	10S	5S
IV. CENTRAL ZONE			
63	CG 1010	80S	10S
64	DDW 30 (D)	5MS	5S
65	GW 451	80S	5S
66	GW 455	60S	5S
67	HD 3146	60S	10S
68	HD 4728 (D)	5MS	0
69	HI 8750 (D)	5MS	0
70	HI 8755 (D)	5MR	5S
71	K 1215	5S	0
72	K 1217	0	0
73	MACS 3916 (D)	20MS	10S
74	MACS 3927 (D)	5MR	5S
75	MACS 6604	60S	10S
76	MP 1279	80S	5S
77	NIAW 2030	40S	0
78	UAS 451 (D)	5MS	0
V. PENINSULAR ZONE			
79	DDW 27 (D)	5MS	5S
80	HI 8751 (D)	40MS	20S
80. A	INFECTOR	80S	60S
81	HI 8754 (D)	20MS	0
82	K 1213	60S	0
83	UP 2864	60S	0
VI. SOUTHERN HILLS ZONE			
84	MACS 6507	40S	5S
85	UAS 358	40MS	0
VII. SPECIAL TRIAL (Dicoccum and Sailinity and Alkalinity)			
86	DBW 154	60MS	20S
87	DBW 155	10MS	0
88	MACS 5040	60S	40S
89	MACS 5031	40S	10S
90	MACS 5022	60S	5S
91	DDK 1046	60S	20S
92	MACS 2971 (C)	40S	20S
93	DDK 1044	60S	20S
94	DDK 1029 (C)	40S	20S
95	HW 1099	60MS	20S
96	MACS 2496	60S	5S
III. SPECIAL TRIAL (TRITICALE)			
97	TL 2996	0	0
98	TL 2997	0	0
99	TL 2998	0	5S
100	TL 2999	0	0
100. A	INFECTOR	80S	60S
101	TL 3000	0	0
IV. SPECIAL TRIAL (MABB/NIL ENTRIES)			
102	PBW 722	0	0
103	PBW 723	10MS	5S
104	KB 2012-03	80S	10S
105	HD 2932+Sr26	60S	5S
106	HD 2932-Lr19/Sr25	60S	5S
107	MMBL 283	40MS	5S
107. A	INFECTOR	80S	60S

Annexure XV: Evaluation of Indian wheat genotypes at Kenya and Ethiopia

For identifying Ug 99 resistance in Indian wheat material, Indian wheat advance lines as well as popular cultivars and registered genetic stocks were evaluated in Kenya since 2005. Indian wheat advance lines (221) were evaluated at Kenya and Ethiopia for resistance against Ug99, as a part of our strategy to meet the threat in case this pt. is able to enter India. Following genotypes evaluated at Ethiopia and Kenya during 2013 were categorized resistant (Coefficient of infection upto 10.00).

Wheat lines resistant to Ug99 in Ethiopia: CoW (W), HD 2864, HI 1563, HW 2044, HW 5216, MACS 6222, MP 4010, NIAW 1415, RAj 4229, Raj 4238, GW 432, HD 3090, HD 3093, HD 3096, HI 1584, HUW 652, HW 5224, NIAW 1689, Raj 4240, Raj 4270, TL 2978 and UP 2825.

Wheat lines resistant to Ug99 in Kenya: DDK 1009, HI 1500, HI 8498, HI 8627, HI 8713, HPW 360, HW 1098, HW 2044, K 8027, MACS 2971, MACS 3828, MACS 3828, MP 3336, MPO 1215, NIDW 292 (d), PDW 291, PDW 314, UAS 428, WHD 948, HI 8728, VL 971, HI 8728 (d), HI 8726 (d), GW 1277 (d), HI 8725 (d), GW 1276 (d), HI 8724 (d), UPD 93 (d), MPO 1255 (d), HI 8725 (d), PDW 329 (d), HI 8724 (d), AKDW 2997-16 (d), MACS 5008, DDK 1042, GW 1280 (d), HI 8730 (d), TL 2978, MACS 3817 (d), HI 8731 (d), HI 8728 (d), K 1016, UAS 439 (d), HS 557, AKDW 4749, MPO 1262 (d), MACS 5012, MACS 5022, HI 8727 (d), PDW 327 (d), DBW 88, RKD 219, PBW 675, VL 975, WHD 950 and GW 1280 (d).

During 2005 screening at Kenya, out of 22 lines, three genetic stocks, FLW 2 (PBW 343 + *Sr* 24), FLW 6 (HP 1633 + *Sr* 24) and FLW 8 (HI 1077 + *Sr* 25) were found resistant alongwith HW 1085. Subsequently 102, 318, 420, 241 and 189 lines consisting of elite advance lines, alongwith released varieties were evaluated in 2006, 2008, 2009, 2010 and 2011, respectively in Kenya and Ethiopia against stem rust (*Puccinia graminis f. sp. tritici*) pathotype Ug99 and its variants. Wheat lines *viz.*, A-9-30-1, AKDW 4021, DDK 1037, DDK 1038, DDW 14, DL 153-2, Dolma, GW 1250, HD 2781, HD 3014, HD 4720, HDR 77, HI 8381, HI 8498, HI 8880, HI 8882, HI 8890, HI 8892, HI 8894, HI 8898, HI 8899, HUW 234, HW 5211, K 9107, MACS 1967, MACS 2846, MACS 2988, MACS 2998, MACS 3742, MACS 5009, MPO 1215, NDB 1173, NDB 209, NDW 1020, NDW 940, NI 5439, NIDW 295, PBW 315, PBW 612, PDW 274, PDW 316, PDW 317, RSP 561, Sonu, *Sr*22, *Sr*32, *Sr*35, *Sr*39, *Sr* 42, TL 2942, TL 2963, TL 2966, VLB 1, VLB 856 and WH 147 showed resistance (coefficient of infection upto 10) against Ug 99 and its variants based on evaluation at Kenya and Ethiopia during 2009-2011. Above lines identified may be utilized for improving Ug99 resistance in popular Indian wheat cultivars.

WHEAT CROP HEALTH NEWSLETTER

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CROP PROTECTION PROGRAMME (AICW&BIP)

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WHEAT CROP HEALTH NEWSLETTER

Directorate of Wheat Research
P.B. 158, Karnal-132 001

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The first issue of Vol. 19 (2013-14) is being brought out in the month of November. Wheat crop health was monitored during off season in high hills of Himachal Pradesh (Lahaul, Spiti and Kullu). The Crop Protection Technologies for different wheat growing zones finalized in the 52nd All India Wheat Workers' Meet held at Kanpur during September 1-4, 2013 are also being presented in this issue.

Off season survey

During June 4-5, 2013, stripe rust survey was conducted extensively in Kullu (Himachal Prades) by scientists of DWR (Dr Indu Sharma, Project Director, DWR, Karnal) and Dr Rakesh Devlash (Wheat Pathologist, CSKHPKVV Regional Research Centre, Bajoura, HP). Stripe rust was observed in Bajoura. As the crop was at maturity only stripe rust teliospores could be seen. In villages, Bragran and Bhaliyani in Kullu district, stripe rust was observed (60-80S) in wheat sown under apple trees and upto 20S on barley. The disease was also observed in self sown wheats. Stripe rust uredospores were observed in high hills in Himachal Pradesh i.e. 1087-1887 mamsl. Looking at the possibility that this inoculum which is available in June may spread to Lahaul valley in July and may multiply further during July-September on a regular offseason crop season, advisory was issued for disease management on June 7, 2013.

Dr Daman Jeet Kaur, Senior Nematologist (Wheat), Dr Ritu Bala Asstt. Pathologist of PAU, Ludhiana and Dr Mangal Singh, Technical Officer, DWR, Karnal monitored the wheat crop for diseases in the wheat and barley fields enroute Bajaura, Kullu, Manali, Rohtag, Koksar, DWR, Dalang, Tandi, Keylong, Trilokinath , Kukumseri, Udaipur adjoining areas of Kullu and Lahaul valley during 17th to 22nd June, 2013. The survey included the high hills having elevation ranging between 2415m to 4007 m. Stripe rust incidence up to 40S was recorded on barley from Manali-Rohtag road near Manali (Elevation 2415m; 32°18.812N and 077°10.883E). The infected barley crop was at grain filling stage. No rust was recorded on wheat from any of the places monitored. Dr Indu Sharma, Project Director, DWR, Karnal surveyed Kullu and Lahaul valley of HP during September 21-22, 2013. Stripe rust was observed in the material planted at Dalang Maidan.

As per report received from Dr. S. C. Bhardwaj, Head, DWR Regional Station, Flowerdale, Shimla, no rust was observed in Wheat Disease Monitoring Nursery planted as staggered sowing at Malan, Dhaulakuan in Kharif season. However, leaf rust was observed at Shimla and pathotype 104-2 was identified in 4 samples analysed. During October 23-24, 2013, Dr. OP Gangwar, Dr. Subodh Kumar and Sh. Bhoop Ram Thakur surveyed Ropar, Nangal, Una, Amb, Kangra, Hamirpur and Bilaspur areas for grasses or any other hosts for rusts in the areas where wheat stripe rust is observed frequently. The team collected leaf rust samples from grasses which will be analyzed further for their role in rust survival in off season. On October 29, 2013, Dr. S. C. Bhardwaj and Dr. M. S. Saharan surveyed Yamunanagar and Ambala areas for observing grasses and other hosts for rusts. Grasses on which leaf rust symptoms were observed have been collected and samples will be analyzed further for their role in rust survival in off season. Other related grass spp. were also collected and carried to Flowerdale, Shimla which will be inoculated with both leaf and stripe rust to see if they get infected with the prevalent races of leaf and stripe rusts.

Awareness for Stripe Rust Management

Stripe rust awareness among farmers was created by organizing Farmers' Fair in collaboration with State Department of Agriculture, Yamunanagar at Bilaspur (Yamunanagar) on September 25, 2013. Lectures related to stripe rust management were delivered by Dr. Indu Sharma, Project Director and Dr. M. S. Saharan, Principal Scientist-Plant Pathology, DWR, Karnal. Dr. Randhir Singh, Principal Scientist-Extension and Dr. Arun Gupta Principal Scientist-Germplasm Unit and Dr Raj Kumar, Sr. Scientist-Plant Breeding also delivered lectures on different aspects related to wheat crop. Posters were also displayed to make farmers aware of the stripe rust diagnosis and management. More than 2500 farmers attended the fair.

Dr. Indu Sharma, Project Director, DWR, Karnal delivered lecture on wheat stripe rust management in Kisan Mela organized at Kaithal on September 28, 2013. Stripe rust management cards were distributed among the farmers in above Kisan Melas. Farmers Innovator and Seed day was organized at DWR, Karnal on October 15, 2013 in which farmers were apprised of the strategies enhancing wheat production including crop production and protection technologies with emphasis on stripe rust management. Dr. R. S. Paroda, Chairman, Haryana Kisan Ayog was the Chief Guest at the occasion. State Department of Agri., Karnal and ICAR institutes of Karnal also participated in the exhibition.

Strategy Planning Meetings

A meeting on evolving strategies for enhancing wheat production with special reference to management of wheat rusts with special emphasis on stripe rust was organized by DAC on Oct. 5, 2013 in Kisan Bhavan, Panchkula under the Chairmanship of Sh. Asish Bahuguna, Secretary (A&C), Govt. of India. In continuation to this, meetings were organized at Dehradoon on October 21 and at Jammu on Oct. 25, 2013. From DWR, Karnal, Dr. Indu Sharma, Project Director alongwith subject experts participated in the above meetings and presented strategic initiatives to be adopted for enhancing wheat production and managing stripe rust.

CROP PROTECTION TECHNOLOGIES

Crop Protection Technology for wheat in different agro-climatic zones/states is given hereunder:

A. North Western Plain Zone, NWPZ (Punjab, Haryana, Northern Rajasthan, Western U.P., foot hills and plains of J&K, H.P. and Uttra Khand)

(a) Stripe Rust Management Strategy

1. For avoiding the losses due to stripe rust of wheat in NWPZ, avoid planting of PBW 343 and other susceptible varieties like UP 2338, HD 2687, HD 2329, HD 2733, WH 711 and PBW 373 etc. Varieties like WH 1105, HD 2967, DBW 621-50,

WH 542, PBW 550, PDW 314 (d) and WHD 943 (d) for timely sown and DBW 16, DBW 71, PBW 590, WH 1021 and HD 3059 for late sown conditions may be preferred. Special attention should be given to the epidemiologically important region, i.e., the foot hills and plains of Jammu and Kashmir, parts of Punjab, especially along the international border, foot hills of Himachal Pradesh and Yamunanagar area of Haryana.

2. Since most of the varieties recommended for NWPZ do not carry high level of resistance, hence, chemical sprays are needed. Spray the crop with propiconazole (Tilt 25 EC @ 0.1 per cent), or tebuconazole (Folicur 250EC @ 0.1%) or triademefon (Bayleton 25WP @ 0.1%) at stripe rust initiation. Usually, it is required in the first half of February. This spray will also help in the control of powdery mildew and Karnal bunt diseases.
3. Vigilance should be kept for stripe rust in the foot hills through extensive monitoring starting from early December onwards. If disease is spotted, the farmers should be immediately advised by the concerned State Departments of Agriculture for taking up recommended spray schedule, since further disease spread from initial infection foci it will depend upon the first appearance of disease. Farmers should also keep monitoring their crop critically and take essential steps if disease is spotted.

   Usually, it is observed that the early infection of stripe rust starts in wheat fields under the poplar trees wherever these are grown having early sown crop (i.e. October). Hence, strict watch is needed by the farmers in such fields.

(b) Other diseases and pests

1. Loose smut control measures should be undertaken in view of the horizontal distribution of the seed material among the farmers and the use of the carry over seed. Seed treatment with a combination of the reduced dosage of the fungicide and *T. viride* is made. The bioagent fungus, apart from enhancing the efficacy of the fungicide, also leads to better germination, growth and protection against diseases through induced systemic resistance. For this purpose, seed treatment should be done with *T. viride* @ 4 g / Kg seed in combination with carboxin (Vitavax 75 WP) @ 1.25 g / Kg seed or tebuconazole (Raxil 2 DS) @ 1.0 g / Kg seed.
2. Karnal bunt control is required for seed crop and the produce grown for export purposes. For producing KB free wheat, farmers are advised to grow KB resistant varieties recommended for the respective area.

   NWPZ: PBW 502, PDW 233 and WH 896

   - In areas where Karnal bunt incidence is low, by growing durum wheat for 2-3 years, fields can become free from Karnal bunt pathogen, *Tilletia indica.*
   - Zero tillage helps in reducing Karnal bunt incidence.
   - Avoid irrigation at heading time
   - One spray of Propiconazole 25EC (Tilt 25 EC) @ 0.1 per cent or Tebuconazole 250 EC (Folicur 250 EC) @ 0.1 per cent be given in mid February to control the disease.
3. For powdery mildew control, one spray of propiconazole (Tilt 25 EC) @ 0.1 % at ear head emergence or appearance of disease (whichever is earlier) is recommended for the powdery mildew prone areas.
4. Flag smut disease also poses problems in isolated fields in Punjab, Haryana, Rajasthan and some other parts of NWPZ. Disease management measures taken for the control of loose smut disease (as discussed above), prove to be

effective against flag smut too. Hence, seed treatment with carboxin or tebuconazole may be followed in fields with flag smut history.

5. In the termite prone areas, seed treatment with chlorpyriphos @ 0.9g a.i /kg seed, be taken up for their management. Seed treatment with thiamethoxam 70WS (Cruiser 70WS) @ 0.7 g a.i./kg seed or Fipronil (Regent 5FS @ 0.3 g a.i./kg seed) is also very effective. In the standing crop, the broadcasting of the insecticide treated soil 15 DAS be practiced. For this, chloropyriphos @ 3 Litre mixed in 50 Kg soil be used for one hectare field. Crop planted under FIRBS is more prone to termite attack in the termite-prone areas, while zero tillage shows less termite damage. Hence, proper attention should be given in crop planted under FIRBS.
6. The IPM module developed and validated in NWPZ can be adopted in parts of north-west plain zone. This involves the seed treatment with *T.viride* (@4g/kg seed) + carboxin (75WP @1.25g/kg seed) or tebuconazole (@ 1.0g/kg seed) for the control of loose smut, followed by broadcast of insecticide treated soil (with chloropyriphos @ 3L/ha) at 15DAS for termites. For the management of aphids, foliar spray of imidacloprid 200SL @20g a.i./ha on border rows at the start of the aphid colonization be given. This will help in protection of the bioagent insect, the lady bird beetle inside the field which feeds on aphids. In KB prone areas, the seed crop can be given one spray of propiconazole or two sprays of *T.viride* at tillering and ear head emergence. For the control of powdery mildew in disease prone areas, one need-based spray of propiconazole (Tilt 25 EC @ 0.1%) can be given at earhead emergence or appearance of disease on flag leaf, whichever is earlier.
7. In this zone, a blanket-recommendation on seed treatment with a combination of the reduced dosage of the fungicide and *T.viride* is made. This involves the seed treatment with *T.viride* (@4g/kg seed) + carboxin (75WP @1.25g/kg seed) or tebuconazole (Raxil 2DS @ 1.0g/kg seed). Seed treatment with *T. viride* alone also is recommended. The bioagent fungus, leads to better germination, growth and protection against diseases including Stripe rust, induced systemic resistance.

B. Northern Hill Zone, NHZ (Hills of J&K State, H.P., Uttrakhand)

1. For avoiding the losses due to stripe rust of wheat, avoid planting of susceptible varieties. Replace the susceptible varieties with resistant varieties like HPW 349, HS 507, HS 365, HS 375, VL 616, VL 907, VL 829, VL 832, VL 892, HPW 155, SKW 196 etc.
2. Growing susceptible varieties in the higher as well as the mid-hills should be discouraged to minimize the inoculum load and further spread to plains of Punjab and other states of NWPZ. Such varieties, if grown, should be sprayed judiciously.
3. Loose smut and hill bunt are the two important diseases of wheat in the hills. Hence, seed treatment, as recommended for NWPZ for loose smut disease, be adopted. Both these diseases will be checked through the seed treatment.
4. Powdery mildew is also important in the hills, especially the valley areas. One foliar spray of propiconazole as mentioned under NWPZ may be given in the disease prone areas.

C. North Eastern Plain Zone, NEPZ (U.P., Bihar, Jharkhand, West Bengal)

1. Foliar blight and brown rust are the main crop health problems in this zone. For effective management of the diseases, cultivation of recommended varieties,

like HD 2985, HI 1563, DBW 39, CBW 38, NW 1014, NW 2036, K 9107, HD 2733 (resistant to LB), DBW 14, HD 2888, K0307, DBW39 and HUW 468 should be encouraged.

2. Loose smut is also important in this zone, hence, seed treatment should be done as mentioned under NWPZ.
3. Ear cockle is an important disease in eastern parts of India, hence proper precautions be taken, especially in eastern U.P., Bihar and Jharkhand. Wider publicity should be given by extension agencies on the use of gall-free seed, well before the sowings. Farmers should adopt floatation technique for the separation of galls from the infested seed lots. The infested seed lot should be floated in 2 percent brine solution for this purpose The galls will float on the surface. These should be separated and destroyed away from the field by burning. The seed should be thoroughly washed to remove the salt solution before sowing.

D. Central Zone, CZ (M.P., Gujarat, Southern Rajasthan, Chhatisgarh)

1. Stem and leaf rusts are the major diseases of wheat in this zone. From rust epidemiology point of view, Central Zone has a great importance in the country. Hence, old and susceptible varieties should be discouraged. For disrupting the *Puccinia* path, following rust resistant varieties are required to be grown in the Zone.
   Timely sowing: HI 1544, GW 322, DL 803-3, MP 3288, HI 8498(durum) and HD 4672 (durum)
   Late sowing: MP 1203, HD 2864, HD 2932 and Raj 4083
2. In parts of northern and eastern M.P., loose smut occurs occasionally. Hence, disease control measures as recommended for NWPZ, be adopted wherever the disease is a problem.
3. Ear cockle nematode occurs in some small pockets in the states of M.P. and Chhatisgarh. Hence, emphasis should be given on the use of gall-free seed in the areas with ECN history.
4. Northern and Central parts of M.P. are prone to KB infection. Congenial environment prevails during ear head emergence. Hence, sprinkler irrigation should be avoided wherever susceptible varieties are grown.

E. **Peninsular Zone (Maharashtra, Karnataka)**

1. Leaf and stem rusts are the main crop health problems in this zone. The old, local and susceptible varieties should be avoided. The rust resistant recommended varieties as given below should be grown.
   Timely sowing: MAACS 6222, Raj 4037, GW 322, HUW 510, HD 2189, MACS 2971 (dicoccum) and HD 8663 (durum).
   Late sowing: AKAW 4627, HD 2932, HD 2833, Raj 4083 and PBW 533.

F. **Southern Hills Zone (Tamil Nadu)**

Rusts resistant varieties of wheat (HW 2044, HW 1085, Co(W)-1) should be grown.

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WHEAT CROP HEALTH NEWSLETTER

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The second issue of Vol. 19 (2013-14) is being brought out this month. Crop health survey was carried out in various parts of the country by the scientists of DWR, cooperating scientists of AICW&BIP and KVK scientists during December, 2013 to January 10, 2014. Crop health reports were received from Dr. R.S.Taya (KVK, Yamunanagar), Dr. S.C. Bhardwaj (Flowerdale, Shimla), Dr. S.K. Rana (Malan, Palampur), Dr. Dhanbir Singh (Dhaulakuan), Dr. Madhu Meeta Jindal (PAU, Ludhiana), Dr. S. P. Singh (Faizabad), Dr. Javed Bahar Khan (Kanpur), Wheat Rust Mycologist, Mahabaleshwar, Dr. O. P. Gangwar (Flowerdale, Shimla), Dr. Deep Shikha (Pantnagar), Dr. B.K. Honrao (ARI, Pune), Dr. I.K. Kalappanavar (UAS, Dharwad), Dr. A.P. Padhye (Niphad). Specially constituted team (Drs. R. Devlash, CSKHPKVV, Bajoura, Dr. R. Selvakumar, DWR, Karnal and Dr. O.P. Gangwar, Flowerdale, Shimla) surveyed Punjab from December 27-29 December, 2013 with special emphasis on stripe rust of wheat.

- Stripe rust (Yellow rust) was observed 1st time on January 1, 2014 in village Ratangarh in Yamunanagar district of Haryana on variety WH 711.
- On Januray 7, 2014, stripe rust was observed in village Dabkhera Upperla (near Nangal) in Punjab on variety HD 2967.
- On 9th January, stripe rust was observed in Khurdban in Yamunanagar in var. HD 2967. On 10th January, stripe rust on few plants was observed in village Hanshumajra (Karnal) in var. HD 2967.
- The disease has not been observed from HP, J & K and Uttarakhand so far
- Advisory for stripe rust management was issued by DWR, Karnal on December 17, 2013 and January 2, 2014.
- A meeting was organized by DAC, Ministry of Agriculture, Govt. of India at Una (HP) on January 8, 2014 for stripe rust management in NWPZ and NHZ. Dr. J. S. Sandhu Agriculture Commissioner, Department of Agriculture & Cooperation, Ministry of Agriculture, Govt. of India chaired the meeting. Dr. P. L. Gautam, former Chairperson, Protection of Plant Varieties and Farmers' Rights Authority, Govt. of India was the Chief Guest.

North Western Plain Zone (NWPZ) and Northern Hill Zone (NHZ)

Wheat rusts survey was carried out by Dr. M. S. Saharan, PI-Crop Protection, DWR, Karnal in Yamunanagar and Ambala districts on December 12, 2013. On December 21, 2013, survey for wheat rusts was conducted by Dr. O. P. Gangwar, Dr. Hanif Khan and Dr. Subash Katare in Yamunanagar district of Haryana. No rust was observed. Dr. Indu Sharma, Project Director, DWR, Karnal surveyed the area between Karnal to Ludhiana on December 29. No rust was observed in any farmers field. On December 23, 2013, wheat crop health was monitored by Drs. M. S. Saharan and Subash Katare in Kaithal district of Haryana. In Harsola village (Kaithal), some fields (zero tillage) were noticed with pink stem borer infestation.

A team of scientists comprising Dr. R. Selvakumar (DWR, Karnal), Dr. R. Devlash (CCSHPKVV, Bajoura) and Dr O. P. Gangwar (DWR Flowerdale, Shimla) monitored new virulences of rusts in NWPZ (foot hills areas of Yamunanagar, Ropar, Hoshiarpur and Una districts) during 27. 12. 13 to 29. 12. 2013. On 27th Dec. 2013, the farmer's fields were surveyed in the route starting from Karnal via Sangipur, Kanjnoo, Yamunanagar, Chandigarh and Una. On 28th Dec. 2012, the survey team visited Akrot, Amb, Bharwain, Gagret (Distt. Una), Hoshiarpur, Sarlran, Jandu Janda, Khanpur, Mehna, Chhabewal, Jian, JahanKhelan (Distt. Hoshiarpur) and Pandoga, Jhalera, Basal, Tyuri, Dhusara, Diara, Bruhi, Takrala (Distt.Una). On 29th December, 2013, the team visited Rampur, Varana, Nangra, Fatehpur, Santoshgarh, Tahaliwal (Distt. Una), Garahshankar, Balachaur (Distt. Hoshiarpur), Kiratpur, Ropar and Kurali (Distt. Roop Nagar). In general, the crop was very good. Most of the fields were in seedling stage to tillering stage. Stripe rust was not observed in any of the field in the surveyed areas.

On 1st January, 2014, one farmer Sh. Nathi Ram s/o Sh. Jandhu Ram of village Ratangarh (Yamunanagar) informed Dr. R. S. Taya, Senior Plant Pathologist, KVK, Damla about stripe rust symptoms in his field in var. WH 711. This variety was sown on Oct. 29, 2013. Dr. R. S. Taya immediately visited the field and confirmed the stripe rust symptom. As per the information received from Dr. R. S. Taya as well as from Dr. S. S. Karwasara, Head, Deptt. of Plant Pathology, CCS HAU, Hisar, DWR team (Drs. M.S. Saharan, Mangal Singh, Vipin Panwar) visited the field on 2nd January. On 4th January, Dr. Indu Sharma, Project Director, DWR, Karnal also visited the field and suggested the necessary measures to be taken by the farmers of area. Dr. Indu Sharma surveyed the Una area of HP and Banur area of Punjab on January 8, 2014. The crop was very good and no rust was observed. Dr. S.C. Bhardwaj, Head, DWR Regional Station, Flowerdale, Shimla surveyed the area enroute Una to Shimla on January 8, 2014. No rust was observed.

On January 8, 2014, the incidence of stripe rust was observed by Mr.Hem Raj Kamboj, A.D.O. in the field of Sh. Bhupinder singh s/o Sh. Satpal Singh in variety HD 2967 in village Khuradban. A team of DDA Yamuna Nagar and scientists of KVK Damla visited the affected field of wheat on same day. DWR team (Drs. M. S. Saharan, Selva R Kumar) alongwith Sh. Hem Raj, ADO visited the field again on January 10, 2014. The stripe rust foci (2 sq m) was of 60S in var. HD 2967 sown on Oct. 30, 2013. Dr. S. C. Bhardwaj, Dr. O. P. Gangwar and Dr. Subodh Kumar surveyed the area enroute from Shimla to Yamunanagar on January 10, 2014. No rust was observed. Both teams (DWR Flowerdale, Shimla and DWR, Karnal) visited the field of Sh. Nathi Ram in Ratangarh village (near Damla, Yamunanagar) in the afternoon of January 10, 2014 and collected stripe rust samples.

As per report received from Dr Madhu Meeta Jindal, Senior Plant Pathologist, PAU, Ludhiana, stripe rust was not observed till January 3, 2014 in Nawanshahar and Ferozpur area of Punjab. On 7th January, 2014, Dr Madhu Meeta Jindal, Dr Puja Srivastava (Asstt Breeder), Deptt of Plant Breeding and Genetics, PAU, Ludhiana and Dr Jagdish Arora, Asstt extension specialist from KVK, Ropar surveyed wheat crop area of district Ropar and Sri Anandpur Sahib. Incidence of stripe rust was observed in village Dabkhera Upperla on variety HD 2967 on one acre field. The infection foci of 40S was of 3 meter radius. In the field, scattered rust infected plants were also observed. The crop was sown on 28.10.2013. The variety DPW 621-50 grown in adjacent field was free from rust. Tarai/Plains of Uttarakhand were surveyed for stripe rust of wheat by Dr. Deepshikha, JRO and Dr. Kanak Srivastava, Jr. Scientist, Plant Pathology on 3rd and 4th Januray 2014 in different wheat growing areas, en route Bazpur (Kanori, Kanora, Karbola and Tanda Azam), Kashipur (Corbett Sun City, Dhanauri and Bhogpur), Gadarpur (Prem Nagar, Mehtosh nagar, Dhaulpur, Kiratpur, Daanpur, Bagwala and Bhagwanpur), Deneshpur, Rudrapur, Kichcha (Village-Sirsa Chowki), Sitarganj (Village-Katanghari, Gurunanak farm, Bari, Jhoka, Kunda Ashraf, Pindari and Turkandasur) and Sara Saria Khatima (Village-Baghura and Uttamnagar). The dominant varieties sown in the areas were DBW 17, PBW 550, PBW 502, UP 2338, HD 2967 and PBW 226. The timely sown crop was in tillering stage whereas the late sown crop was in seedling stage. The crop health was good and crop was found free from stripe rust at all the locations.

Wheat crop health was monitored by Dr. S. K. Rana, Senior Plant Pathologist, CSKHPKVV, Malan, Palampur in parts of Dehra, Pragpur, Kangra and Nagrota Bagwan blocks of district Kangra (HP) during second fortnight of December. Wheat crop at locations viz. Bangoli, Bhatoli, Maleta, Karol, Lower Ghalor, Kangra, Trind etc. was critically monitored for germination, general performance and appearance of stripe rust. Overall performance of crop was good. Stripe rust was not recorded anywhere at these locations. Poor germination was recorded under trees in rainfed areas. Stripeing due to moisture stress was recorded in rainfed areas especially at Karol in Pragpur block. Wheat varieties viz. HPW 349 (FLDs at Bangoli), HS 295, S - 308, VL 829, Raj 3777, PBW 621 etc. were grown by the farmers at these locations during current rabi season. Dr. Dhanbir Singh, Senior Plant Pathologist, CSKHPKVV, Dhaulakuan conducted survey in third week of December in Paonta and Nahan blocks of District Sirmour. No disease was recorded anywhere in both the blocks. Crop was in tillering development stage. Good rains were received on 22, 23 and 31 December, 2013. Overall condition of crop was very good.

Peninsular Zone

Dr. S.D.Patil, Entomologist and Dr.K.P.Deolankar, Agronomist of Agril. Research Station, Niphad conducted survey in Nasik and Dhule districts of Maharashtra state during last week of December 2013 and first week of January 2014. The wheat crop was at tillering, booting or flowering stage. Late sown wheat crop was at crown root initiation to seedling stage. The varietis grown by farmers were, NIAW-1415, NIDW-295, Lok-1, HD-2189, NIAW-301, NIAW-34, WHD-948 and, GW-496. The rust infection was not noticed in any surveyed field. However, heavy infestation of foliar aphids was recorded on early and timely sown wheat in Nasik and Dhule districts. Initiation of aphids was recorded in first week of December 2013. Among FLDs, heavy incidence of root aphids was also observed in farmer's field in the villages *viz.*, Waghadi, Bharwade Tal. Shirpur, Dist. Dhule.

Survey was undertaken by Mr. B.C. Game, Jr. Wheat Pathologist, ARS Niphad on 10/01/2014, in the Dindori Tehsil of Nasik district. Farmer's fields from Mohadi, Janori, Materwadi, Khadak Sukena and Jopul village were surveyed for disease incidence. Majority of the fields were disease free and in tillering stage. Some of the early sown wheat fields were in dough stage. Natural incidence of leaf rust was recorded in two fields at Jopul village (Dindori Tehsil, Nasik). The variety grown in both the fields was Lok-1. Farmers own saved seed was used for sowing in both the fields. In first field, off-types were upto 20% and infection in patches recorded on off-type was 100S, while on Lok-1 it was upto 50S. The crop was sown on 7/10/2013 and was in dough stage. The second field which is adjoining to first one, was sown on 10/11/2013 and was in flowering stage. The rust incidence was low i.e. upto 20S and in patches. Control measures were suggested to farmers for rust control. Wheat disease monitoring nursery sown at Pimpalgaon (Baswant) was free from diseases as observed on 9/1/2014.

Dr. B K Honrao, Senior Plant Pathologist of ARI, Pune surveyed the different fields in surrounding areas of Pune in December, 2013. The wheat crop was at tillering to stem elongation stage in different fields. In some farmer's fields and Hol farm, infestation of foliar aphids was noticed in traces. Overall crop health was good. There was no natural incidence of any rusts, blight and other pests. Dr. Ishwar K. Kalappanavar, UAS, Dharwad surveyed the Dharwad area on December 13, 2013. Leaf rust was observed in Amrut variety planted in rain fed condition for the multiplication of seeds. Leaf rust had appeared in small patch during 1st week of December 2013. Incidence of shoot fly was also observed at Dharwad center during 2nd week of December, 2013. No wheat rust was observed in farmers fields in Mahabaleshwar area till January 1, 2014.

North Eastern Plain Zone

As per report received on January 6, 2014, from Dr. Javed Bahar Khan, Asstt. Wheat Pathologist, CSAUA&T, Kanpur, wheat crop was generally good in Kanpur area. Termite infestation (15 %) was observed in wheat rainfed trial. Leaf blight, rust and other diseases were not observed. Dr. S. P. Singh, Asstt. Wheat Pathologist, NDUAT, Kumarganj, Faizabad informed the crop health status of Faizabad area. Incidence of root rot, foot rot and blight symptoms were noticed in some fields. Light rains were observed on 27 and 31-12-2013. In general the crop was good in Faizabad area.

Advisory for Stripe Rust (Stripe Rust) Management in NWPZ and NHZ

Keeping in view the favorable weather for stripe rust development and its further spread, farmers are advised to visit their crop regularly for observing stripe rust incidence. Farmers should give special emphasis in the early sown crop and the crop planted under trees. Farmers are advised to inform or consult the wheat scientists/experts/extension workers for confirmation of stripe rust disease symptoms as sometimes yellowing of leaves may be due to other factors than disease. If farmers observe stripe rust in patches in their wheat fields, following measures are recommended:

- One spray of Propiconazole 25EC (Tilt 25 EC) @ 0.1 per cent or Tebuconazole 250 EC (Folicur 250 EC) @ 0.1 per cent or Triademefon (Bayleton 25 WP) @ 0.1 per cent be given at the foci of infection to avoid its further spread.
- One ml of chemical should be mixed in one litre water and thus 200 ml of fungicide mixed with 200 L of water should be sprayed in one acre wheat crop. If need, farmers are advised to repeat the spray.
- Farmers who have applied one type of fungicide previous year, it is suggested to apply alternate recommended fungicide this year.
- Farmers should spray the crop when weather is clear - no rain, no fog/dew etc.

A training course on Techniques and Procedures in Crop Health Monitoring and Field Evaluation of Host Resistance in Wheat and Barley will be organized for the co-operators of AICW&BIP at DWR, Karnal from January 29-31, 2014.

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WHEAT CROP HEALTH NEWSLETTER

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The crop health reports received from mid January to February, 28, 2014 have been compiled in this issue. Wheat crop health reports were received from State Department of Agriculture, Co-operators of AICW&BIP, SAUs' and KVKs'. Dr. Indu Sharma, Project Director, DWR, Karnal monitored the wheat crop health in different states of the country. During this period, crop health reports were sent regularly to ICAR, DAC (Ministry of Agriculture), G.O.I., New Delhi and advisories for stripe rust management were issued as and when required.

North Western Plain Zone (NWPZ)

Extensive surveys were undertaken in Yamunanagar and Karnal districts by the Officers of State Department of Agriculture (Yamunanagar, Karnal) and scientists of KVK, Yamunanagar, DWR, Karnal and CCS HAU, Hisar. Regular wheat crop health reports were received from Dr. A. P. Dabas, Deputy Director of Agriculture, Yamuna Nagar. Till end of February, 2014, stripe rust (yellow rust) was observed at 40 farmers fields in 25 villages in Yamunanagar. The disease was observed on wheat varieties, WH 711, HD 2932, HD 2851, HD 2967, DPW 621-50, Shri Ram 271, DBW 16, DBW 17 and Barbat. Dr. Madhu Meeta Jindal (PAU, Ludhiana) observed stripe rust on var. HD 2967 (20-40S) in village, Dabkera and on var. HD 2733 (20-40S) in village Theri, Mohali on January 13, 2014. A team of DWR Regional Station, Flowerdale, Shimla (Dr. O. P. Gangwar, Dr. Parmod Parsad, Dr Subodh Kumar) conducted extensive survey in Punjab and HP during Jan. 15-16, 2014. Wheat crop health was monitored by Dr. M. S. Saharan (DWR, Karnal) in Yamunanagar on Jan 16, 2014. On 17th Jan., Dr. M. S. Saharan, Dr. S. K. Rana (CSKHPKV, Malan) and Dr. Ritu Bala (PAU, Ludhiana) conducted survey in Punjab. On 18th Jan, Dr. M. S. Saharan conducted survey in Banur area of Punjab. Stripe rust was observed only at two locations in Punjab (Ananadpur Sahib area).

Dr. Dhanbir Singh (CSKHPKV, Dhaulakuan) reported stripe rust in Trap Plot Nursery in infector rows with 5 to 10S severity at Dhaulakuan on January 17, 2014. Stripe rust infection was also recorded in Kharchia mutant (10S) and also in SAARC nursery susceptible check (10S) at Dhaulakuan. On January 21, 2014, Dr. S.S. Karwasara Dr. I. S. Panwar and Dr. R. S. Beniwal (CCSHAU, Hisar), Dr. R.S. Taya (KVK, Damla) and Dr. Sudheer Kumar and Dr. R. Selvakumar (DWR, Karnal) surveyed and did not observe any rust in Karnal and Yamunanagar. Powdery mildew was noticed in Kishanpura village on variety PBW 343 on lower leaves only. On January 22, 2014, Dr. S.S. Karwasara Dr. I. S. Panwar and Dr. R. S. Beniwal surveyed farmers fields enroute Nilokheri, Tarowari, Shahabad, Pipli, Ambala, Mullana, Kapli, Broda, Siwan Majra, Kurukshetra and Dhand. In the field of Sh.

Sawarn Singh of Siwan Majra village (Brada Block), stripe rust foci of about $2m^2$ (20S) was observed on var. Barbet.

A team of APPO, Yamunanagar, SDAO, Jagadhri and scientist from KVK Damla visited village Haripur Jattan, Sudhal, Sudhail, Rajpura and Kotar Khana of district Yamunanagar on January 22, 2014 and observed stripe rust in traces in villages Haripur Jattan and Kotar Khana on varieties, DPW 621-50 and HD 2967, respectively. Dr. Indu Sharma, Project Director, DWR, Karnal monitored the crop health in Punjab (Ludhiana, Anandpur Sahib, Nawasahar) on January 24, 2014 and in Yamunanagar area of Haryana on January 28, 2014. Dr. Madhu Meeta Jindal conducted survey on January 31, 2014 and reported stripe rust on DPW 621-50 (40S) in village Rainsara (Nurpur Bedi, Ropar), on HD 2967 (40S) in villages, Surewal (Ropar), Hardo, Naushehra, Bhagtena Tulian (Gurdaspur).

Dr. M. K. Pandey (SKUAST, Jammu) extensively surveyed Jammu, Kathua and Samha districts during January 25-28, 2014. Stripe rust was observed in a field at Devigarh, (RS Pura, Jammu) on variety PBW-550 (20S) sown in about 2 Kanal areas and also in village Saikalan on var. HD 2967 (20S) sown on first week of Nov., 2013. In Samba district stripe rust was observed in village Kotli on variety PBW-343 (40S) and one field at Matkali (Ramghar) on variety PBW-550 (30S) in 2-3 meter patch. Incidence of stripe rust was observed in village Sultanpur (Kathua) on variety WH 711 (20S) on one acre field. The crop was sown in first week of Nov., 2013. Further the survey conducted on route via Udhaywalla, Marh, Chinnor, Bishnah and Akhnoor. No rust was observed at this route. In general, the crop was very good in Jammu, Kathua and Samba district. Dr. Vishal Gupta (SKUAST, Jammu) also observed stripe rust (10-15 MS) in village Talhar (RS Pura, Jammu) in the field of Sh. Darshan Lal on January 21, 2014.

Survey was carried out from 3 to 5th February in the area of Haryana and Punjab by a team of scientists. Dr. Sudheer Kumar (DWR, Karnal) and Dr. Vaibhav Kumar Singh (IARI, New Delhi) did not observe any rust in the route starting from Karnal to Ludhiana via Yamunanagar on February 3, 2014. On February 4, 2014, Dr. Madhu Meeta Jindal also joined the team. Farmers fields were visited in Macchiwara, Chamkaur Sahib, Rasidpur, Rasidpur, Phool Khurd, Balachaur, Nawashahr, Badala, Nawashahr and Garhi Ajit Singh. Stripe rust was observed at Chamkaur Sahib, Rasidpur and Phool Khurd. At Chamkaur Sahib, stripe rust of 20 to 40S severity was observed in about 10 meter patch on variety HD 2967. At Rasidpur, stripe rust severity was 10 to 20S on variety HD 2967 in about 5 meter patch and at Phool Khurd, stripe rust was observed in traces. On February 5, 2014, Dr. Sudheer Kumar surveyed Ludhiana, Fatehgarh Sahib, Mohali and Ambala. No rust was observed. On February 5, 2014, Dr. M. S. Saharan and Dr. R. Selvakumar surveyed Karnal area for wheat rusts. No rust was noticed. On February 13, 2014, Dr. M. S. Saharan did not observe any rust in Indri area. During February 19-20, 2014, Dr R Selvakumar and Dr Sujay Datta (ISRO, Ahemdabad) surveyed Haryana and Punjab (Roop Nagar, Gurdaspur, Pathankhot, Amritsar) for wheat rusts. No rust was observed. Dr Sujay Datta and Dr Mangal Singh observed stripe rust in Yamunanagar area of Haryana on February 22, 2014.

On February 19 , 2014, Dr Madhu Meeta Jindal and Dr Beant Singh (PAU, Ludhiana) surveyed wheat crop area of districts, Ludhiana, Hoshiarpur enrouting Phillaur, Nagar, Bisla, Banga, Behrampur, Balowal, Dholanwal, Phagwara for rusts and insect pests. At KVK Bahowal, stripe rust was observed on HD 2967 (One foci of 40S) and

DPW 621-50 (20S). At Bahowal, stripe rust was recorded on Agra Local, Lai Bahadur, HD 2329 and HD 2204 in TPN. In village Dholewal, HD 2967 grown on ~ 5 acres was having stripe rust (5-10S). This field was also having flag smut and high incidence of aphids. In village Taunli, HD 2967 and DBW 17 were infected with stripe rust (40S). There was severe incidence of aphids also. Stripe rust was also observed in fields on Hoshiarpur-Phagwara road. Overall the crop was healthy. Stripe rust was observed in five villages (Darba, Paniwala Mota, Bhagsar, Audhan and Bara Gurha) in Sirsa (small foci of yellow rust in the range of 20-30S) on February 19, 2014 by State Department Officers of Sirsa. In the stripe rust infected fields, the farmers have planted the varieties HD 2851, WH 147 and PBW 343. These fields were also visited by CSHAU, Hisar scientists.

The team comprised of Dr. Dhanbir Singh, Dr. S. L. Gartan (HAREC Dhaulakuan), Dr. Susheel Chauhan (ATMA), Dr. Rathore (BTM, Paonta Sahib) and Dr. Pawan (BTM, Paonta Sahib) visited wheat fields in a number of villages on February 21, 2014. The incidence of stripe rust was noticed in the fields of Sh. Sanjay Kumar, Sh. Raghbir Singh and Sh. Bhagwan Singh in village Kolar. The incidence of stripe rust in fields of Shri. Sanjay Kumar was recorded to the tune of 25% with severity of 50S (6 Bighas). In other fields, incidence was about 2% with a severity of 30S. In village Rukhree, disease was noticed in fields of Sh. Prem Das (3 Bighas) with incidence of less than 1% and severity of 50S. In the fields (2 Bigha) of Shri Dinesh Bansal village Rukhree, stripe rust was recorded with less than 0.5% with a severity of 10S. The team also monitored wheat crop health on February 25, 2014. Stripe rust was recorded on wheat varieties, HD 2894 (60S), Barbet (100S), PBW 343 (40S) and unknown variety (40-80S) in village Barotiwala. In village Nawada, stripe rust was recorded on wheat variety, WH711 (70S). Stripe rust severity to the tune of 20S was also recorded on wheat variety HPW 236. Incidence of stripe rust on this variety was less than 1% in three bighas.

Northern Hill Zone (NHZ)
On January 29, 2014, Dr. S. K. Ghabru (PC KVK, Berthin, Bilaspur, HP) and PD (ATMA, Bilaspur) conducted survey in villages, Kalol, Jaddu Kulzar, Baroti, Bhadoli Khurd, Bhadoli Kalan and Bakain. Stripe rust was observed in Kalol on HD 2733 in about 4 meter patch and also in villages, Jaddu Kulzar (HPW 236) and Bakain (HD 2967) in traces. On February 18, 2014, Dr. S. C. Bhardwaj (Flowerdale, Shimla) visited some of the areas in district Bilaspur (Chandpur and Kandraur) and Solan (Bhararighat) of HP. The areas visited were those where stripe rust occurs every year. Most of the areas were free from stripe rust. At Kandraur, on one side variety HS 420, grown in about 0.4 ha was free of stripe rust. Adjacent field of DPW 621-50 had one month old, three foci of stripe rust with 80S severity. Stripe rust was further spreading to other parts of the field which was about 0.5 ha. Crop stand was very good. Dr. Bhardwaj also surveyed wheat and barley crops in East of Shimla (villages, Bakhrai and Malyana) on February 25, 2014. These areas were free from rusts. As per report received from the Project Director ATMA, Mandi and Kullu, no stripe rust was noticed in Mandi and Kullu area during January, 2014. In mid February, stripe was observed in villages, Baldwara, Karni, Khayalag in Mandi area.

Wheat crop health was monitored by conducting survey and surveillance tours in parts of Nagrota Bagwan, Bhedu Mahadev, Bhawarna, Lamba Gaon and Baijnath blocks of district Kangra and Chauntra, Darang, Mandi Sadar, Balh and Sunder Nagar blocks of district Mandi during the month of February, 2014 by Dr. S. K. Rana.

The overall crop condition was very good in all the areas due to the rains received almost at regular intervals during February. Stripe rust had started appearing at some locations viz. Bagh/ Alampur and Jangal in Lamba Gaon block, Sunder Nagar in Sunder Nagar block, Nagchala in Balh block and Mehar in Mandi Sadar block with severity ranging from 5-40S on wheat varieties like HS 240, HPW 249, HPW 184, PBW 343 etc. Flag smut in traces was recorded at Alampur and Jangal areas of Lamba Gaon block. Powdery mildew with high severity was recorded on HPW 184 at Alampur area in Kangra district and low to moderate severity at Sunder Nagar, Nagchala and Mehar areas in Mandi district with intensity varying from 3-7 (on 0-9 scale). Moderate to severe attack of aphids was recorded in Balh valley and Sunder Nagar. Wheat Disease Monitoring Nursery (TPN) was found free from stripe rust at Sunder Nagar, however, YR was recorded on VL 892 in TPN planted at SAREC, Kangra.

Wheat crop health monitoring survey was undertaken on 6th February in the Almora district covering Chaukhutia, Binta Valleys and Someshwar area by Dr. Lakshmi Kant and Dr. S. K. Jain (VPKAS, Almora). No rust incidence at Manila, Ida (Bagwali Pokhar), Binta, Mehal Chaura, Basbhida. Ganai and Simalti. At most of the places, farmers have planted improved varieties and the crop was at tillering to late tillering stage at present. The first natural occurrence of yellow rust of wheat was observed in the infector rows of trap nurseries planted at Hawalbagh experimental farm on 5-6 February 2014 and the severity was recorded on 12.2.2014 up to 10-20S. Similarly, natural occurrence of yellow rust in one entry of station trial at Hawalbagh was observed up to 10S in the first week of February.

Wheat crop was monitored for rust in the farmers' field by Dr. J. P. Jaiswal, Dr. Deepshikha and Dr. Kanak Srivastava (GBPUA&T, Pantnagar) on February 11, 2014 enroute Rudurpur (villages, Gangapur, Premnagar and Narainpur), Dineshpur (villages, Buksora and Sakenia), Gadarpur (villages, Mohanpur, Badakheda, Motipur, Jai nagar, Kundan nagar and Chandi pur), Bajpur (villages, Bajpur, Tanda Azam, Maheshpur Doraha, and Namoona) and Kashipur (villages, Khadakpur, Kunda gaon and Kundesari). The varieties sown in the areas were PBW 550, PBW 502, WH 711, PBW 226, DBW 17, PBW 343 and PBW 154. The crop health was good and rusts were not observed. On February 12, 2014, area between Pantnagar and Khatima enroute Kichha (villages, Shankar farm (Bhanga), Bara, Sirsa chowki and Gurunanak farm (Bari), Sitarganj (Turkattisor and Nakha farm), Nanakmatta and Khatima (villages, Sara Saria, Jhankat, and Lohiyapul) were surveyed. Varieties sown in these areas are PBW 226, DBW17, PBW 343 and PBW 550. All the varieties were found free from rust and other diseases. Survey was conducted from Pantnagar to Haldwani via Golapar (Nawarkheda, Purvikhera, Devlatalla, Kuwarpur naya gaon, Sambal), Gorapadao (Haripur tula), Motinagar and Motahaldu on February 13, 2014. Dominant variety sown in these areas was PBW 154 and other varieties grown by the farmers were PBW 550, UP 2425, PBW 502 and PBW 373. Overall crop was good and no rust was observed but between Pantnagar to Haldwani, powdery mildew was noticed at many farmers fields.

As per report received from Joint Director (QC), Uttarakhand, stripe rust (traces) was observed in last week of February in Khatima block of Udham Singh Nagar on varieties PBW 343, PBW 502, HD 2967, PBW 550 and DPW 621-50.

As per report received from Director of Agricultur, Himachal Pradesh stripe rust was observed furing February 1-2, 2014 in Hamirpur (villages, Kot, Drogan, Neri Blata, Khirki and Jangal Berry), Mandi (villages, Baldwara, Karni, Nabhai, Khayalag, Bari and Seyoh), Una (villages, Chaksari, Jubehar, Suri, Nandpur, Kotohar, Kalan, Chururu, Baheri, Tanoh, Tihra, Sohari, Talmera, Bhadsali, Solah, Badehra, Kangar, Palkawah, Panjawar, Khad, Ispur, Pandoga, Basal, Rampur, Dangoli, Lamlehri and Dangoli)

Central Zone (CZ)

Dr. Indu Sharma monitored the crop health in Rewa (MP) on February 5 and Rajkot (Junagarh, Gujarat) on Feb. 19-20, 2014. She also monitored wheat crop health in MP (Raipur, Bilaspur, Jabalpur) during Feb. 23-24, 2014. She observed leaf rust in off types in farmers fields of Jabalpur. On Feb., 28, 2014, monitored wheat crop health in Sawai Madhopur and adjoining hilly areas of Vindhyachal. Crop was very good in MP and Rajasthan. She observed leaf rust (TR-5MS) at farmers fields on off type plants on the way from Kota to Sawai Madhopur. Dr. K. K. Mishra conducted extensive survey in Powarkheda area during January-February, 2014.

North Eastern Plain Zone (NEPZ)

Dr. S. P. Singh (NDUA&T, Faizabad) observed moderate incidence of foliar blight in timely as well as late sown crop. Leaf rust had appeared on Agra Local on February 27, 2014. During first fortnight of February, shoot fly and aphids were also observed in some fields. Dr. Javed Bahar Khan did not observe any rust in Kanpur area at farmers fields as well as in TPN genotypes till February end. On February 24, Dr. R. Selvakumar did not observe any rust in the fields of CSAUA&T, Kanpur station as well as Dalip Nagar research farm. Leaf blight was observed in many wheat genotypes. On February 25, 2014, no rust was observed in NDUA&T, Faizabad and nearby farmers fields. No rust was noticed in BHU, Varanasi experimental farm (natural conditions) and nearby fields on February 25, 2014. Leaf blight was noticed in many wheat genotypes.

Peninsular Zone (PZ)

Dr. I. K. Kalappanavar (UAS, Dharwad) reported leaf rust appearance in Dharwad area on var. Amrut. Shoot fly incidence was severe at Dharwad in mid January. Dr. B. K. Honrao (ARI, Pune) reported leaf rust in TPN nursery on January 22, 2014 on varieties, WL 711(TS), C 306 (5S), and Agra Local (TS) planted at Pune. By 3rd February, it had spread on more varieties and ARI germplasm (WL 711, HD 2329, Agra Local. Lal Bahadur, C306, WH 147, HD 2160, BARI 82, BARI 102, Kenphad 25 and *T. sphaerococuum*) with severity ranging from TS to 40S. Black rust was not observed in farmers fields as well as in Trap Plot Nursery in Pune area till February 28, 2014. On Jan. 13, leaf blight was observed in varieties, Kharchia mutant, Bijaga Stripe, A 206, NI 973 and NI 146 at ARI, Pune. On 30th Jan., leaf blight was observed at farmers fields on varieties, Gold 21 and Gold in villages Sakharwadi and Phadtarwadi (Satara). On January 31, 2014, leaf rust (5-60S) was observed on off types in villages Murum, Songaon, Malad (Baramati, Pune) and in villages, Sakharwadi, Phadtarwadi, Phaltan, Sangavi, Shirseni, Lonand (Satara). By February end, incidence of foliar blight was observed at ARI, Pune in many varieties *viz;* Agra local, Lal Bhahdur, Bijaga stripe, A 206, NI 146, Lok-1, Gold 21, ARI breeding material etc. with severity ranging from 12 to 79. Some traces of stem borer was observed in late sown crop at Hol farm. Dr. J. P. Tandon and Dr. S. C. Misra visited Dharwad and Gadag district in Karnataka state during Feb. 6-7. Natural incidence of leaf rust was observed on varieties, DWR 162 and off type mixtures on MACS 6222 with severity ranging from 30 to 60S.

Leaf rust (10S) was observed on January 29, 2014 by Dr S. G. Sawashwe (Regional Wheat Rust Research Station, Mahabaleshwar) in TPN sown at ARS, Radhanagri (Kolhapur) and College of Agriculture, Kolhapur on wheat vars., MACS 9 and Lal Bahadur. Leaf rust (TS-40S) was observed in off types plants at farmers fields in Western Maharashtra during 2nd fortnight of February. As per report received from Dr B C Game, Niphad, the first natural incidence of leaf rust was observed in Wheat Disease Monitoring Nursery on Lal Bahadur variety on February 2, 2014, which increased upto 80S on Feb. 26, 2014. The incidence of stem rust was not seen in the nursery till February 28, 2014. Out of 20 genotypes in TPN, only HD 2329, HD 2160, HW 2021, HD 2204, C 306, HW 2008, DL 784-3, MACS 2496 and HW 971 were free from leaf rust. Incidence of stem rust has not been observed on the surveyed farmers fields in Nasik district. Dr. Indu Sharma also monitored the crop health in Dharwad (Karnataka) on February 18, 2014. The crop was very good in Dharwad area.

Training on wheat health management

A training course on Techniques and Procedures in Crop Health Monitoring and Field Evaluation of Host Resistance in Wheat and Barley was organized by DWR (Karnal and Flowerdale, Shimla) and DRRW project of BGRI for the co-operators of AICW&BIP at DWR, Karnal from January 29-31, 2014. In training programme, there were total 23 participants. 18 participants were from different SAUs, ICAR institutes and co-operating centres of DWR. Participants belonged to 12 states of India (Major wheat growing states): West Bengal, Karnataka, Tamil Nadu, Bihar, MP, Gujarat, Delhi, J & K, Himachal Pradesh, Uttarakhand, Punjab and Haryana. Most participants were young and there were three women participants also.

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Crop health surveys were carried out in various parts of the country by the scientists of DWR, AICW&BIP, SAUs', KVKs'and extension officers during March-June, 2014. Dr. Indu Sharma, Project Director, DWR, Karnal also monitored the crop health in different parts of the country.

Northern Hill Zone (NHZ)

Deputy Director of Agriculture, Bilaspur, HP reported stripe rust on 10 wheat varieties at seed Multiplication farm, Auhar on 4.3.2014. The stripe rust was observed in traces in areas such as Chandpur, Majari, Bassi Dabt, Auhar, Bhaani, Reshikesh, Luharwin and Tikkri in Bialspur district in 2nd fortnight of March. The stripe rust in patches was observed in districts *viz.*, Hamirpur, Kullu, Mandi, Sirmour, Shimla, Solan, Una and Kangra. Dr. Satyavir Singh Bajwa (DWR, Karnal), Dr. S. K. Ghabru (KVK, Berthin) and Dr. Akhilesh Singh (Bilaspur) monitored wheat FLDs at Malan (Kangra), Bajaura (Kullu) and Berthin (Bilaspur) centers in HP on March 11, 2014. Stripe rust (30-40S) was observed on variety HS 240. Variety VL 907 was free from yellow rust. The yellow rust (50S - 60S) was observed in few plants on wheat variety DPW 621-50.

Wheat crop health report was received from Dr S K Rana, CSKHPAU, Palampur. The crop was monitored by conducting survey and surveillance tours in parts of districts, Kangra, Mandi, Kullu, Una, Sirmaur, Solan, Bilaspur and Hamirpur during the month of April, 2014. The overall crop condition was very good in all the areas due to the rains received at regular intervals during the crop season. Yellow rust was recorded in severe form on susceptible wheat varieties *viz.*, HPW 251, VL 829, VL 616, HS 277 (early sown vars), HPW 184, HPW 211, HS 240, VL 738, VL 804, DBW 17, Raj 3765, PBW 343, PBW 502, PBW 550, WH 711, Super 369, Sonak, Kanaku, Local (varietal mixture) (timely sown vars), HPW 42, HS 295, HS 420, VL 892, Raj 3777, Sonalika (late sown vars) etc. at farmers' fields and severity ranged from 40-80S. Most of these varieties have been phased out from the package of practices but farmers are still growing them at their own level. Wheat varieties *viz.*, HPW 89, HPW 147, HPW 236 and HPW 249 which were earlier resistant - moderately resistant to stripe rust recorded severity up to 60S at HAREC Bajaura, RWRC Malan and KVK Sunder Nagar due to delayed winter season. These varieties however, overall recorded 5-20S severity in majority of foot and mid hill areas. Wheat varieties of recent times *viz.*, HPW 349, HPW 360, HS 542, HS 507 and VL 907 recorded overall 5-20S severity however, at hot spots (Bajaura, Malan, Sunder Nagar) for stripe rust, they recorded high severity up to 40-60S in isolated plants/ foci. Wheat varieties HPW 155, HS 490 and WH 1080 recorded 5-30S severity at three hot spots and farmers' fields. HD 2967 and DPW 621-50/ PBW 621 recorded severity (40-60S) at some locations in mid and foot hill areas where farmers have not gone for propiconazole spray.

The stripe rust severity remained comparatively low in foot hills due to warmer climate/ rise in temperature in March-April and the wheat varieties *viz.*, HPW 236, HPW 211, HPW 249, VL 829, VL 616 etc. which succumbed to stripe rust in mid hills (Bajaura, Malan, Sunder Nagar) recorded less severity 5-20S in foot hill areas (Akrot, Una, Dhaulakuan). Since, the area under resistant varieties has gone up in the state as well as farmers have become vigilant against stripe rust and spraying their crop with propiconazole at the appearance of yellow rust so, the overall severity of yellow rust remained moderate not causing much loss to the wheat crop. Leaf rust with severity 20-60S was recorded at few locations viz. Una, Nalagarh, Kunihar, Malan, Kangra etc. Flag smut with incidence ranging from 3-11% was recorded at some locations in foot and mid hill areas. Powdery mildew with high intensity/ severity up to 8 (on 0-9 scale) was recorded on susceptible varieties at some locations, otherwise, its overall intensity/ severity remained low to moderate (3-5) during current *rabi* season.

An extensive survey was conducted by Dr. Pramod Prasad and Dr. Subodh Kumar, Regional Station, DWR, Shimla (HP) during 18th to 21st May, 2014 for monitoring of rusts on wheat and grasses in different parts of Himachal Pradesh, Uttarakhand and Uttar Pradesh. During the survey, wheat and grasses were monitored for rust infection throughout the route connecting Shimla to Bhowali (Uttarakhand). On 18.05.14, on the way from from Shimla to Pantnagar, monitored all type of grasses for rust infection at regular interval, but could not observe any rust on the grasses. On May 19, 2014, heavy infection of all three rusts was observed on most of the collections planted at Bhowali. Surprisingly, there was high (60-80S) stem rust infection on about 50 % of the collections. According the Dr. S.K. Verma, In-charge of the Station, stripe and leaf rusts are consistently present in the farm over the years but stem rust was observed after a long time and that too in a severe form. Also monitored the grasses growing around the wheat fields of the station and across the river flowing through the NBPGR station. Wheat rusts like symptoms were noticed on about 20 grasses. On 20th of May, on the way to Haridwar, grasses were monitored for rust infection at different locations viz. Rudrapur (UK), Doraha (UK), Kashipur (UK), Jaspur (UK), Afjalgarh (UP), Dhampur (UP), Nagina (UP), Najibabad (UP). While coming back to Shimla from Haridwar on 21st May, 2014 monitored grasses at Chiddarwala (UK), Paonta Sahib (HP), Dhaulakuan (HP), Nahan (HP), Sarahan (HP), Naina Tikkar (HP), Kumarhatti (HP) etc. At most of the locations, rust like infection on many grasses were very frequent . Stripe rust in few wheat plants and leaf rust in traces was seen at a farmer's field at Sarahan village of Sirmour district (HP). The grasses in the nearby areas surrounding that wheat field were also monitored. Wheat and grass rust samples were collected and taken to Shimla for further studies.

The farmer's fields were surveyed by Dr S.S. Karwasra, Head Department of Plant Pathology, CCS HAU, Hisar, Dr. Sudheer Kumar, Principal Scientist (Plant pathology), DWR, Karnal, and Dr Rakesh Devlash, Scientist, HPKVV on 13th June, 2014 for presence of rusts in Kullu Valley of Himachal Pradesh. In Kullu area, yellow rust was observed but most of the pustules were converted in to teliopustules. However under shade some leaves were green and there urediopustules were observed. The severity was 20 – 30 S. Leaf rust was also observed but most of the pustules are converted in to teliopustules. However under shade some leaves were green and there urediopustules were observed. The severity was 40-60 S. In village Bhutti (Kullu), yellow rust was observed (20S). Loose smut was also observed but incidence was very low. In village Bhalayani, yellow rust severity was more (60-80S). Powdery mildew was also observed under apple trees. Leaf rust was also observed (20S) in villages Bhutti and Bhalayani. Dr Parmod Prasad, DWR Regional Station Flowerdale, Shimla and Mr. Deldan Namgyal, Technical Assistant, KVK, Leh (SKUAST) conducted wheat rust survey in Leh Ladakh district of Jammu and Kashmir during June 20-22, 2014. The surveyed villages include Nimmu, Basgo, Chuchot, Shay, Chog lamsar, Spitak, Khardung, Gompa, Gangles, Khalser, Diskit, Hunder etc. Grasses were also monitored for rust diseases and grasses showing stripe rust like symptoms were collected. No rust was observed in wheat crop. During last week of June, Dr. R. P. Dua, ADG (FFC) and Dr. Indu Sharma, PD, DWR, Karnal surveyed Lahaul valley of HP. No rust was observed. Dr. S.S. Singh, former Project Director, DWR, Karnal and Dr. Rakesh Devlash (Bajaura) also monitored rusts situation in Kullu area during June, 2014.

North Western Plain Zone (NWPZ)

On March 3, 2014, farmer Sh.Sanjeev Kumar of village Chorpura (Near Indri), has informed that his crop in 25 acres was affected by yellow rust. On March 5, 2014, Dr Madhu Meeta Jindal (Senior Wheat Pathologist) and Dr Puja Srivastava (Asstt Plant breeder), PAU, Ludhiana, surveyed wheat crop area of Ladowal (Ludhiana). Yellow rust was observed on one plant of HD 2967 in village Churpur. At Ladowal seed farm, one foci of yellow rust ($100m^2$) having disease severity of 80S was observed in HD 2967. The farmer's fields in Punjab were surveyed by Dr. Sudheer Kumar, Principal Scientist (Plant pathology), DWR, Karnal and Dr O.P. Gangwar, Scientist (Plant Pathology), Shimla on March 4, 2014. Stripe rust was observed in traces in fields in Fatehgarh Sahib, Pathankhot, Kishangarh and Jallandhar. In village Pada (Gurdaspur), stripe rust was upto 20S in some fields. On 5th March, 2014, Dr. M.K. Pandey, Assistant Professor (Plant Pathology) SKUAST- Jammu also joined the team and survey was conducted in Jammu region *viz.*, Jammu, Samba and Kathua districts. Overall it was observed that Jammu and Samba districts in Jammu region were more severely infected by yellow rust. In this area, yellow rust infection (trace-80S) was observed in almost in all the fields. However, yellow rust in about 10% of wheat fields in both the districts was upto 40S. Comparatively, Kathua wheat fields had less yellow rust ranged from traces to 10S severity. The varieties grown were Raj 3077, Raj 3765, PBW 175, PBW 550 and HD 2967.

A team of scientists comprising of Dr Beant Singh (Assistant Entomologist), Wheat Section, Department of Plant Breeding and Genetics, PAU, Ludhiana and Dr Subhash Katare (Entomologist) DWR, Karnal surveyed the wheat crop on 12-13 March, 2014 in different districts of Punjab and Haryana enrouting Karnal, Kaithal, Jind, Hisar, Fatehabad, Dabwali, Sirsa, Malout, Muktsar, Sarenaga, Moga, Jagraon, Ludhiana and adjoining areas. Moderate to severe incidence of wheat aphid was observed in some villages of Karnal (Bastli), Kaithal (Batta and Dakala), Jind (Danola), Hisar (DWR research Farm), Mukatsar (Chakdiwala), Sarenaga (Sekha Kalan) and Moga. Moderate termite damage was recorded in some parts of Karnal (Basthali) and Kaithal (Batta) while minor incidence of Pink Stem Borer was observed in village Bilaspur (Dabwali). Lodging of wheat crop was observed in some parts of Haryana *viz.*, Kaithal, Karnal and Jind. Minor incidence of yellow rust (traces) was also recorded in two fields of districts, Jind and Moga.

Dr. Indu Sharma, Project Director, DWR, Karnal surveyed Bawal, Neemrana and Rewari. No rust was observed in any field. On 6.3.2014, stripe rust was observed on DBW17, Super 172 and DPW 621-50. On 8.3.2014, foliar blight was observed in Khanna and Sirhind areas but there was no rust. In village, Ahawri near Ambala, stripe rust (20MS to 20S) was observed. Dr. Sudheer Kumar, DWR and Dr. Sujay Dutta, ISRO surveyed Karnal and Yamunanagar areas on 13.3.2014 and observed stripe rust infection (20-40S) in patches in Karnal . Leaf blight was also observed in few fields. In Yamunanagar, 20-40S stripe rust severity was observed. Dr. Sudheer Kumar, DWR and Dr. Sujay Dutta, ISRO surveyed farmers fields in Karnal, Panipat, Rohtak and near by areas on 14.3.2014. Dr. Gyanendra Singh and Dr. S.K. Singh, DWR, Karnal observed leaf blight in farmers fields of Bijnaur, Hapur, Mukteshwar, Mordabad, Rampur districts in U.P during 26-29.3.2014. Drs. M.S. Saharan, Gyanendra Singh and S. K. Singh surveyed Western UP on 2.4.2014 and collected leaf blight and rusts samples from farmers fields. Powdery mildew was also noticed on few plants. The stripe rust was observed in traces in Shahpur (Panipat). Dr. Subhash Katare and Mr. Jitender Kumar, DWR surveyed Asandh, Jind and Hisar areas on 7.4.2014. Stripe rust was found (20-40S) in farmers fields. Dr. O.P. Gangwar, DWR, Flowerdale and R. Selvakumar, DWR, Karnal made a survey on 21.4.2014 to collect the weed samples infected with rust from wheat fields. The samples were collected and sent to Flowerdale for further analysis. Dr. Sudheer Kumar and R. Selvakumar, DWR surveyed farmers fields on 20.6. 2014 in Kalesar, Ponta Sahib, Herbertpur, Vikas Nagar and Dak Pathar areas for observation of any plants/ grasses showing rust. The rust was not noticed on any of the grasses observed.

Peninsular Zone

Survey was undertaken for wheat crop health status in Nasik district on 11/3/2014 and 13/3/2014 by Dr. B.C.Game, ARS, Niphad. Stem rust in farmers field was not noticed. Leaf rust was recorded for the first time in two fields on variety LOK-1 at Jopul village (Dindori Tahsil, Dist.Nasik). In Dindori Tehsil, leaf rust severity up-to 80S on Lok-1 and other susceptible off-types. Incidence of stem rust was found in two fields, first field of Lok-1 and in second field on off-types from Mohadi and Korhate villages. During first fortnight of March, leaf rust upto 60S was reported in farmers fields of western Maharashtra and Marathwada region. Dr. Sawashe, Mahabaleshwar reported stem rust severity upto 40S in wheat fields from Nashik and Dhule districts of Maharashtra during 2nd fortnight of March, 2014. Leaf rust and stem rust incidence was recorded in trap plot nursery planted at IARI Regional station, Indore on 12.3.2014. Leaf rust was observed in range of 5MR to 80S and stem rust (TR-50MS) on the test varieties in trap plot nursery.

North Eastern Plain Zone

Dr. Javed Bahar Khan, CSAUA&T, Kanpur reported termite infestation ranged from 12-15% in rainfed crop and about 5% infestations was recorded in irrigated crop. Wheat crop showed moderately resistant reaction against aphid. In late sown wheat crop, shoot fly infestation ranged from 10-13%. The first incidence of yellow and brown rust was observed in wheat on 24.02.2014 at Kanpur. Initiation of brown rust infection was also observed in Kharchia (TPN) at Araul at Dalipnagar on 24th Feb., 2014. Dr. Sunita Mahapatra, Coochbehar observed leaf blight during 1st week of March in Pundibari, Coochbehar, West Bengal.

CZ: Dr. T. L. Prakasha, IARI, Indore informed the rust status on TPN entries. Dr. Indu Sharma, PD, DWR conducted survey on 13.3.2104 in Gwalior to Mathura road for rusts. Brown rust was observed on off type plant near village Chhata.

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