प्रगति प्रतिवेदन

PROGRESS REPORT

2018-19

अखिल भारतीय समन्वित गेहूँ एवं जौ अनुसंधान परियोजना

AICRP on Wheat and Barley

फसल सुरक्षा

CROP PROTECTION

भा.कृ.अनु.प.–भारतीय गेहूँ एवं जौ अनुसंधान संस्थान, करनाल

ICAR-Indian Institute of Wheat and Barley Research, Karnal

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ALL INDIA COORDINATED WHEAT AND BARLEY IMPROVEMENT PROJECT

PROGRESS REPORT
2018-19

CROP PROTECTION

Sudheer Kumar
D. P. Singh
Poonam Jasrotia
Prem Lal Kashyap
Gyanendra Pratap Singh

ICAR – INDIAN INSTITUTE OF WHEAT AND BARLEY RESEARCH
KARNAL – 132 001, HARYANA, INDIA
www.iiwbr.org

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(Sudheer Kumar)
Principal Investigator
(Crop Protection Programme)

ICAR-IIWBR, Karnal
Dated: 03.08.2019

C O N T E N T S

ANNEXURES

PROGRAMME OF WORK, 2018-2019

The programme for the crop year 2018-2019 was chalked out in the 57th All India Wheat and Barley Research Workers Meet held at BAU Ranchi during August 24-26, 2018. The various activities to be executed at respective centres are given below:

PROGRAMME 1: status of disease resistance in the entries of pre coordinated and coordinated yield trials and released check varieties, 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, Faizabad, Kanpur (7)

Yellow Rust: Gurdaspur, Dhaulakuan, Malan, Karnal, Durgapura, Ludhiana and Jammu (7)

South:

Stem Rust + Leaf Rust: Dharwad**,** Mahabaleshwar, Wellington, Powarkheda, Niphad and Indore (6)

(b) **Leaf Blight:** Faizabad, Pusa (Bihar), Varanasi, Murshidabad, Kalyani, Sabour and Coochbehar (7)

ii. Plant Pathological Screening Nursery (PPSN)

Objectives

Promotion of entries from one stage to the other in the coordinated trials and identification of varieties for release after AVT level on the basis of their level of disease resistance.

a. Rusts:

North:

Stripe Rust: Dhaulakuan, Gurdaspur, Malan, Bajaura, Karnal, Delhi, Ludhiana, Pantnagar, Durgapura, Jammu, Kudwani and Hisar (12)

Leaf Rust: Delhi, Hisar, Jammu, Kanpur, Karnal, Ludhiana, Pantnagar, Durgapura, Faizabad(9)

South:

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

b. **Leaf blight (NIVT 1A, 1B, 3A):** Kalyani, Coochbehar, Pusa (Bihar), Faizabad, Varanasi, Sabour, Shillongani (7)

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 Incharge, IIWBR Regional Station Flowerdale, Shimla for pathotype analysis, with information to P.I. (Crop Protection). The rusts have to be recorded every month.

Monitoring of PPSN

The teams of Plant Pathologists and breeders were constituted during the work-planning meeting for effective monitoring and data recording in PPSN at various locations indifferent zones. The team consists of

NWPZ:

Drs. Sudheer Kumar, Satish Kumar and M. K. Pandey will monitor PPSN at Dahulakuan, Ludhiana, Gurdaspur and Jammu centres.

Drs. Vaibhav K Singh, Jaspal Kaur, Anil Kumar and P.L. Kashyap will monitor PPSN at Pantnagar.

Drs.O. P. Gangwar, Rajender Singh Beniwal, Vikram Singh and P.S. Shekhawat will monitor, Karnal, Hisar, Durgapura and Delhi centres.

CZ:
Drs. Sudheer Kumar, K. K. Mishra, Gurvinder Singh Mavi, and I.B. Kapadia will monitor Vijapur, Junagarh, and Powarkheda
Drs. D. P. Singh, T.L. Prakasha, Dr. S K Goyal, and S.I. Patel will monitor Indore centre

PZ:
Drs. D. P. Singh, B. C. Game, Ajit Maruti Chavan, T.K. Narute will monitor PPSN at Mahabaleshwar, Pune and Niphad
Drs. Sudheer Kumar, Dnyandeo A. Gadekar, and M.A. Gud will monitor Dharwad centre

SHZ: Drs. Vaibhav K Singh, S. P. Singh, J. Nanjundan and K.K. Mishra (Almora) will monitor Wellington centre

The Plant Pathologists and Breeders of other zones will monitor PPSN during Zonal monitoring tours.

iii AUDPC based identification of slow rusters in AVT material:
Leaf and Stripe rusts - IIWBR, Karnal
Stripe rust - Ludhiana
Stem and leaf rusts -Mahabaleshwar
Leaf rust: Faizabad
Stem rust -Indore

iv. APR: Race specific and slow rusting
1. **Leaf rust:** AVT entries of NWPZ, NHZ and NEPZ, along with the check entries of the respective zones.
Centres: New Delhi and Ludhiana under field conditions and Flowerdale, Shimla (under glass house conditions)
2. **Stem rust:** AVT of CZ and PZ, along with the check varieties of the respective zone.
Centres: Indore, Pune, Powarkheda and Mahabaleshwar
3. **Stripe 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 in North.

- **(i)** Leaf rust: 77-5, 77-9, 104-2, 12-5
- **(ii)** Yellow rust: 46S119, 110S119, 47S103, 110S84
- **(iii)** Stem rust: 40A,11,42 and 117-6

A mixture of races in case of leaf and stem rusts will be supplied from Mahabaleshwar centre in South.

v. Seedling Resistance Tests and postulation of Rust Resistance Genes

1. Leaf, Stem and Yellow rusts (All races): IIWBR, Regional Station, Flowerdale, Shimla for AVT's (*T. 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.
2. Stem and Leaf rusts: Mahabaleshwar for SRT on AVT entries of CZ, PZ and NIVT (durum entries).

PROGRAMME 2: Resistant sources to different diseases and their utilization

i. **Elite Plant Pathological Screening Nursery (EPPSN):** The resources of resistance to three or two rusts identified in PPSN will be retested to confirm their resistance to rusts:

North: New Delhi, Malan, Karnal, Ludhiana, Pantnagar, Durgapura, Hisar, Chattha and Almora (9)
South: Wellington, Mahabaleshwar, Dharwad and Indore, Niphad (5).

ii. **Multiple Disease Screening Nursery (MDSN):** It will have sources of resistance to rusts and other diseases found earlier and will revalidate their status to different diseases:

DISEASES
North: 14 Locations
Stripe rust: Karnal, Ludhiana, Hisar, Dhaulakuon, Malan, Pantnagar
Leaf rust: Karnal, Ludhiana, Delhi, Hisar
Karnal Bunt: New Delhi, Karnal, Ludhiana, Dhaulakuan, Pantnagar
Powdery mildew: Dhaulakuan, Almora, Pantnagar, Malan, Chattha
Foliar blights: Faizabad, Varanasi, Coochbehar, Sabour, Hisar, Kalyani, Mushidabad (W.B.)
Loose smut: Hisar, Durgapura, Ludhiana, Almora
Flag smut: Hisar, Durgapura, Ludhiana
Head scab: New Delhi, Dhulakuan, Gurdaspur
South: 4 locations
Leaf and Stem rust: Mahabaleshwar, Indore Dharwad, Niphad and Wellington
Nematodes (CCN) : Durgapura, Hisar, and Ludhiana

The confirmed sources of resistance will be multiplied and seed will be shared with breeders along with passport data in NGSN.

iii. Leaf Blight

Leaf Blight Screening Nursery (LBSN): No. of Centres: 12

This nursery will consist of earlier identified resistant materials as well as the AVT's and NIVTs. It will have all the released varieties and material found resistant in preceding years. It will have entries sent to CIMMYT for screening against wheat blast also.

NWPZ: Pantnagar, Ludhiana, Karnal and Hisar.
NEPZ: Varanasi, Faizabad, IARI Pusa, Coochbehar, Shillongani, Ranchi, Kalyani and Murshidabad (W.B.)
PZ: Dharwad

iv. Karnal Bunt

Karnal Bunt Screening Nursery (KBSN): This nursery will consist of the earlier identified resistant materials, released varieties alongwith AVT entries under artificially inoculated conditions.
Dhaulakuan, Ludhiana, New Delhi, Pantnagar, Hisar, Karnal and Jammu (7).

v. Loose Smut

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

vii. Powdery Mildew

Powdery Mildew Screening Nursery: All entries of AVT, previously identified resistant Material and released varieties (NHZ, NWPZ)
Centres: Almora, Pantnagar, Shimla, Malan, Bajaura, Dhaulakuan and Chatha (8)
viii. Flag Smut Screening Nursery: Ludhiana, Hisar, Karnal and Durgapura (AVT entries).
ix. Foot rot: Dharwad (AVT entries)
x. Hill bunt: Malan, Bajaura and Almora (AVT entries NHZ).
xi. Head scab: New Delhi, Dhulakuan, Gurdaspur

The pathogenomics of Powdery mildew samples will be done at IIWBR Karnal.

PROGRAMME 2: Crop Health

Pre- harvest crop health monitoring

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 2018 till the harvest of crop.

- 'Wheat Crop Health Newsletter' will be issued on monthly basis by PI (CP) IIWBR, 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-mountainous areas in NWPZ. Entomologists will also accompany the teams.

Team I (last week of Dec. 2018): Drs. Sudheer Kumar, Vaibabh Kumar Singh, Jaspal Kaur, (Punjab and Haryana at strategic locations)
Team II (second week of Jan. 2019): Drs. P.L. Kashyap, O. P. Gangwar, M. K. Pandey
Route: Karnal- Ambala-Khanna- Ludhiana-Phillaur-Jalandhar-Dhilwan-Amristsar-Batala-Gurdaspur-Kathua-Jammu
Team III (last week of January, 2019): Drs. Sudheer Kumar, P. Prasad, R.S. Beniwal
Route: (Karnal to Rupnagar via Indri, Ladwa, Yamunanagar, Bilaspur, Sadhaura, Naraingarh, Panchkul and Kharar-Garhshankar, Nawanshahar, Machhiwara, Samrala, Khanna, Ambala, Kurukshetra)
Team IV (Second week of Feb. 2019): Drs. D. P. Singh and Charan Singh (Karnal-Muzaffarnagar, Western U. P.)
Team V (Fourth week of Feb., 2019): Drs. Poonam Jasrotia, Beant Singh and Sachin Upmanyu (Haryana, West U. P. and Uttarakhand)

Monitoring the pathotype distribution of rust pathogens: It will be undertaken by IIWBR, 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 centers are required to send the rust infected samples (natural infection) for pathotype analysis to the concerned centres according to recommended protocol.

Wheat Disease Monitoring Nursery (To be co-ordinated by Flowerdale, Shimla): The nursery will be planted at 38 locations including Kudwani (Srinagar), Varanasi KVK, Rampur and Yamunanagar (Haryana). Samples from this nursery should be sent regularly to IIWBR RS 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 will be recasted.

Off-season Disease Monitoring Nursery (To be coordinated by IIWBR 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 coordinated 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.

Foliar and spike diseases monitoring nursery: It will be planted adjoining at key locations of Indo-Bangladesh borders and different centres of NEPZ. This will help in monitoring of leaf blight, head blight / head scab and wheat blast.

Monitoring of wheat blast: The following teams are constituted to monitor wheat crop in West Bengal and Assam along the Indo-Bangladesh borders for the presence of wheat blast.

Team 1: Drs.Sudheer Kumar, Javed Bahar Khan and Dhiman Mukherjee
Team 2: Drs. P.L. Kashyap, Sunita Mahapatra and Satyajit Hembram
Team 3: Drs.D. P. Singh, S. P. Singh, M. K. Pandey and Dhiman Mukherjee

The samples of wheat blast like disease will be analyzed at Kalyani and Coochbehar centre.

Leaf blight samples to be sent from all the centres to PI (CP) for pathogen monitoring from naturally infected fields.

Post- harvest crop health monitoring

Monitoring of Karnal bunt and black point 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) and PZ (Pune, Niphad and Dharwad) may also supply grain samples to IIWBR Karnal for analysis to PI (CP)

PROGRAMME 3: Integrated disease management

Chemical control of leaf and spike diseases of wheat: Chemical control of leaf and spike diseases: This will be planted in west Bengal at 4 locations in Nadia, Murshidabad and Malda districts.

Chemical control of stripe rust: New chemicals will be tested at Karnal, Hisar, Ludhiana and Jammu.

PROGRAMME 4. Wheat Nematology

i. Monitoring of Nematodes: *Anguina tritici, Tylenchus spp. Pretylenchus spp. & Heterodera avenae*: All centres of Nematology

ii. Evaluation of resistance against nematodes parasitizing wheat
***Heterodera avenae*:** Hisar, Durgapura and Delhi
***Heterodera filipjevi*:** Ludhiana
***Meloidogyne graminicola*:** Ludhiana and Hissar

iii. Eco-friendly management of CCN nematodes in wheat:
centres: Durgapura, Hisar, Ludhiana and New Delhi
(To be coordinated by Delhi centre)

PROGRAMME 5. Wheat Entomology

A. Host Plant Resistance: Entomological screening nurseries (ESN), Multiple pest screening nurseries (MPSN), National initial varietal trial nurseries (NIVT) and special screening nurseries of promising entries identified during previous season

A1: Entomological screening nurseries (ESN)- In these nurseries, AVT entries along with those found resistant during previous years will be screened for
(a) Shoot fly (Centres: Dharwad, Ludhiana, Kanpur, Niphad)
(b) Brown wheat mite (Centres: Durgapura and Ludhiana)
(c) Wheat Aphids (Centres: Niphad, Ludhiana, Karnal, Shillongani and Kharibari)
(d) Root aphid (Centres: Karnal and Ludhiana)
The NIVT entries will also be screened against foliar aphids at Niphad, Ludhiana and Karnal

A2: Multiple pest screening nurseries (MPSN)- In these nurseries, the germplasm having resistance to multiple diseases and insect-pests will be screened for
(a) Shoot fly (Centres: Dharwad, Ludhiana, Kanpur and Niphad)
(b) Brown wheat mite (Centres: Durgapura and Ludhiana)

(c) Foliar aphids (Centres: Niphad, Ludhiana, Karnal, Shillonganiand Kharibari)
(d) Root aphid (Centres: Karnal and Ludhiana)

B. Integrated Pest Management

B1: Survey and surveillance of insect-pests and their natural enemies in wheat and barley cropping systems *(All centres)*

Roving surveys will be carried out at fortnightly intervals during the cropping season in wheat and barley crops for insect-pests and their natural enemies. Population and damage levels of different insect-pests will be recorded and indicated as grades or percent damage inflicted to crop. The peak period of pest activity and its severity of damage will also be recorded. Keeping in view of the threat from fall armyworm (*Spodoptera frugiperda*), a strict vigil will be kept to check its spread in different wheat growing areas.

B2. Influence of sowing time on the incidence and population build-up of major insect pest of wheat (Centres: Karnal, Niphad, Ludhiana, Kharibari)

The effect of sowing time on the population build-up of major insect-pests of wheat will be studied at four geographical locations to better understand the insect-pest behaviour under different climatic conditions

B3. Evaluation of trapping efficiency of different type of insect-traps for aphids (New trial) (**Centres:**Niphad, Ludhiana, Karnal, Kharibari)

Different types of traps viz., tray-traps, sticky-traps and pheromone lures and their placement in the crop will be tested to determine the efficiency of traps to capture aphids in the field. The criterion of trap colour, material and cost of trap will be considered for selection of traps for the experiment. The population of alate (winged) and wingless forms of aphids captured in traps will be recorded during the season.

B4. Effect of varied nitrogen fertilization on aphid and termite infestation in wheat (New trial) (**Centres:**Karnal, Ludhiana, Niphad)

Impact of three different doses (low, medium & high) of nitrogen application on population abundance of foliar aphid and termites will be investigated in wheat. The nitrogen doses for NWPZ locations will be 0, 75,150 and 225 kg/ha while for PZ location, it will be 0, 60,120 and 180 kg/ha. Population of aphids per plant, natural enemies (adult and grubs) per plot, yield per treatment and nitrogen status of plants before the treatment and at the time of harvest will be recorded to determine the individual effect of each dose of Nitrogen application on aphid abundance. To know effect of nitrogen fertilization on termite infestation the observations on plant population per meter row length, per cent damaged shoots and effective tillers in each treatment will be taken at different stages of crop along with yield at harvest.

B5. Basic studies for development of IPM strategies (Centres: Karnal, Niphad, Ludhiana, Kharibari)

The study will be conducted to generate region-wise data on population dynamics of major insect-pests of wheat and barley for developing pest-forecasting models. Weather parameters of a location will be correlated with insect population to determine the effect of climatic variations on the pest population dynamics under changing climate scenario.

B6. Zone specific IPM modules (Centres: Karnal, Ludhiana, Niphad, Kanpur)

The integrated pest module consisting of effective cultural, physical, biological and chemical components of integrated pest management will be formulated and tested against major pests of wheat viz., foliar aphids, shootfly and termites.

B7. Eco friendly management of foliar aphid (Centres: Karnal, Ludhiana, Niphad and Kharibari)

New bio-pesticides and new chemicals at lower doses will be evaluated against foliar aphids in wheat. Insect population counts before and after the treatment will be recorded along with yield in each treatment.

B8. Eco friendly management of termites (Centres: Durgapura, Kanpur, Ludhiana and Vijapur)
Few selected new chemicals along with botanicals as seed treatment will be tested against termites. The observations on plant population per meter row length, per cent damaged shoots and effective tillers will be taken at different stages of crop.

C. Post Harvest Entomology
C1. Studies on the insecticidal treatments on seed viability during storage under ambient condition against store grain pests, *Trogoderma granarium or Rhizopertha dominica* (Centres: Karnal, Niphad, and Kharibari). Plants having toxicity effects on insects will be tested as seed protectant to wheat seed/grains against major stored grain insect pests; *Sitophilus oryzae* or *Rhizopertha dominica*

List of Cooperators
Plant Pathology Programme

NHZ

ICAR-IIWBR, Regional Station, Flowerdale, Shimla.
S.C. Bhardwaj, O.P. Gangwar, Pramod Prasad, Subodh Kumar

VPKAS, Almora
K.K. Mishra

HPKVV, Palampur, Malan
Sachin Upmanyu

SKUAST-K, Khudwani, Sri Nagar
F.A. Mohiddin

Dhaulakuan
V. K. Rathee, Akhilesh Singh

Bajoura
Rakesh Devlash

NWPZ

ICAR-IIWBR, Karnal
Sudheer Kumar, P.L. Kashyap D.P. Singh,

ICAR-IARI, New Delhi
V.K. Singh, M.S. Saharan

GBPUA&T, Pantnagar
J. Kumar, Deep Shikha, Kanak Srivastava

CCS HAU, Hisar
R. S. Beniwal

PAU, Ludhiana
Jaspal Kaur, Ritu Bala

PAU, RS, GURDASPUR
Jaspal Kaur

RAU, Durgapura
P.S. Shekhawat

SKUAST-J, Chatha, Jammu
M.K. Pandey

NEPZ

ICAR-IARI, Regional Station, Pusa, Bihar
T. R. Das

CSAUA&T, Kanpur
Javed Bahar Khan

BHU, Varanasi
S.S. Vaish

BCKV, Kalyani (W.B.)
Sunita Mahapatra, Dhiman Mukherjee

BAU, Kanke, Ranchi
H.C. Lal

NDUA&T, Faizabad
S.P. Singh

UBKV., Pundibari, Coochbehar
Satyajit Hembram

BAC, Sabour
C. S. Azad

RARS, Assam Agricultural University, Shillongani
Ranjana Chakrabarty

CZ

ICAR- IARI, Regional Station, Indore
T.L. Prakasha

JAU, Junagadh
I.B. Kapadia

SDAU, Vijapur
S.I. Patel

JNKV Research Station, Powarkheda
K.K. Mishra

PZ

ARI, Pune
Sudhir Navathe

UAS, Dharwad
P.V. Patil, Gurudatt M. Hegde

MPKV, Mahabaleshwar
T.K. Narute, R. R. Perane

ARS, Niphad
B.C. Game

SHZ
ICAR-IARI, Regional Station, Wellington
P. Nallathambi, C. Umamaheshwari

NEMATOLOGY PROGRAMME

ICAR-IARI, New Delhi
Pankaj

PAU, Ludhiana
Ramanna Koulagi

ARS, Durgapura
S.P. Bishnoi

CCS HAU, Hisar
Priyanka Duggal

ENTOMOLOGY PROGRAMME

ICAR-IIWBR, Karnal
Poonam Jasrotia

PAU, Ludhiana
Beant Singh

RARS, Assam Agricultural University, Shillongani
K. K. Sarma

Wheat Research Station, Vijapur
A. A. Patel

ARS, Durgapura
A.S. Baloda

CSAUA&T, Kanpur
J. K. Singh

UAS, Dharwad
P.V. Patil, Gurudatt M. Hegde

ARS, Niphad
S.D. Patil

Kharibari, WB
Wasim Reza

Summary of trials and nurseries allotted and conducted at different cooperating centres during 2018-19 in Crop Protection Programme (Plant Pathology & Nematology)

S.N	Centre	Cooperators	Nurseries & Trials	Allotted	Conducted	Data not considered	Data not received
	NHZ						
1.	Almora	K.K. Mishra	MDSN, EPPSN, PMSN, LSSN, HBSN	5	5		MDSN(LS) HBSN
2.	Dhaulakuan	V.K. Rathee Akhilesh Singh	IPPSN, PPSN, MDSN, KBSN, PMSN, FHB	6	5	KBSN,	MDSN(KB)
3.	Malan	Sachin Upmanyu,	IPPSN, PPSN, MDSN, EPPSN, PMSN, HBSN,	6	6	IPPSN(YR)	
4.	Bajaura	Rakesh Devlash	PPSN, PMSN, HBSN	3	3	PPSN(YR)	
5.	Shimla	S.C.Bhardwaj, Pramod Prasad, O.P. Gangwar,	PMSN, SRT, APR	3	3		
6.	Kudwani (J & K)	M. Najeeb Mughal	PPSN	1	1		
NWPZ							
1.	Chattha (Jammu)	M. K. Pandey	IPPSN, PPSN, MDSN, EPPSN, KBSN, Chemical control of stripe rust	6	6		
2.	Ludhiana	JaspalKaur, Ritu Bala, Ramanna Koulagi	IPPSN, PPSN, LBSN, MDSN, EPPSN, KBSN, LSSN, FSSN, APR, , CCNSN, Chemical control of stripe rust	12	12		
3.	Gurdaspur	Jaspal Kaur	IPPSN, PPSN, FHB, MDSN	4	4		
4.	Pantnagar	J. Kumar, Deepshikha, Srivastava	PPSN, LBSN, MDSN, EPPSN, KBSN, PMSN	6	6	MDSN(KB)	
5.	Duragupra	P.S. Sekhawat, S.P. Bishnoi	IPPSN, PPSN, MDSN, EPPSN, LSSN, FSSN, Nematode survey, CCNSN	9	7	PPSN (LR)	IPPSN(LR)
6.	Karnal	Sudheer Kumar, P.L. Kashyap, D.P.Singh,	IPPSN, PPSN, LBSN, MDSN, EPPSN, KBSN, FSSN, chemical control of stripe Rust	8	8		
7.	New Delhi	M. S. Saharan, V.K. Singh, Pankaj	IPPSN, PPSN, MDSN,EPPSN, KBSN, APR, FHB, CCNSN	8	8		
8.	Hisar	R.S. Beniwal, R. S. Kanwar, Priyanka	LBSN, EPPSN, IPPSN, PPSN, LSSN, FSSN, MDSN, KBSN, CCNSN,	11	11	IPPSN (LR), EPPSN(YR), MDSN(LR)	MDSN(LB)
NEPZ							
1.	Faizabad,	S.P. Singh, J. Verma	IPPSN, LBSN, MDSN, PPSN, NIVT	5	5		
2.	Varanasi	S.S. Vaish	IPPSN, LBSN, MDSN, NIVT	5	5		
3.	Coochbehar	Satyajit Hembram	IPPSN, LBSN, MDSN, NIVT	4	4		

4.	Ranchi	H.C. Lal	LBSN	1	1		
5.	Shillongani	R. Chakravarty	LBSN, NIVT	2	2		
6.	Kalyani	Sunita Mahapatra, Dhiman Mukherjee	IPPSN, LBSN, NIVT, MDSN,	5	5		
7.	IARI, Pusa	T.R. Das	IPPSN, LBSN, NIVT	3	3		
8.	Kanpur	Javed Bahar Khan	PPSN	1	1		
9.	Sabour	C.S. Azad	IPPSN, MDSN, NIVT	3	3		
CZ							
1.	Indore	T.L. Prakasha	IPPSN, PPSN, MDSN, EPPSN, APR	5	5		
2.	Powarkheda	K.K. Mishra	IPPSN, PPSN, APR	3	3		
3.	Vijapur	S.I. Patel	PPSN	1	1		
4.	Junagarh	I.B. Kapadia	PPSN	1	1		
PZ							
1.	Dharwad	P. V. Patil	LBSN, EPPSN, FRSN, PPSN, IPPSN, MDSN, FRSN	7	7		
2.	Wellington	P. Nallathambi, C. Umamaheshwari, J. Berliner	IPPSN, PPSN, EPPSN, MDSN,	4	4		
3.	Mahabaleshwar	S.G. Sawashe, N. V. Savant, M. A. Gud, T.K.Narute	IPPSN, PPSN, EPPSN MDSN, SRT, APR	6	6		IPPSN, PPSN, EPPSN, MDSN,
4.	Niphad	B.C. Game, P. E. More	IPPSN, PPSN, EPPSN MDSN	4	4	PPSN(SR)	
5.	Pune	B.K. Honrao	PPSN, APR	2	2	PPPSN (SR&LR)	

Entomology Programme

S.N.	Centre	Cooperators	Nurseries	Nurseries		Data not considered	Other trials	
				Trial allotted	Trial conducted		Trial allotted	Trial conducted
NWPZ								
1	Ludhiana	Beant Singh	ESN, NIVT, MPSN	3	3		8	8
2	Duragupra	A.S. Baloda	ESN, MPSN	2	2		2	2
3	Karnal	Poonam Jasrotia	ESN, NIVT, MPSN	3	2		9	9
NEPZ								
1	Shillongani	K.K. Samra	ESN,MPSN	2	2		1	1
2	Kanpur	J.K. Singh	ESN,MPSN	2	2		5	5
3	Kharibari	Wasim Reza	ESN, MPSN	2	2		3	3
CZ								
1	Vijapur	A.A. Patel	-	-	-		4	4
PZ								
1	Dharwad	P.V. Patil	ESN, MPSN	2	2		1	1
2	Niphad	Sanjay D. Patil	ESN, NIVT, MPSN	3	3		9	9

SUMMARY

Crop protection programme aimed to minimise losses cause by biotic stresses through keeping strict surveillance, identification of resistance sources and development of management strategies. Crop protection programme also worked hand in hand with wheat breeders to evaluate status of resistance to biotic stresses in initial and advanced breeding material with check varieties aiming to help breeders for promotions their entries in yield trials and identification of proposing variety for release. Additionally, keep vigil on new pathotypes of rusts and occurrence of any exotic diseases, as well as status of Karnal bunt and other diseases and insect pests. Coordination and sharing of knowledge among different agencies like DAC & FW, ICAR, SAUs, State Agriculture Departments, KVKs, and Farmers etc. about the potent diseases and insect pests and their management through regular strategy planning meetings, trainings, field days, discussions and distributions of literature and using IT tools. The achievements during 2018-19 are summarised below:

Host resistance

Advance breeding material was evaluated against disease and insect pests to support the breeding programme at various hot spot locations under artificially inoculated conditions. The major nurseries were: Initial Plant Pathological Nursery (IPPSN), Plant Pathological Nursery (PPSN), Elite PPSN, Multiple Disease Screening Nursery (MDSN), Multiple Pest Screening Nursery (MPSN), and disease / insect pest specific nurseries.

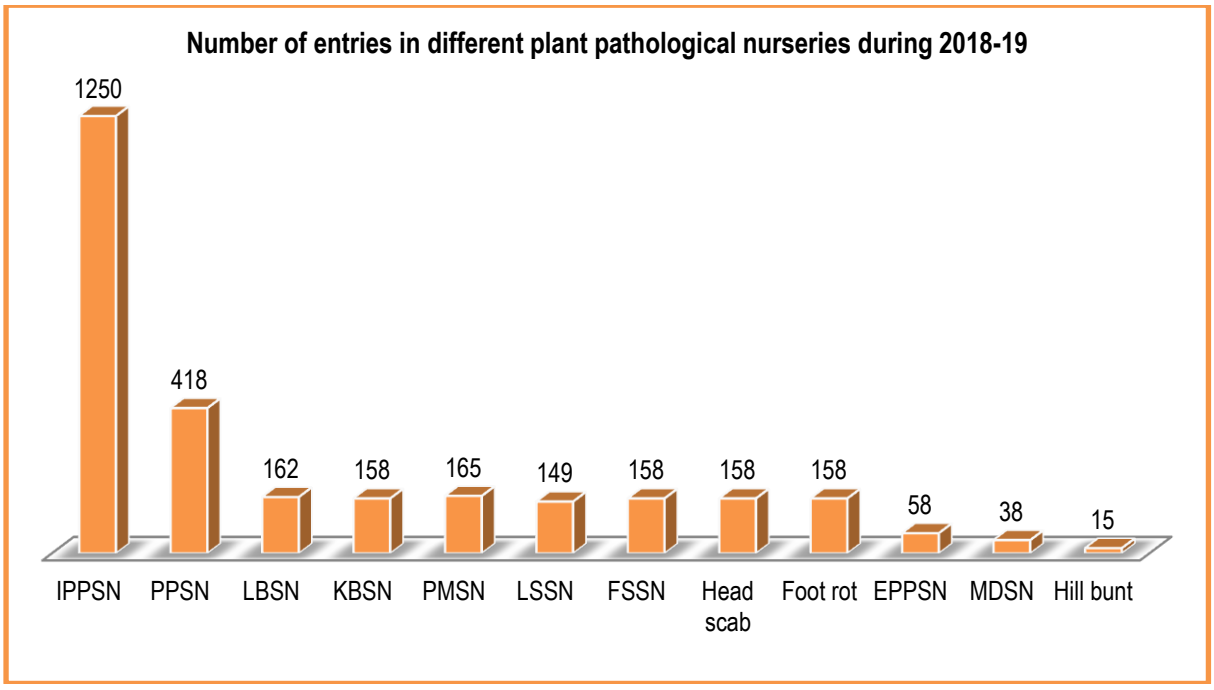

Fig. Constitution of different plant pathological nurseries during 2018-19

Rust resistance in IPPSN

A total 1250 entries were screened for rusts at multilocation under artificially inoculated condition. Out of these, 618, 923, 982 and 391 entries found resistant against stem rust, leaf rust (S), leaf rust (N) and stripe rust, respectively.

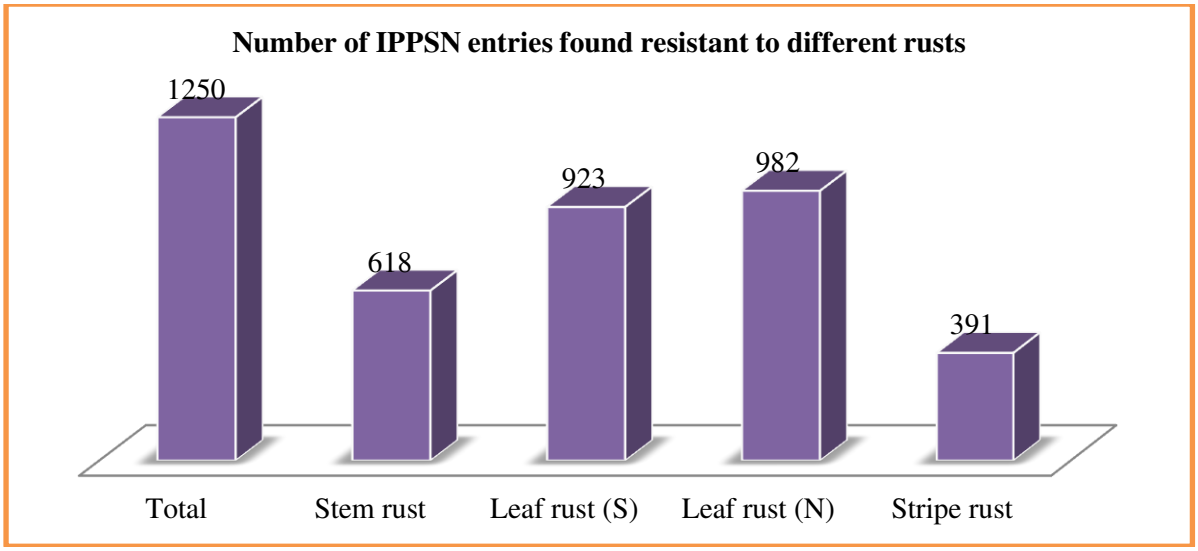

Fig. Number of IPPSN entries found resistant to different rusts.

Entries and check varieties identified resistant in PPSN:
Rust resistance materials in AVT entries (2018-19) with ACI upto 10.0 are given below:

Stem, Leaf and Stripe rusts
HPW467, PBW820[M], PBW821[M], PBW 771*,HD3249*[#Q], HD 3277, HI8713(d) (C), NIDW 1158 (d), HI 8811 (d), HI 8812 (d), GW 1348 (d), PBW 822[B], DDW 48 (d), DDW 47(d)*[Q], HI8808 (d), HI8807 (d), PBW 823[B], UAS428 (d) (C), MACS3949 (d) (C), HI 8805(d)*, UAS446(d) (C), NIDW 1149(d), HI 8802(d)*, WH1270, DBW303 and DBW302

Leaf and Stripe rusts
NW 7049, PBW752(I) (C), PBW 781, DBW187(I) (C), WH 1239, HI1612 (C), HI8737(d) (C), WHD 963 (d), AKDW2997-16(d) (C), DBW301, UP3043, UP3042 , WH1223, NW 7060, HD3271 and PBW 797

Leaf and Stem rusts
VL907 (C), VL892 (C), PBW550 (C), HD2967 (C), DPW621-50 (C), DBW173 (C), HI1620(I) (C), HI 1628*, NIAW 3170*, DBW39 (C), HD2888 (C), K8027 (C), HI1544 (C), HI8627(d) (C), MP3288 (C), DBW 277, HD2864 (C), MP4010 (C), CG1029, HI1633, HI1634, MACS6222 (C), DDW 48 (d), GW509, HD3090 (C), NIAW 3170* , GW 1346(d)*, MACS 4058(d)*, DDK1029 (C), MACS5052, DDK1056, HW1098 (C), MACS5053, DDK1057, DBW304, PBW825, PBW757 (C) and DBW14 (C)

Stem and Stripe rusts
HS507 (C), VL3020, VL3021, HD3226 (I) (C), PBW 796, WH1142 (C), HD3317, WH1254 and HI1621

Identification of multiple diseases resistant entries:
Based on rigorous screening of under Multiple Diseases Screening Nursery (MDSN) at multilocations the following genotypes have been identified as conformed source of resistance for multiple diseases:

A. Resistant to stem, leaf and stripe rusts +
Resistant to all three rusts + PM + FS + KB: PBW 777, TL 3011(T), TL 3012(T), TL 3013(T), TL 3014(T), TL 3015(T)
Resistant to all three rusts + FS + KB: HS 611, PBW 778, B662, HG 110
Resistant to all three rusts + FS: HI 8791(d)
Resistant to all three rusts + PM + FS: VL 3014
Resistant to all three rusts + LB + FS + FHS: HS 645
Resistant to all three rusts + LB +PM + FS + KB: UAS 462(d)

B. Resistant to Stem and Leaf rust +

Resistant to Stem and Leaf rust + FS + KB: HI 1620, DDK 1053(dic.), HS 644, MACS 5047, MACS 5049, WH 1232, IWP 5019, Line 1172

Resistant to Stem and Leaf rust + LB + PM + FS + KB: DDK 1052(dic.)

Resistant to Stem and Leaf rust + PM + FS + KB: HS 646

Resistant to Stem and Leaf rust + KB: VL 3013

C. Resistant to leaf and stripe rust +

Resistant to leaf and stripe rust + PM + FS + KB: HPW 439, PBW 780, DBW 246

Resistant to leaf and stripe rust + LB + FS + KB: HD 3271

Resistant to leaf and stripe rust + FS + KB: HI 1619, KRL 370, DBW 251

Resistant to leaf and stripe rust + KB: HI 1612

Resistant to leaf and stripe rust + FS: HS 468, WH 1233

D. Resistant to LB +

Resistant to LB + PM + FS + KB + FHS: VL 1013

Source of resistance to foliar blight

The entries from AVTs which showed the moderate level of resistance within average score below 35 and the HS of 57 are DDW 47(d)*Q, DDW 48 (d), HD 3345B, HD2967 (C), HD2967 (C), HPW 349 (C), HS 652 and VL 907 (C). The entries HD 3293, HD 2967 (C), HD 3171 (C), HI 1612 (C), HPW 467, HS 562 (C), PBW 550 (C) and VL 3021also showed moderate resistance to leaf blight with average score upto 35 but the highest score exceeded 57 due to high disease at one locations. Among entries previously identified moderately resistant, PBW 800 again showed moderate resistance to leaf blight with average score below 35 and the HS of 57 whereas entry HPW 451 and VL 1014 showed average score up to 35 but highest score exceeded more than 57 due to high score at one location.

Sources of resistance to Karnal bunt (average incidence upto 5%):

AKDW2997-16(d) (C), DBW 252*#, DBW 273, DBW14 (C), DBW173 (C), DBW187, DBW187(I) (C), DBW301, DBW304, DBW93 (C), DDW 47(d)*Q, DDW 48 (d), DDW 48 (d), DDW 49 (d), DDW 49 (d), DPW621-50 (C), GW 1348 (d), HD 3277, HD 3293, HD 3345B, HD2932 (C), HD3059 (C), HD3086 (C), HD3226(I) (C), HD3298, HI 8802(d)*, HI 8811 (d), HI 8812 (d), HI1544 (C), HI1612 (C), HI1634, HI8627(d) (C), HI8713(d) (C), HI8737(d) (C), HI8807 (d), HI8807(d), HS507 (C), HS673, K1317 (C), KRL210 (C), MACS 6696*, MACS3949 (d) (C), MACS5052, MACS6222 (aest.) (C), MACS6222 (C), MP3336 (C), NIAW 3170*, NIDW 1149(d), NIDW 1158 (d), PBW 781, PBW 822B, PBW 823B, PBW752(I) (C), PBW757 (C), PBW820M, PBW821M, PBW824, UAS 3002, UAS3002, UAS428 (d) (C), UAS446(d) (C), UP3041, UP3043, VL3019, VL3021, WH 1239, WH1080 (C), WH1124 (C), WH1142 (C) and WHD 963 (d)

Sources of resistance to powdery mildew (Av. score 0-3, highest score upto 5)**:**

DBW 257, DBW187 , DBW187(I) (C), DBW301, DBW302, DBW303, DBW304, DBW39 (C), DBW71 (C), DDK1029 (C), DDK1056, DDK1057, DDW 47(d)*^{Q}, DDW 49 (d), HD 3277, HD 3293, HD2932 (C), HD2932 (C), HD3086 (C), HD3086 (C), HD3226(I) (C), HD3271, HD3298, HD3347, HI1612 (C), HI1621, HI1634, HI8807 (d), HPW 451, HS 660, HS 662, HS507 (C), HS674, HW1098 (C), K 1601, KRL19 (C), KRL210 (C), MACS6222 (C), MACS6478 (C), NW 7060, PBW 766, PBW 781, PBW 796, PBW 797, PBW757 (C), RAJ 4529, Raj4083 (C), UAS3002, UP3042 , UP3043, VL 1014, VL3021, WH 1228, WH1105 (C), WH1223, WH1254 and WH1270

Utilization of resistance sources

The total 16 entries with confirmed sources of multiple disease and insect pest resistance were shared with 27 breeding centers across different agro-climatic zones of country for their utilization in breeding for resistance to biotic stresses. All 16 entries were utilized in the range of 7.4 – 48.1% by the breeding centres. The most utilized entries at many centres were HS 626, DBW 179, WH 1310 and HS 627. Out of these, Faizabad centre, utilized maximum 13 entries in their breeding programme followed by Niphad centre.

Survey and surveillance
Crop health was rigorously monitored during the crop season 2018-19 with major emphasis on occurrence of yellow rust in NWPZ and surveillance for wheat blast. The extensive surveys were conducted by the wheat crop protection scientists of different cooperating centers including ICAR-IIWBR Karnal and information was share among through the *"Wheat Crop Health Newsletter",* Vol. 24 (Issues 1 to 5) which was issued during the crop season and also uploaded on ICAR-IIWBR website (www.iiwbr.org). The first report of stripe rust was observed from village Fatehgarh Viran of block Chamkour Sahib of district Roopnagar on 14.1.2019. The yellow rust could not make any dent on wheat production and was very well managed. So far, the exotic diseases and pathotypes like Ug99 race of stem rust and wheat blast were not reported from any part of the country. The overall crop health status was excellent in the country.

Strategy Planning Meetings
Successful and time implementation of crop protection technologies first strategy planning meeting on "Evolving strategies for enhancing wheat production with special reference to management of wheat rust and Karnal bunt" was held on 22.10.2018 under the Chairmanship of Secretary, DAC & FW in New Delhi and attended by officials of DAC & FW, ICAR and Director Agriculture of different states. Second strategy planning meetings was also conducted on "Preparedness on occurrence of blast disease on wheat" on 31.8.2018 in Kolkata under Chairmanship of Agriculture Commissioner, GOI. It was attended by Director, Agriculture, Govt. of West Bengal, ADG (PP&B), Director, IIWBR and other higher officials of Govt. of West Bengal, ICAR and SAUs.

Advisory for stripe rust management: Advisory for stripe rust management was issued time to time i.e. in December, January and February for northern states. Awareness among farmers for stripe rust management was created through mobile, internet, toll free number, newspapers, discussions and delivering lectures in farmers training programmes.

Preparedness to wheat blast
Survey were conducted in North and South West Bengal near Indo-Bangladesh boarder by team of scientist from ICAR-IIWBR, Karnal, UBKV, Cooch Behar, West Bengal and BCKV, Kalyani, Nadia, West Bengal and no wheat blast was observed. To check entry of blast from Bangladesh, strict quarantine has been observed and wheat holiday in Murshidabad and Nadia district as well as No wheat zone in 5 Km along Bangladesh boarded was implemented. For identification of wheat blast resistant sources, a total of 353 Indian wheat varieties and advance breeding material were screened at Jessore, Bangladesh through CIMMYT and out of these 26 found free from blast infection and 31 showed resistance against wheat blast under artificially inoculated conditions. The varieties showed resistance are DBW 187, DBW 173, HD 2967, HD 3043 etc. which should be deployed in the disease prone areas. Anticipatory breeding programme has been initiated for faster breeding of blast resistant cultivars. During the current year 30 fresh crosses were made involving resistant donors.

Wheat Disease Monitoring Nursery (WDMN)
Wheat disease monitoring nursery (earlier trap plot nursery) is an effective tool to monitor the occurrence of wheat diseases especially rusts across different wheat growing areas of India. The 51st wheat disease monitoring nursery having 20 entries was planted at 41 locations, covering all the major wheat growing areas in the country, especially those situated near the bordering areas to the neighbouring countries.

SAARC Wheat Disease Monitoring Nursery
For monitoring of wheat diseases in SAARC countries to combat wheat diseases jointly SAARC-Wheat Disease Monitoring Nursery (SAARC-WDMN) was planted at 28 locations across the six SAARC countries.

Pathotype distribution of wheat rusts during 2018-19
Yellow rust of wheat (*Puccinia striiformis*)

More than 600 samples of three rusts from thirteen Indian states, and Nepal were analyzed during 2018-19. During this crop year, 201 samples of yellow rust of wheat were analyzed from eight Indian states and Nepal. Six pathotypes (46S119, 110S119, 238S119, 110S84, P and T) of wheat stripe rust pathogen were identified and frequency of pathotype 46S119 was maximum (47.3 %) in this cropping season. Pathotype 110S119, first identified in 2013-14, has increased to 34.3 % of the samples.

Black rust of wheat (*Puccinia graminis* f. sp. *tritici*)

Eight pathotypes of black rust of wheat were identified from the analyses of 134 samples, received/collected from five Indian states and Nepal. Pathotype 11 (79G31), was recorded in 50% of the samples, which was followed by 15-1 (22.3 %) and 40A (15.6 %). Other pathotypes were observed in few samples only. Diversity of black rust pathotypes was maximum in Karnataka. Pathotypes 40A and 11 were detected in nine barley samples, received from Tamil Nadu and Karnataka.

Brown rust of wheat (*Puccinia triticina*)

Twenty-three pathotypes of *P. triticina* were identified in 292 samples analyzed from 11 states of India, and Nepal. Indian *P. triticina* population showed resistant infection type on *Lr24*, *Lr25*, *Lr29*, *Lr32*, *Lr39, Lr42, Lr45* and *Lr47*. Among 12,77,104 and 162 group of pathotype, 77 was the most predominant and was ascribed to 88.7% samples whereas remaining groups were attributed to 11.3% samples. The pathotype 77-9 (121R60-1) was most frequent and identified in 149 rust samples (51.1 %). It was followed by pathotypes 77-13(121R60-1,7) in 20.2 % and 77-5 (121R63-1) in 15.1 % rust samples. The diversity of *P. triticina* was comparatively higher in Haryana, Karnataka and Himachal Pradesh. The pathotype 77-9 was most frequent in all the states except Himachal Pradesh and Punjab.

Seedling resistance against pathotypes of wheat rust pathogens in AVT entries

To identify rust resistant lines, 158 entries were evaluated at seedling stage using an array of pathotypes of *Puccinia graminis* f. sp. *tritici* (black rust), *P. triticina* (brown rust) and *P. striiformis* f. sp. *tritici* (yellow rust) possessing different avirulence/virulence structures. Out of these, four entries (PBW821, PBW822, PBW823, PBW757) found resistance to all the pathotypes of black, brown and yellow rust pathogens. Four lines, CG1029, HD2864, K8027, and MACS6222 were found resistant to brown and black rusts. Entries NIDW1158, PBW752 and PBW781 were resistant to yellow rust only. Twelve entries (DBW110, DBW303, HD3226, HD3237, HD3277, HD3298, HI1628, NW7049, RAJ4529, PBW825, WH1105 and WH1223) showed resistance to all the pathotypes of black rust pathogen only. Fourteen entries (DDW47, DDW48, DDK1057, HD3090, HI1633, HI1634, HS562, MACS3949, PBW550, PBW797, PBW820, PBW824, UAS446, UAS466) were resistant to all pathotypes of brown rust pathogen only, whereas, five entries which possessed *Lr24,* were also resistant to brown rust. All the entries carrying *Sr*31, were resistant to black rust.

Rust resistance genes in AVT lines (Gene postulation)

***Yr*-genes**

In advanced wheat material, 4 *Yr*-genes (*Yr9*, *2*, *18* and *A*) were characterized in 91 entries. Among these, *Yr2* was characterized in 57 lines. *Yr9*, alone or in combination, was postulated in 25 lines. *YrA* was characterized in 9 lines. Gene combinations *Yr9+A+* and *Yr9+18+* were inferred in 3 and 1 lines, respectively.

***Lr*-genes**

Eleven *Lr*-genes (*Lr1*, *Lr2a*, *Lr3*, *Lr10*, *Lr13*, *Lr18*, *Lr19*, *Lr23*, *Lr24*, *Lr26* and *Lr34*) were characterized in 119 lines. Genes were postulated alone or in combination. *Lr13* and *Lr23* were the most common resistance genes postulated in advanced wheat material. Both were characterized either alone or in combination, were characterized in 47 lines (39.5 %) each followed by *Lr10* in 34 lines. Resistance gene *Lr26* (linked with *Sr31* and *Yr9*) was postulated in 25 entries. *Lr13* is known to confer high temperature resistance. Therefore, in most wheat growing areas in India, lines possessing *Lr13* will show less terminal disease severity as the temperature rises towards the maturity. Brown rust effective resistance gene *Lr24* (linked with *Sr24*), was postulated in GW509, HD2888, HI1544, MP3288 and MP4010. Another effective gene *Lr19* was characterized in WH1254. Other brown rust

resistance genes *Lr3, Lr2a, Lr18* and *Lr34* were characterized only in four, two, two and one entries, respectively.

***Sr*-genes**

Fourteen *Sr* genes (*Sr2*, *Sr5*, *Sr7b*, *Sr8a*, *Sr8b*, *Sr9b*, *Sr9e*, *Sr11*, *Sr13*, *Sr24*, *Sr25*, *Sr28* and *Sr31*) were characterized in 125 lines. Genes were postulated alone or in combinations. *Sr2*, whose postulation is based on characteristic micro-flecking, was postulated in 81 lines (64.5 %) followed by *Sr11* in 34 lines. *Sr31* is linked with *Lr26* and *Yr9*, was observed in 25 lines. Entries DBW252 and KRL19 possessed a combination of four genes.

Post Harvest Surveys

A total of 7321 grain samples collected from various mandies in different zones and were analyzed at cooperating centers. Overall 32.02% samples were found infected. The samples from Haryana showed maximum infection (56.69%) followed by Jammu (54.85%) and Punjab (45.18%). Among different states from where samples were taken Madhya Pradesh, Gujarat, Maharashtra and Karnataka were found free from Karnal bunt infection.

Survey and surveillance for insect pests

- The aphid incidence was above economic threshold level in some places in Punjab viz. village Mullanpur & Jagraon (Ludhiana), Ajitwal & Dagru (Moga) and Salabatpura (Bhatinda) during the second and third week of March. Minor incidence of pink stem borer (3-5 %) was also observed in one patch of 0.5 acre in farmers field in village Farwahi (Barnala). The incidence of armyworm was observed in patches and damage varied from 1-5 per cent except one field in village Kheri Malan where it was 15-20 per cent.
- In Vijapur, the incidence of aphids was low to moderate during ear head stage of the crop. The population of *H. armigera*, pink stem borer and surface grasshopper were very low. The appearance of minor pests like spodoptera, thrips, shoot fly, brown mite, jassids and cut worm were in occasional and in negligible form.
- In Rajasthan, survey of wheat and barley fields in Jaipur indicated moderate infestation of termite, mite *H. armigera* and pink stem borer. Besides, the cutworm population was observed in Tank bed condition of Tonk districts.
- Moderate to severe incidence of wheat aphid and pink stem borer was observed in villages Ladwa, Yamunanagar, Kunjpura, Subhari, Racina and Hajwana etc of Karnal. The grubs and adults of coccinellid beetles were seen frequently in fields infested with aphids.
- Heavy incidence of aphids was recorded in Nasik district. The Coccinellid predatory grubs and beetles feeding on the aphid and spyrphid fly infested fields were also observed. The incidence of Jassids and stem borer were recorded in medium intensity.

Host plant resistance against insect pests

Shoot fly: Amongst 158 AVT entries tested at five locations during 2018-19, 113 entries showed average shoot fly infestation below 10%. The lowest infestation of shoot fly i.e. 5.04 % was recorded in entry HI 1628.

Brown wheat mite: Out of 158 AVT entries, two entries viz., PBW821M and MACS6478 (C) recorded the minimum mite population of 7/10 cm^2 area at Ludhiana while entry HI8627 (d) (C) recorded the minimum mite population of 9.33/10 cm^2 at Durgapura.

Foliar aphid: None of entry AVT found resistant across all the four locations, whereas, three entries viz. GW 1348 (d), DBW93 (C) and UP3043 at Ludhiana and six entries DBW93 (C),UP3043, HD3086 (C),WH1223,KRL19 (C) and PBW757 (C) at Karnal showed moderate level of resistance to foliar aphid. However, at Kharibari, one entry UP3042 was found to be resistant (grade 2) and three entries viz., DBW304, DBW302 and PBW825 were found to be moderately resistant.

Root aphid: Out of total 158 entries, eight entries *viz.* PBW752 (I) (C), WH1124 (C), BRW 3806, NIDW 1158 (d), GW322 (C), UAS 466(d), AKDW2997-16(d) (C) and HI1621 showed the moderately resistance reaction at Ludhiana.

Screening against multiple pests: The average minimum score (6.01%) for shoot fly was observed in entry HI1612 and the maximum score of 15.26% was recorded for GW 173 (C). The lowest population of 10 brown wheat mites/ 10 cm^2 area was recorded for DBW251 at Ludhiana while entry HI8791(d) had lowest population of 10.66 mites/ 10 cm^2. Based on average score of four locations, two entries DBW251 and PBW780 showed moderately resistance to foliar aphid. At Ludhiana, one entries B622 was found to be moderately resistant (grade 3) to root aphid.

Integrated pest management

- Amongst the different tested monitoring traps viz., sticky-traps and tray-traps, the efficiency of yellow sticky traps was comparatively more than tray traps.
- Foliar application of imidacloprid 17.8 SL @ 100 ml/ha, acetamiprid 20 SP@ 100 g/ha and quinalphos 25EC @400 ml/ha was more effective in checking aphid population at its minimum.
- The integrated pest modules tested against major pests of wheat viz., foliar aphids, shootfly and termites pink stem borer revealed comparatively lower pest population in IPM module treatment as compared to Farmer practice (FP). However, in FP treatment the population of natural enemies was little higher than IPM treatment.
- Impact of three different doses (low, medium & high) of nitrogen application on population abundance of foliar aphid was investigated in wheat. Treatments with higher doses of nitrogen i.e. 150 & 225 kg/ha had highest number of aphids as compared to lower doses of nitrogen.
- Population dynamics of foliar studies on wheat and barley crops revealed comparatively higher population of aphid on barley as compared to wheat crop. The coccinellid beetle appeared after the peak period of aphid infestation on wheat and barley crop.

Stored grain pest management

Efficacy of various plant materials as seed protectant was evaluated against grain weevil (*Sitophilus oryzae*) and it was found that seed treatment with Vekhand powder and its combinations with Neem leaves, Jungli Imli and Gulwel powder proved to be significantly effective in controlling the population of grain weevil as compared to rest of the treatments.

Survey for Nematode diseases

To know the status of diseases caused by nematodes, survey was conducted in Rajasthan, Haryana and Punjab. Cereal cyst nematode infestation was recorded in all three districts surveyed i.e Dausa, Jaipur and Sikar districts of Rajasthan. A large number of infested fields were observed in Amer, Bassi, Chomu, Jamwa Ramgarh, Kotputli, Sahapura, Sanganer and Viratnagar tehsil of Jaipur district. Post harvest survey was also conducted to observe the infestation of Ear Cockle Nematode (ECN) disease in various grain market of Jaipur district and none of the collected grain sample showed the presence in ECN. A total of 2250 wheat grain samples were collected from 150 different grain markets of the Punjab and were analyzed for ear cockle nematode (ECN). None of the samples showed incidence of ear cockle nematode. Whereas, 108 soil samples were collected from Punjab. *Heterodera avenae* cyst, species of *Meloidogyne, Tylenchorhynchus, Hirschmanniella, Helicotylenchus* and *Hoploloaimus* were recorded. CCN cysts were recorded from Ariayan (Jalandhar District), Baghapurana (Moga district), Wara Daraka, Kotakapura (Faridkot), Malout (Muktasar) and Abohar (Fazilka).

Resistance against *Heterodera avenae*

One hundred fifty eight entries of AVT were screened for resistance against *H. avenae* (CCN) under sick plot conditions at three locations i.e. Ludhiana, Durgapura and Hisar. No entry showed resistance across all the locations. Out of these, three had been found resistant [HI 1628, NIAW 3170 and K8027

(C)] and four showed moderately resistant reaction *viz.*, HS652, HD2967 (C), HI 8812 (d) and HI8807(d) at Durgapura, whereas only six entries namely HS673, DPW621-50 (C), K0307 (C), PBW 822, DDW 47(d) and HW1098 (C) have shown moderately resistant reaction at Ludhiana.

Management of *Heterodera avenae*

An experiment was conducted, wherein two formulation of Chalcone alone and in combination with Carbofuran were evaluated against Cereal cyst nematode. The results revealed that all the treatments gave significantly higher grain yield with reduced number of cysts/plant over control. The maximum reduction of population was observed in Chalcone C1 @40 ppm conc. + half dose of Carbofuran (60 %) with high grain yield. It showed overall superiority by keeping larvae entry away from root and better plant growth.

Brain storming session on blast proofing in agriculture: A brain storming session on blast proofing in agriculture was jointly organized by IIWBR-Indian Phytopathological Society, Indian Society of Plant Pathologists and Society for the Advancement of Wheat and Barley Research at IIWBR Karnal on 8th August, 2018. It was attended by about 100 delegates all over India.

Training of wheat health management

A training programme on "Disease surveillance and adoption of new wheat and barley varieties for better productivity and resistance" was conducted on 31.10.2018 at BCKV Kalyani (West Bengal). About 60 farmers and state government officials participated.

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: 1250
No. of breeding centers: 35

Test Locations
Rusts:
North:
Leaf Rust: Delhi, Hisar, Durgapura, Karnal, Faizabad, Kanpur and Ludhiana (7)
Yellow Rust: Gurdaspur, Dhaulakuan, Malan, Karnal, Durgapura, Ludhiana and Jammu (7)
South:
Leaf Rust and Stem Rust: Dharwad, Mahabaleshwar, Wellington, Powarkheda, Niphad and Indore (6)
Leaf Blight: Faizabad, Pusa (Bihar), Varanasi, Kalyani, Murshidabad, Sabour and Coochbehar (7)

Data was not considered due to poor/erratic disease development from the following centres:
Yellow rust: Malan
Stem and Leaf rust: Dharwad
Data not received:
Stem and Leaf rust: Mahabaleshwar
Leaf 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 IIWBR Regional Station Flowerdale and Mahabaleshwar centers. Following pathotypes were supplied for inoculation:

Stem Rust Pathotypes
Flowerdale (Shimla)
40A, 11, 42 and 117-6
Mahabaleshwar
40A, 11, 42 and 117-6

Leaf Rust Pathotypes
Flowerdale (Shimla)
77-5 (121R63-1), 104-2(21R55), 77-9 and 12-5

Mahabaleshwar
77-5 (121R63-1), 104-2(21R55), 77-9 and 12-5

Stripe Rust Pathotypes
Flowerdale (Shimla)
46S119, 110S119, 110S84 and 47S103

The entriest found resistant (ACI>10) and qualify for promotion (ACI>20) to three rusts are given in Table 1.1. A total 1250 entries were screened for rusts at multilocation under artificially inoculated condition. Out of these, 618, 923, 982 and 391 entries found resistant against stem rust, leaf rust (S), leaf rust (N) and stripe rust, respectively (Fig. 1.1). The center wise per cent entries in each zone found resistant were represented by Fig. 1.2 to 1.6. The disease data of IPPSN entries was also uploaded on IIWBR website in last week of June 2019.

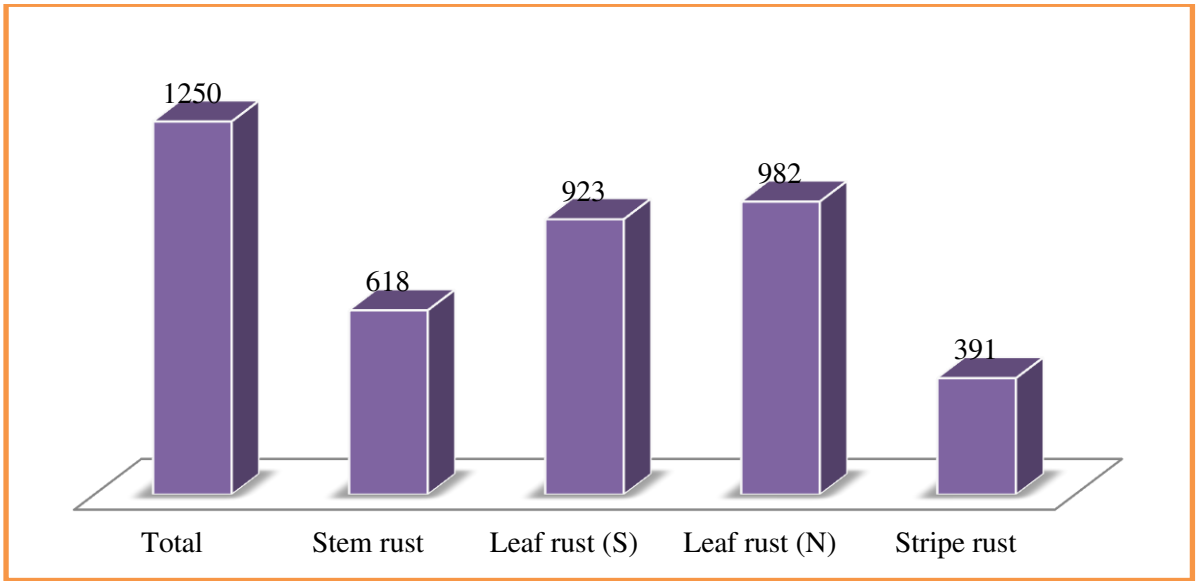

Fig. 1.1. Number of IPPSN entries found resistant to different rusts.

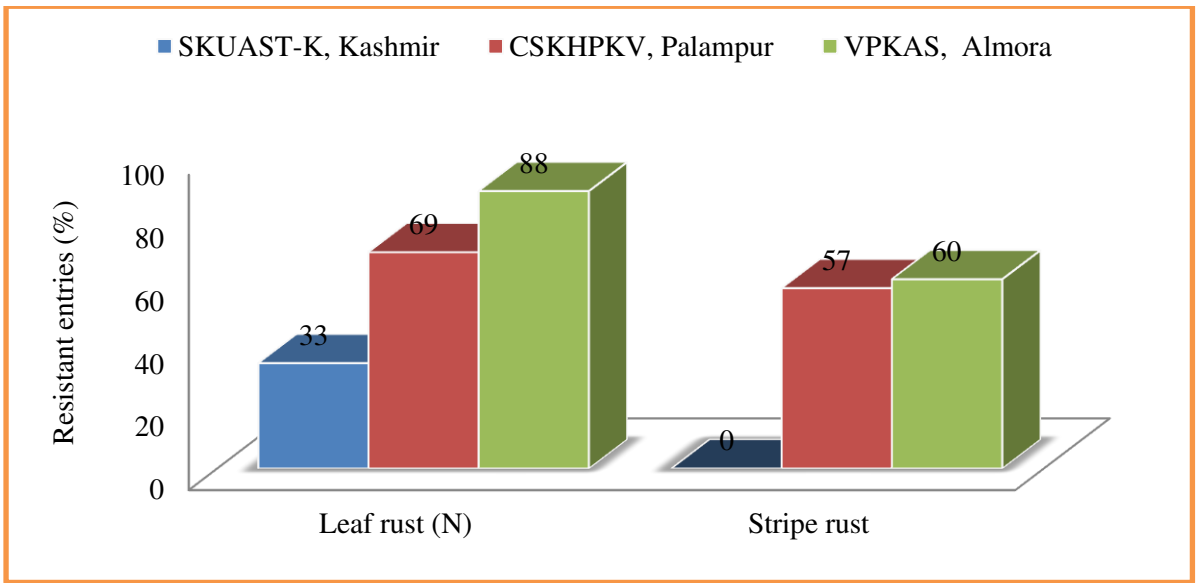

Fig. 1.2. Per cent of rust resistant entries in IPPSN slots belonging to cooperating centres of NHZ (Leaf and Stripe rust)

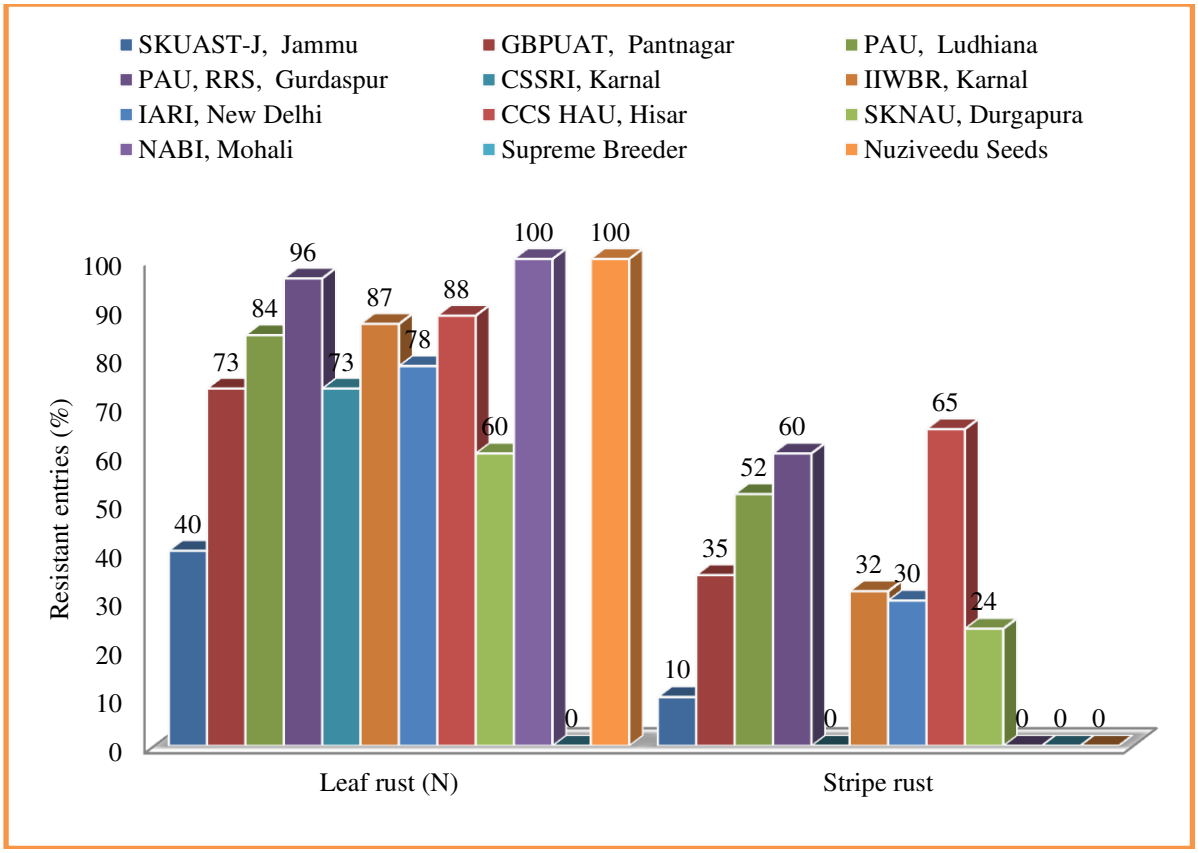

Fig. 1.3 Per cent of rust resistant entries in IPPSN slots belonging to cooperating centres of NWPZ (Leaf and Stripe rust)

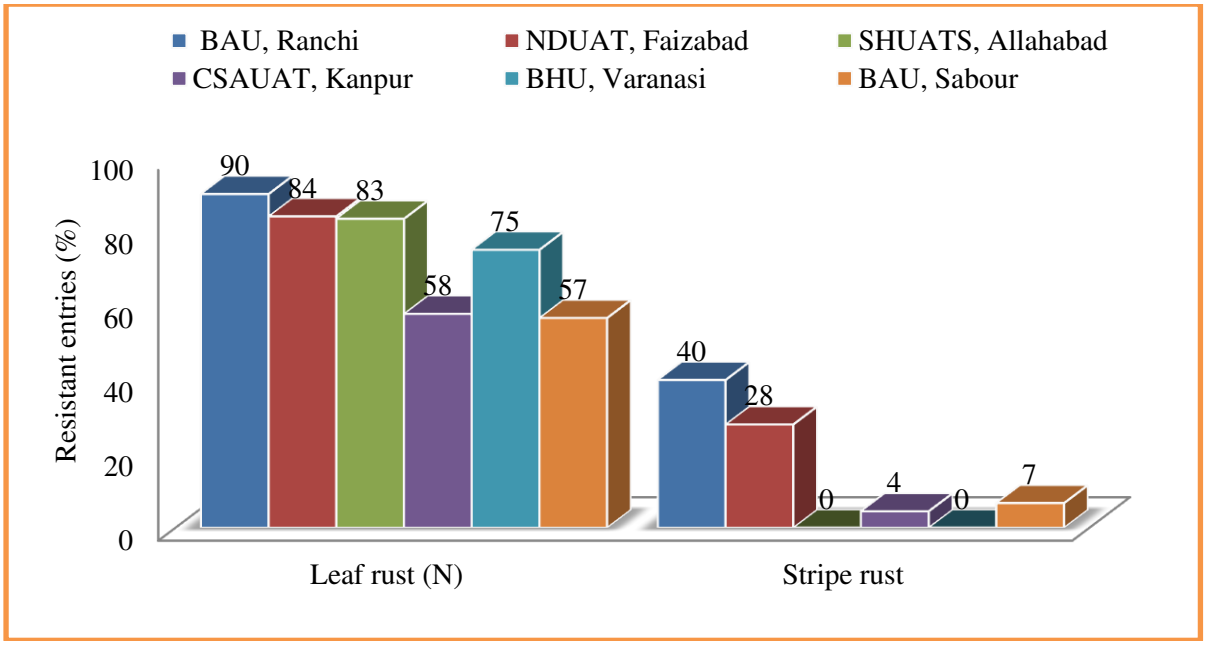

Fig. 1.4 Per cent of rust resistant entries in IPPSN slots belonging to cooperating centres of NEPZ (Leaf and Stripe rust)

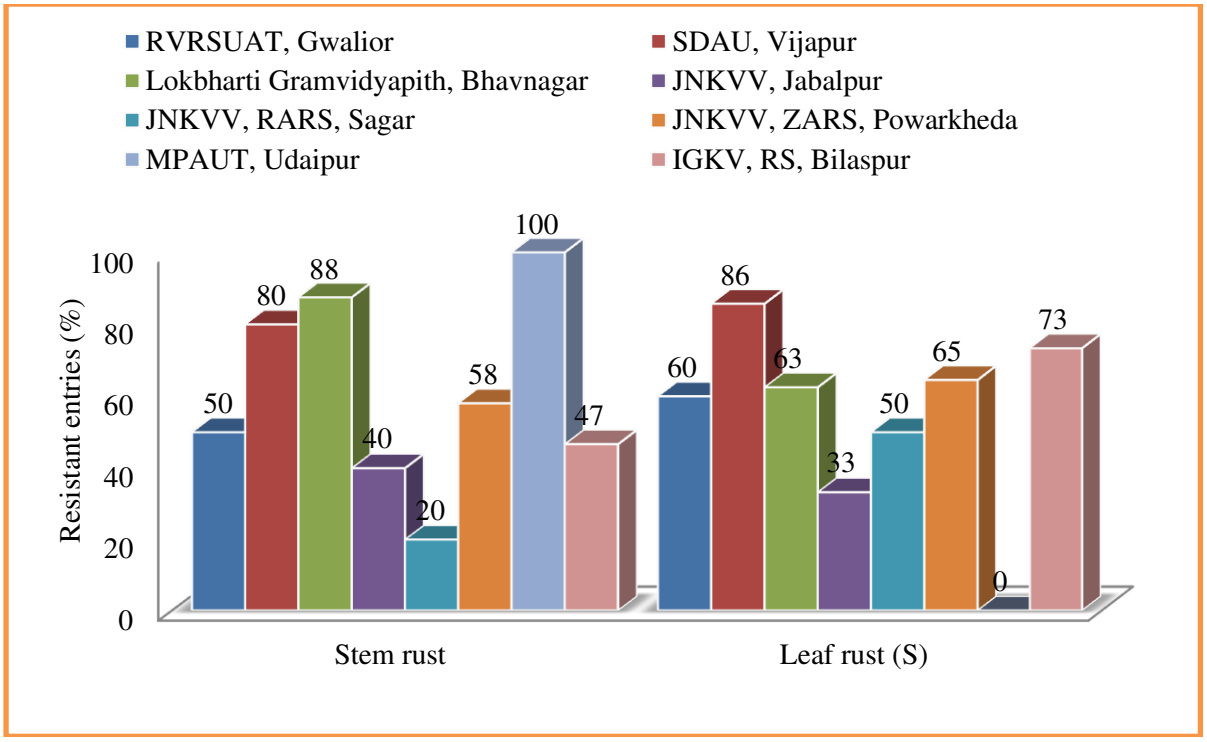

Fig. 1. 5. Per cent of rust resistant entries in IPPSN slots belonging to cooperating centres of CZ (Stem and Leaf rust)

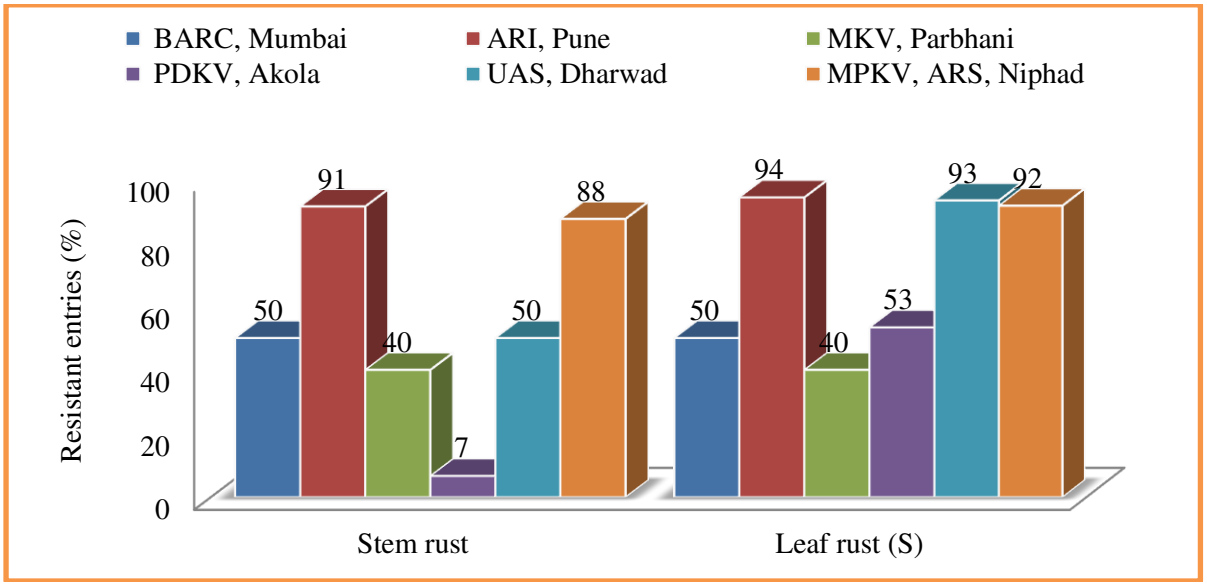

Fig. 1.6. Per cent of rust resistant entries in IPPSN slots belonging to cooperating centres of PZ (Stem and Leaf rust)

Table 1.1: Number to resistant entries (ACI<10) and entries qualify for promotion (ACI <20) in IPPSN slots of different centres during 2018-19.

Centers	Total Entries	Resistant entries (ACI<10)				Promotional entries (ACI<20)			
		Stem rust	Leaf rust (S)	Leaf rust (N)	Stripe rust	Stem rust	Leaf rust (S)	Leaf rust (N)	Stripe rust
NHZ									
SKUAST-K, Khudwani, Kashmir	3	2	3	1	0	3	3	3	2
CSKHPKV, Palampur	35	13	12	24	20	25	26	33	29
ICAR-VPKAS, Almora	50	26	34	44	30	40	43	50	44
NWPZ									
SKUAST-J, Jammu	10	1	8	4	1	9	10	9	1
GBPUAT, Pantnagar	60	22	40	44	21	50	53	56	39
PAU, Ludhiana	153	96	132	129	79	139	146	147	105
PAU, RRS, Gurdaspur	25	9	24	24	15	16	24	25	22
CSSRI, Karnal	30	15	24	22	0	28	29	29	6
IIWBR, Karnal	202	102	160	175	64	180	192	198	114
IARI, New Delhi	168	75	128	131	50	125	151	160	112
CCS HAU, Hisar	60	23	50	53	39	41	58	60	52
SKNAU, Durgapura	50	38	36	30	12	50	48	45	31
NABI, Mohali	5	1	3	5	0	4	4	5	4
Supreme Breeder	1	1	1	0	0	1	1	1	0
Nuziveedu Seeds	3	1	3	3	0	3	3	3	0
NEPZ									
BAU, Ranchi	10	2	10	9	4	8	10	10	8
NDUAT, Faizabad	25	4	21	21	7	18	25	25	12
SHUATS, Allahabad	6	1	2	5	0	2	5	6	0
CSAUAT, Kanpur	45	11	15	26	2	31	29	43	7
BHU, Varanasi	40	18	27	30	0	33	34	37	3
BAU, Sabour	30	9	13	17	2	27	25	27	3
CZ									
RVRSUAT, Gwalior	10	5	6	6	1	8	7	8	1
SDAU, Vijapur	35	28	30	32	1	33	33	35	3
LG, Bhavnagar	8	7	5	7	0	8	7	8	0
JNKVV, Jabalpur	15	6	5	12	1	12	12	15	2
JNKVV, RARS, Sagar	10	2	5	4	1	6	9	8	1
JNKVV, ZARS, Powarkheda	31	18	20	20	8	28	29	29	10
MPAUT, Udaipur	2	2	0	0	0	2	1	2	0
IGKV, RS, Bilaspur	15	7	11	9	0	15	14	15	2
PZ									
BARC, Mumbai	4	2	2	2	0	3	4	4	1
ARI, Pune	35	32	33	30	9	34	35	35	12
MKV, Parbhani	5	2	2	2	2	2	2	5	2
PDKV, Akola	15	1	8	7	2	12	11	11	2
UAS, Dharwad	30	15	28	30	6	23	30	30	10
MPKV, ARS, Niphad	24	21	22	24	14	24	24	24	16
Total	**1250**	**618**	**923**	**982**	**391**	**1041**	**1137**	**1201**	**656**

1.2 Plant Pathological Screening Nursery (PPSN)

Objective
Evaluation of entries for promotion from one stage to 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 have 418 entries that comprises AVT, NIVT and special trials including checks during 2018-19. 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, MACS 2946, MP 4010 and Bijaga 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. 1.7).

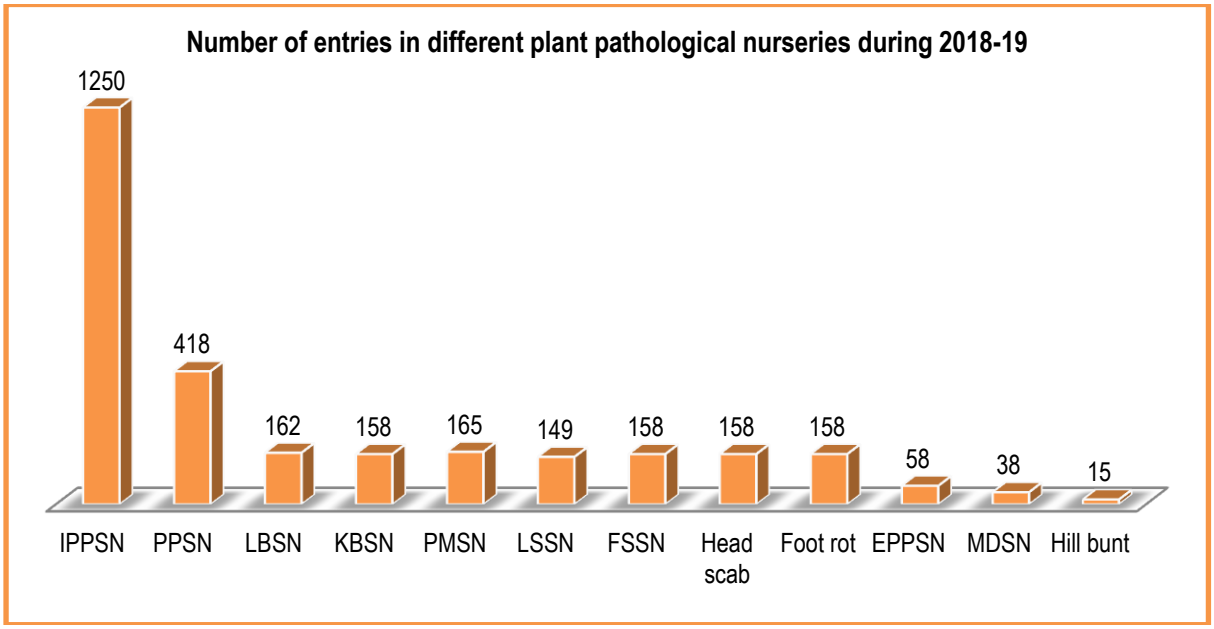

Fig. 1.7. Constitution of different plant pathological nurseries during 2018-19

Test Locations

North:
Yellow Rust: Dhaulakuan, Gurdaspur, Malan, Bajaura, Karnal, Delhi, Ludhiana, Pantnagar, Durgapura, Jammu Hisar and Kudwani (J&K) (12)
Leaf Rust: Delhi, Hisar, Jammu, Kanpur, Karnal, Ludhiana, Pantnagar, Durgapura and Faizabad (9)
South:
Leaf and Stem Rusts: Wellington, Mahabaleshwar, Niphad, Vijapur, Pune, Junagarh, Powarkheda, Dharwad and Indore (9)
Leaf blight (NIVT1A, 1B, 3A): Kalayani, Coochbehar, Pusa (Bihar), Faizabad, Varanasi, Sabour, Shillongani (7)

Data was not considered due to poor/erratic disease development from the following centres:
Leaf rust: Durgapura, Pune
Stem rust: Pune, Niphad

Yellow rust: Bajaura
Data not received:
Stem and leaf rust: Mahabaleshwar

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. Inoculum of yellow, brown and black rusts was supplied by IIWBR Regional Research Station, Flowerdale, Shimla. Mahabaleshwar center also supplied the inoculum to centres in CZ and PZ. The mixture of pathotypes supplied by Flowerdale and Mahabaleshwar centres are given in IPPSN.

The data on rust severty and gene postulation have if AVT material been given in the Tables 1.2. The data on other then rust disease of AVT entries are given in Table 1.3. The performance of AVT final year entries with check for last three years has been given in Table 1.4. The reaction of NIVT entries against rusts are depicted in table 1.5.

Rust resistance materials in AVT (2018-19) with ACI upto 10.0 are given below:

Stem, Leaf and Stripe rusts
HPW467, PBW820^{M}, PBW821^{M}, PBW 771*,HD3249*$^{\#Q}$, HD 3277, HI8713(d) (C), NIDW 1158 (d), HI 8811 (d), HI 8812 (d), GW 1348 (d), PBW 822^{B}, DDW 48 (d), DDW 47(d)*^{Q}, HI8808 (d), HI8807 (d), PBW 823^{B}, UAS428 (d) (C), MACS3949 (d) (C), HI 8805(d)*, UAS446(d) (C), NIDW 1149(d), HI 8802(d)*, WH1270, DBW303 and DBW302

Leaf and Stripe rusts
NW 7049, PBW752(I) (C), PBW 781, DBW187(I) (C), WH 1239, HI1612 (C), HI8737(d) (C), WHD 963 (d), AKDW2997-16(d) (C), DBW301, UP3043, UP3042 , WH1223, NW 7060, HD3271 and PBW 797

Leaf and Stem rusts
VL907 (C), VL892 (C), PBW550 (C), HD2967 (C), DPW621-50 (C), DBW173 (C), HI1620(I) (C), HI 1628*, NIAW 3170*, DBW39 (C), HD2888 (C), K8027 (C), HI1544 (C), HI8627(d) (C), MP3288 (C), DBW 277, HD2864 (C), MP4010 (C), CG1029, HI1633, HI1634, MACS6222 (C), DDW 48 (d), GW509, HD3090 (C), NIAW 3170* , GW 1346(d)*, MACS 4058(d)*, DDK1029 (C), MACS5052, DDK1056, HW1098 (C), MACS5053, DDK1057, DBW304, PBW825, PBW757 (C) and DBW14 (C)

Stem and Stripe rusts
HS507 (C), VL3020, VL3021, HD3226 (I) (C), PBW 796, WH1142 (C), HD3317, WH1254 and HI1621

COOPERATORS:

NAME	CENTRES
RAKESH DEVLASH	BAJAURA
SACHIN UPMANYU	MALAN
V.K. SINGH	DELHI
AKHILESH SINGH	DHAULAKUAN
JASPAL KAUR, RITU BALA	LUDHIANA
J.KUMAR, DEEP SHIKHA, KANAK SRIVASTAVA	PANTNAGAR
R. S. BENIWAL	HISAR
M. K. PANDEY	JAMMU
P.S. SEKHAWAT	DURGAPURA
K. K. MISHRA	POWARKHEDA
I.B. KAPADIA	JUNAGARH
T.L. PRAKASHA	INDORE
S.I. PATEL	VIJAPUR
P.V. PATIL, GURUDATT M. HEGDE	DHARWAD
B.K. HONRAO	PUNE
T.K. NARUTE, R. R. PERANE	MAHABALESHWAR
B.C. GAME	NIPHAD
P. NALLATHAMBI, C. UMAMAHESHWARI	WELLINGTON
JAVED BAHAR KHAN	KANPUR
S. P. SINGH	FAIZABAD
S. S. VAISH	VARANASI
SUNITA MAHAPATRA	KALYANI
C. S. AZAD	SABOUR
SATYAJIT HEMBRAM	COOCHBEHAR
H. C. LAL	RANCHI
T. R. DAS	PUSA, BIHAR
SUDHEER KUMAR, D.P. SINGH AND PREM LAL KASHYAP	KARNAL (COORDINATING UNIT)

Table 1.2. Adult plant response of AVT entries against three rusts under epiphytotic conditions at hot spot locations in field during 2018-19

S. No.	Entry	Rusts score								Postulated genes		
		Stem		Leaf				Stripe				
		South		South		North		North				
		HS	ACI	HS	ACI	HS	ACI	HS	ACI	*Sr*	*Lr*	*Yr*
I. Northern Hill Zone												
1	HPW349 (C)	30S	13.7	60S*	10.2	30S	9.6	20S	8.1	*Sr7b+2+*	*Lr13*+10+	*Yr2+*
2	VL907 (C)	20MS	3.1	5S	0.8	30S	9.4	40S	15.2	*Sr31+2+*	*Lr26+*	*Yr9+*
3	HS507 (C)	5MS	1.4	5MS	1.7	60S	13.2	30MS	8.8	*Sr31+*	*Lr26*+1+	*Yr9+*
4	HS652	40S	10.5	20MS	6.8	40S	11.1	20S	6.3	*Sr2+*	*Lr23*+10+	-
5	HS562 (C)	60S	26.0	40S	8.9	40S	15.3	20S	5.1	*Sr8a+9b+2+*	R Seed*	seed
6	VL892 (C)	10MS	4.2	20S	3.3	30S	7.2	60S	30.3	*Sr30+11+*	*Lr13*+10+	*YrA+*
7	HS490 (C)	40S	16.7	20MS	4.9	20S	7	60S	24.0	*Sr28+9b+*	*Lr23+*	*YrA+*
8	HPW468	30S	7.5	20S	5.9	30S	13.1	60MS	21.3	*Sr9b+11+*	*Lr23*+10+	*Yr2+*
9	HS673	60S	32.0	40S	14.3	60S	33.5	30MS	7.8	*Sr31+*	*Lr26+*	*Yr9+*
10	VL3020	5MS	1.2	10S	1.5	40S	12.1	30MS	10.0	*Sr31+*	*Lr26*+23+1+	*Yr9+*
11	UP3041	40S	14.3	40S	11.6	60S	14.5	40S*	5.5	*Sr9b+11+*	*Lr23*+10+	-
12	HPW467	20MS	3.5	60S*	9.6	20S	10	30MS	8.8	-	*Lr13+*	*YrA+*
13	HS674	40S	17.7	20S	9.1	40S	24.3	60S	14.9	*Sr30+*	*Lr23*+10+	*YrA+*
14	VL3019	10MS	2.0	20S	3.2	40S	16.5	40S	10.3	*Sr31+*	*Lr26+10+*	*Yr9+*
15	VL3021	10S	3.7	40S*	6.6	30S	10.8	20S	2.4	*Sr13+11+2+*	*Lr23*+13+	*Yr2+*
II. North Western Plain Zone												
16	WH1105 (C)	30S	11.5	40S	7.5	60S	17	40S	12.4	R*	*Lr13+*	*Yr2+*
17	HD3226(I) (C)	30S	7.3	20S	8.7	40S	12.4	20S	4.5	*Sr2+*	*Lr23*+10+	*Yr2+*
18	HD3086 (C)	40S	26.7	60S*	10.8	40S	28.1	40MS	10.0	*Sr7b+2+*	*Lr13+10+*	*Yr2+*
19	PBW820[M]	30MS	8.9	10MS	2.9	20S	3.9	20MS	3.9	*Sr31+2+*	*Lr26+R*	*Yr9+*
20	DBW 221*	60S	40.7	80S	23.7	70S	30.6	40S*	12.0	*Sr7b+2+*	*Lr13+*	*Yr2+*
20A	Infector	100S	70.0	100S	78.6	100S	76.3	100S	78.2			
21	DBW 222*	40S	20.7	10MS	1.2	10S	2.5	60S	14.6	*Sr31+*	*Lr26+23+*	*Yr9+*
22	PBW550 (C)	10MS	4.3	20MS	4.9	5MS	0.8	80S	46.3	*Sr31+2+*	*Lr26+R*	*Yr9+*
23	PBW821[M]	20MS	6.7	20S	5.1	5S	1.4	20S	4.8	R	R	Resistant
24	HD2967 (C)	30S	8.7	10MS	1.5	30S	6.5	80S	37.5	*Sr8a+11+2+*	*Lr23+*	*Yr2+*
25	NW 7049	40S	12.5	20MS	3.8	20S	4.9	40S	9.8	*Sr2+*	*Lr23+10+*	*Yr2+*
26	DPW621-50 (C)	20S	7.6	10MS	3.1	20S	4.7	80S	32.5	*Sr2+*	*Lr13+10+*	-
27	DBW88 (C)	20S	11.0	10MS	2.4	20S	4.1	80S	36.6	*Sr11+2+*	*Lr13+10+3+*	*YrA+*
28	PBW752(I) (C)	60S	28.0	20MS	7.3	20S	6.3	10S	1.0	-	*Lr13+10+*	Resistant

29	DBW173 (C)	10MS	2.6	20S	3.1	10S	3.6	60S	19.3	*Sr31+5+*	*Lr26+10+3*	*Yr9+A+*
30	WH1021 (C)	20MS	3.8	40S*	6.7	60S	15.9	80S	46.2	*Sr31+2+*	*Lr26+1+*	*Yr9+*
31	HD3059 (C)	30S	11.0	5MS	1.2	40S	7.3	80S	35.8	*Sr11+2+*	*Lr13+*	*Yr2+*
32	WH1124 (C)	60S	38.8	60S*	9.6	40S	17.6	20S	6.0	*Sr7b+2+*	*Lr13+10+*	*Yr2+*
33	PBW 771*	30S	7.5	10R	0.4	5S	0.9	10S	2.4	*Sr31+*	*Lr26*+23+1+	*Yr9+*
34	HI1620(I) (C)	20S	8.6	5S	1.6	10S	3.3	40S	10.6	*Sr11+7b+*	*Lr13+10+3+*	*YrA+*
35	PBW 796	20S	8.5	10MR	0.6	40S	10.8	20S	4.2	*Sr9b+11+2+*	*Lr23+10+*	-
36	HI 1628*	10MS	5.2	60S*	8.9	20S	5.8	40S	13.5	*Sr2+*	*Lr13+10+*	*Yr2+*
37	WH1142 (C)	30MS	7.0	60S*	11.6	50S*	11.8	20S	4.9	*Sr31+2+*	*Lr26+23+10+*	*Yr9+*
38	HD3043 (C)	20MS	4.5	60S*	15.6	100S	28.1	60MS	23.0	*Sr31+2+*	*Lr26+23+*	*Yr9+A+*
39	PBW644 (C)	20S	15.5	10MS	1.3	50S*	10.3	60MS	21.4	*Sr11+2+*	*Lr13+1+*	*Yr2+*
40	HD3237(I) (C)	40S	24.0	60S	18.6	90S	22.8	10S	4.5	*Sr5+*	*Lr13+3+*	*Yr2+*
40A	Infector	100S	66.7	100S	82.9	100S	76.3	100S	77.3			
41	BRW 3806*[#]	30S	16.0	60S*	14.3	80S*	20.6	60S	25.7	*Sr28+5+*	*Lr10+*	*Yr2+*
42	NIAW 3170*	10MS	3.0	5S	1.6	20S	4.8	60S	17.4	*Sr2+*	*Lr13+10+*	-
43	WH1080 (C)	40MS	11.7	20S	4.3	80S*	17.3	30S	7.6	*Sr9e+2+*	*Lr13+*	-
III. North Eastern Plain Zone												
44	HD3249*[#Q]	10S	4.0	5S	0.8	30S	8.8	20S	6.4	*Sr11+2+*	*Lr13+10+*	*Yr2+*
45	HD2733 (C)	20S	4.8	40S*	8.4	60S	21.9	80S	49.3	*Sr31+2+*	*Lr26+34+*	*Yr9+18+*
46	PBW 781	40S	19.1	5S	1.1	20S	5.5	5S	1.3	*Sr11+*	*Lr23+10+*	Resistant
47	DBW 257	60S	22.3	60S*	10.9	40S	14.9	15S	4.2	*Sr28+5+*	*Lr23+10+*	*Yr2+*
48	DBW39 (C)	5MS	0.7	20S	2.9	5S	2.7	80S	36.2	*Sr31+2+*	*Lr26+23+10+*	*Yr9+*
49	HD 3277	30MS	9.0	5S	1.4	5S	0.9	20S	3.9	R	*Lr23+10+*	*Yr2+*
50	RAJ 4529	60S	26.0	20S	5.9	80S	19.4	40S	11.4	R	*Lr13+*	-
51	DBW187(I) (C)	30S	10.2	5S	0.7	15S	5.4	20MS	6.5	*Sr5+11*	*Lr23+10+*	*Yr2+*
52	WH 1239	60S	26.8	40S*	7.1	20S	5.4	40S	10.0	*Sr7b+*	*Lr13+10+*	*YrA+*
53	K0307 (C)	60MR-MS	18.0	60S*	9.4	80S	21.6	60S	27.0	*Sr2+*	*Lr23+1+*	*Yr2+*
54	HD2967 (C)	20MS	6.3	5S	1.5	30S	6.5	60S	36.8	*Sr8a+11+2+*	*Lr23+*	*Yr2+*
55	K1317 (C)	30MS	9.4	10MS	2.3	60S	15.1	40S	18.7	*Sr31+2+*	*Lr26+1+*	*Yr9+A+*
56	HI1612 (C)	40S	24.3	10MS	1.8	30S	7.8	40MS*	5.4	*Sr7b+2+*	*Lr23+*	*Yr2+*
57	HD 3293	40S	24.7	10MS	2.8	70S	18.4	10S	3.1	*Sr13+*	*Lr13+10+*	*Yr2+*
58	HD3171 (C)	20S	14.1	60S*	10.9	80S	31.5	60S	19.9	*Sr11+7b+2+*	*Lr23+13+10+*	*Yr2+*
59	HD2888 (C)	5MS	0.8	5S	0.7	20S	6.4	60S	26.5	*Sr24+2+*	*Lr24+R*	*Yr2+*
60	DBW 252*[#]	20S	12.0	5MR	0.5	30S	6.9	60S	21.0	*Sr8a+5+11+2+*	*Lr13+10+*	*YrA+*
60A	Infector	100S	70.0	100S	82.9	100S	80	100S	75.0			
61	K8027 (C)	10MS	3.5	10MS	1.5	20S	4.5	60S	32.7	-	R Seed*	*Yr2+*

62	DBW 273	60S	28.0	40S*	6.9	15S	6.1	40S	12.3	*Sr9e+*	*Lr23+10+*	*Yr2+*
IV. Central Zone												
63	HI8713(d) (C)	10MS	1.6	5MR	0.3	10S	3.4	20S	3.9	*Sr9e+2+*	*Lr13+*	-
64	NIDW 1158 (d)	5MS	2.0	20MS	2.6	5S	0.6	5S	0.7	*Sr7b+2+*	*Lr23+*	Resistant
65	HI 8811 (d)	10S	3.4	10MR	1.2	30S	7.1	40S*	5.7	*Sr11+2+*	*Lr13+*	-
66	HD3343[M]	40S	23.0	60S*	12.3	60S	23	80S	50.9	*Sr13+2+*	*Lr23+10+*	*Yr2+*
67	GW322 (C)	40S	12.6	40S*	6.8	80S	23	80S	44.1	*Sr11+2+*	*Lr13+1+*	*Yr2+*
68	HI1544 (C)	10MS	1.4	10R	0.3	40S	7.6	100S	62.7	*Sr24+2+*	*Lr24+R*	*Yr2+*
69	HI8737(d) (C)	40S	11.0	20MS	3.0	20S	3.3	15S	3.0	*Sr9e+2+*	*Lr24+R*	*Yr2+*
70	HI 8812 (d)	5MS	2.0	20MS	2.6	20S	2.6	10S	3.4	*Sr7b+2+*	*Lr13+*	*Yr2+*
71	GW 1348 (d)	10S	3.7	10R	0.3	5S	0.9	30MS	9.4	*Sr7b+*	*Lr13+*	*Yr2+*
72	DDW 49 (d)	40S	12.8	60MS*	17.1	60S	13.8	20MS	6.5	*Sr7b+*	*Lr18+*	-
73	PBW 822[B]	20MR	2.1	20S	2.9	40S*	7.6	40S*	4.1	R	R	Resistant
74	HD 3345[B]	30MS	11.0	10S	3.5	80S	19.4	60S	28.0	*Sr30+8a+2+*	*Lr13+*	-
75	DDW 48 (d)	20S	8.8	20MR	2.6	20S	7.6	30MS	7.1	*Sr7b+2+*	-	-
76	HI8627(d) (C)	30MS	6.5	20MS	3.3	10S	4.7	60S	12.1	*Sr9e+2+*	*Lr13+*	*Yr2+*
77	DBW110 (C)	40MS	14.7	10MS	2.3	40S	11.7	80S	41.6	R	*Lr13+*	*Yr2+*
78	UAS 466(d)*	40S*	10.7	10S	1.6	40S*	6	60S	13.4	*Sr11+2+*	*Lr13+*	-
79	MP3288 (C)	10MS	6.0	10MS	1.5	20S	7.6	80S	35.9	*Sr24+2+*	*Lr24+R*	*Yr2+*
80	DBW 277	20S	9.0	20MS	4.1	40S*	6	60S	31.7	*Sr5+8a+*	-	*Yr2+*
80A	Infector	100S	66.7	100S	85.7	100S	71.3	100S	77.3			
81	DDW 47(d)*[Q]	40MR	5.8	5S	1.4	5S	0.7	10MS	1.1	*Sr11+7b+2+*	R	-
82	HD2932 (C)	20MS	8.4	40S	19.4	90S	34.6	80S	55.0	*Sr11+*	*Lr13+*	-
83	HD2864 (C)	10S	2.8	40S*	6.5	20S	6	100S	61.8	R	R	*Yr2+*
84	MP3336 (C)	40S	15.3	40S*	8.1	40S	19.3	100S	53.0	*Sr11+2+*	*Lr13+*	-
85	MP4010 (C)	10MS	2.2	5S	0.7	20S	4.8	100S	60.2	*Sr24+2+*	*Lr24+R*	*Yr2+*
86	CG1029	10MS	3.0	5S	0.7	10S	2.5	100S	69.1	R	R	-
87	UAS3002	10MS	4.2	40S*	10.6	60S	24.8	100S	48.9	*Sr31+5+*	*Lr26+10+*	*Yr9+*
88	HI1633	20MS	3.4	10S	1.5	20S	3.9	100S	46.6	*Sr31+*	*Lr26+*	*Yr9+*
89	HI1634	5MS	1.0	10S	1.4	10S	3.1	100S	46.6	*Sr31+*	*Lr26+R*	*Yr9+*
90	HI8808 (d)	10MS	5.4	20R	1.2	20S	2.7	30MS	6.3	*Sr7b+2+*	-	-
91	HI8807 (d)	20MS	3.3	5MS	0.6	20S	2.8	20MS	3.4	*Sr11+2+*	*Lr23+*	-
V. Peninsular Zone												
92	PBW 823[B]	20MS	3.7	5S	0.7	10S	1.4	10S	2.7	*Sr2+*	R	Resistant
93	UAS428 (d) (C)	30MS	4.8	20MR	2.3	10MS	1.9	10S	3.6	*Sr7b+*	-	-
94	DDW 49 (d)	40S	13.7	40S*	13.1	40S	12.4	30S	11.7	*Sr7b+2+*	*Lr18+*	-
95	UAS 3001	20S	8.1	60S	18.7	60S	21.3	80S	41.1	*Sr31+*	*Lr26+*	*Yr9+*

96	MACS3949 (d) (C)	30S	7.3	20S	5.2	10S	2.3	20MS	3.7	*Sr7b+2+*	R	*Yr2+*
97	MACS6222 (C)	10MS	3.0	5S	0.7	10S	1.3	80S	27.4	R	R	-
98	GW 322 (C)	40S	17.0	20S	4.3	40S	15.9	80S	46.1	*Sr11+2+*	*Lr13+1+*	*Yr2+*
99	DDW 48 (d)	20S	6.7	20MS	2.6	15S	2.4	60S	15.0	*Sr7b+2+*	R	-
100	MACS6478 (C)	60S	34.7	15MS	6.9	30S	9.9	100S	49.8	*Sr28++*	*Lr23+1+*	*Yr2+*
100A	Infector	100S	70.0	100S	85.7	100S	76.3	100S	71.8			
101	HD3343^{M}	40S	24.7	80S*	15.1	90S	24.3	60S	42.0	*Sr13+2+*	*Lr23+10+*	*Yr2+*
102	WHD 963 (d)	40S*	11.3	10MS	3.8	30MS	4.9	20S	5.5	*Sr7b+2+*	*Lr23+*	-
103	HI8807(d)	20MS	5.3	20MS	3.5	20S	3.8	20MS	4.4	*Sr11+2+*	-	-
104	HI1633	10MS	1.7	10S	1.7	40S*	6.5	80S	44.3	*Sr31+*	*Lr26+*	*Yr9+*
105	UAS 3002	30S	9.7	60S	16.1	80S	19.5	80S	36.2	*Sr31+5+*	*Lr26+10+*	*Yr9+*
106	Raj4083 (C)	20MS	6.0	40S	9.3	40S	11.5	40S	16.3	*Sr11+2+*	*Lr13+*	*Yr2+*
107	HD2932 (C)	20S	10.3	60S	16.7	80S	31.6	100S	51.6	*Sr11+*	*Lr13+*	-
108	GW509	30MS	8.8	10MS	1.2	20MS	3.8	80S	41.4	*Sr24+2+*	*Lr24+R*	-
109	HD3090 (C)	40MR	5.7	TR	0.1	10S	3.3	100S	48.4	*Sr31+2+*	*Lr26+*	*Yr9+*
110	NIAW 3170*	10MS	4.3	10S	2.5	15S	3.6	40S	14.9	*Sr2+*	*Lr13+10+*	-
111	GW 1346(d)*	10S	2.5	5MR	0.3	15S	3.5	100S	33.0	*Sr7b+2+*	*Lr13+*	-
112	MACS 4058(d)*	20MS	7.0	20MS	3.9	20S	5.4	100S	34.8	*Sr11+*	*Lr23+*	-
113	DBW93 (C)	5MS	2.3	60S*	14.6	40S	15	100S	51.5	*Sr31+2+*	*Lr26+*	*Yr9+*
114	HI 8805(d)*	5S	1.7	10MS	1.9	40S	8.1	20S	4.2	*Sr13+11+2+*	*Lr23+*	-
115	AKDW2997-16(d) (C)	40S	14.3	10MS	2.3	10S	4.1	30S	8.8	*Sr7b+2+*	*Lr23+*	-
116	MACS 6695*	30S	15.7	60S	22.0	90S	30.6	80S	56.5	*	*Lr13+*	-
117	UAS446(d) (C)	20S	7.7	10S	1.5	10S	2.3	10MR	1.2	*Sr11+2+*	R	-
118	HI1605 (C)	20S	7.6	40S	13.2	40S	16.5	40S	22.4	*Sr5+11+*	*Lr13+*	*Yr2+*
119	MACS 6696*	40S	15.2	60S	26.9	90S	29.8	80S	48.5	*Sr9e+*	*Lr13+*	-
120	NIDW 1149(d)	40MR	6.0	5MS	0.8	30MS	5.5	10S	3.0	*Sr11+2+*	*Lr23+*	-
120A	Infector	100S	66.7	100S	82.9	100S	75	100S	74.5			
121	HI 8802(d)*	20S	5.0	10MR	1.2	20S	3.2	20S	2.9	*Sr13+2+*	*Lr23+*	-
VI. Special Trial (Dicoccum)												
122	DDK1029 (C)	5MS	0.7	TR	0.1	10S	2.8	60S	27.2	*Sr11+*	*Lr13+*	-
123	MACS5052	10MS	2.3	TR	0.0	5S	1.3	60S	31.4	-	-	-
124	MACS6222 (aest.) (C)	10MS	2.8	0	0.0	10S	1.9	60S	25.7	R	R	-
125	DDK1056	5MS	1.0	TR	0.0	10S	2.4	60S	29.5	*Sr7b+2+*	-	*Yr2+*
126	HW1098 (C)	10MR	0.8	TR	0.0	10S	4.3	40S	25.5	*Sr11+2+*	*Lr18+*	*Yr2+*
127	MACS5053	5S	1.7	20S	2.9	20S	3	60S	24.5	*Sr11+*	-	*Yr2+*
128	DDK1057	5MS	1.5	TR	0.0	30S	5.4	60S	26.5	*Sr13+*	R	-
VII. Special Trial- SPL-HYPT												

129	HD3317	10MS	5.0	15MS	4.1	40S	15	20S	8.0	*Sr31+*	*Lr26+*	*Yr9+*
130	WH1254	30S	8.3	60S*	11.2	5S	0.6	20S	6.5	*Sr25+*	*Lr19+*	*Yr2+*
131	DBW301	40S	14.4	10MS	2.8	TR	0.1	5R	0.1	*Sr11+*	*Lr23+*	-
132	WH1270	5S	1.0	20S	3.4	20S	4.4	30S	4.5	*Sr13+*	*Lr23+*	*Yr2+*
133	HD2967 (C)	40S	23.2	10MS	1.4	15S	6.8	60S	33.4	*Sr8a+11+2+*	*Lr23+*	*Yr2+*
134	PBW824	20S	12.0	10MS	2.0	15S	2.8	50S	22.8	*Sr28+2+*	R	*Yr2+*
135	UP3043	40S	36.8	10MS	1.5	15S	3.8	20S	5.0	*Sr2+*	*Lr13+*	-
136	DBW187	40MS	12.8	10MS	2.7	30S	8.3	30S	6.9	*Sr5+11+*	*Lr23+1+*	*Yr2+*
137	HD3086 (C)	60S	28.0	40S	10.3	60S	16.9	30S	5.8	*Sr2+*	*Lr23+*	*Yr2+*
138	DBW303	20MS	5.2	10MS	2.8	10S	2.4	20S	9.5	R	*Lr13+*	*YrA+*
139	DBW304	20MS	7.2	40MS	5.4	20S	4.2	40S	10.5	*Sr30+5+2+*	*Lr23+*	*Yr2+*
140	UP3042	60S	27.2	10MS	1.7	5MR	0.5	20MS	8.1	*Sr30+5+2+*	*Lr23+2a+*	*Yr2+*
140A	Infector	100S	70.0	100S	86.7	100S	80	100S	74.5			
141	DBW302	20S	6.1	30S	5.0	5S	0.9	20MS	4.5	*Sr31+2+*	*Lr26+23+2a+*	*Yr9+*
142	PBW825	10MS	6.7	10S	2.8	30S	6.4	40S	15.4	R*	*Lr23+*	*Yr2+*
143	HD3347	40MS	18.7	40S	13.3	90S	30.8	30S	8.6	*Sr11+7b+2+*	*Lr23+*	-
VIII. Special Trial (SPL-AST)												
144	WH1223	20S	11.4	20S	6.4	30S	8.9	15S	4.3	R*	*Lr13+*	*Yr2+*
145	KRL19 (C)	40S	13.2	60S*	11.7	70S	31.8	100S	63.8	*Sr8b+9b+11+2+*	*Lr13+*	-
146	Kharchia65 (C)	100S	42.5	100S	68.6	70S	52.5	100S	76.4	*Sr7b+*	-	-
147	NW 7060	60S	27.1	40S	10.0	10S	3.1	10S	4.4	*Sr30+5+*	*Lr23+1+*	*Yr2+*
148	KRL210 (C)	40S	25.8	20MS	6.6	60S	26.9	10S	3.2	*Sr7b+2+*	*Lr23+*	*Yr2+*
149	WH 1228	40S	17.4	40S*	8.6	60S	19.4	10S	3.9	*Sr28+2+*	*Lr13+*	*Yr2+*
150	NW 7062	40MR	5.9	40S	12.1	80S	32.4	60S	36.0	*Sr31+5+2+*	*Lr26+*	*Yr9+*
IX. Special Trial (SPL-VLS)												
151	PBW757 (C)	20MS	7.0	20S	2.9	20S	4.5	60S	16.6	*Sr2+**	R	Resistant
152	WR544 (C)	40S	17.2	40S	12.1	70S	22.4	80S	55.2	*Sr28+8a+2+*	*Lr13+1+*	-
153	HD3298	30S	18.3	60S*	10.8	30S	6.2	60S	9.8	R*	*Lr23+*	*Yr2+*
154	HD3271	30S	15.7	20MS	4.2	40S*	5.8	40S	8.4	*Sr11+2+*	*Lr23+*	-
155	DBW14 (C)	20MS	9.3	40S*	6.4	20S	7.2	60S	27.5	*Sr28+11+2+*	*Lr23+*	*Yr2+*
156	DBW71 (C)	20S	13.4	40S	11.6	50S*	12.5	20S	6.4	*	- Seed	-
157	HI1621	20S	8.1	60S*	12.0	40S	12.5	20S	6.4	*Sr28+*	*Lr13+*	-
158	PBW 797	60S	38.7	20MS	2.6	20S	4.1	10S	5.1	*Sr11+7b+2+*	R	-
158A	Infector	100S	70.0	100S	80.0	100S	77.5	100S	74.5			

Table 1.3. Performance of AVTs entries against different diseases under multilocation testing during 2018-19

S. No.	Entry	LB (dd)		KB (%)		PM (0-9)		FHB (0-5)		FS (%)		LS (%)		FR	HB (%)	
		HS	Avg.	HS	Avg.	HS	Avg.	HS	Avg.	HS	Avg.	HS	Avg.	(%)	HS	Avg.
I. Northern Hill Zone																
1	HPW349 (C)	56	35	15.7	9.2	9	3	4	3	6.8	1.7	76.6	34.9	70.0	40.2	20.1
2	VL907 (C)	56	35	11.4	7.4	7	3	4	2	7.5	2.7	73.3	39.8	45.0	45.4	24.7
3	HS507 (C)	89	46	7.1	3.5	5	2	4	3	8.3	2.1	75.0	32.1	33.3	60.0	31.1
4	HS652	46	35	10.9	7.0	7	3	4	2	9.3	4.4			30.0	61.3	36.0
5	HS562 (C)	58	35	11.1	7.0	7	3	5	3	11.1	2.9	65.0	36.9	0.0	0.0	0.0
6	VL892 (C)	58	36	9.0	6.6	7	3	7	5	10.5	5.3	49.0	30.0	44.4	50.0	29.8
7	HS490 (C)	78	46	9.3	6.8	7	3	5	4	9.6	2.6	75.0	30.5	25.0	3.8	1.9
8	HPW468	68	46	8.3	5.3	7	2	5	4	8.3	2.1			5.0	52.3	26.8
9	HS673	78	46	7.5	4.0	7	2	4	3	13.6	8.3			0.0	57.7	29.8
10	VL3020	68	36	8.6	6.3	6	2	4	3	6.8	2.4			6.2	23.3	12.0
11	UP3041	57	46	5.0	2.9	7	3	4	3	10.3	5.4			NG	50.0	30.1
12	HPW467	58	35	12.2	5.7	9	4	4	3	9.6	2.4			NG	23.2	12.4
13	HS674	79	45	13.3	7.1	3	2	5	3	8.6	2.2			NG	46.9	26.0
14	VL3019	79	45	8.6	3.3	7	4	4	3	7.5	3.0			NG	62.3	34.0
15	VL3021	67	35	5.7	4.3	5	3	4	4	8.1	2.5			NG	5.7	5.0
II. North Western Plain Zone																
16	WH1105 (C)	78	46	13.4	7.2	5	2	4	3	9.3	2.3	26.9	15.7	NG		
17	HD3226(I) (C)	89	46	6.1	4.4	5	2	4	3	8.1	2.4	47.6	30.3	NG		
18	HD3086 (C)	78	46	9.9	5.7	5	2	5	3	7.8	2.2	17.8	7.6	NG		
19	PBW820^{M}	67	46	5.0	4.2	7	4	4	3	6.6	1.8			NG		
20	DBW 221*	68	46	13.0	6.2	7	4	4	2	8.3	3.7	73.3	29.7	NG		
20A	Infector	79	67	21.3	16.6	9	5	4	4	30.8	22.7					
21	DBW 222*	67	46	9.1	5.4	7	4	4	2	6.3	2.5	14.6	4.9	10.0		
22	PBW550 (C)	68	35	11.2	6.7	7	3	5	3	6.1	3.8			0.0		
23	PBW821^{M}	78	46	6.7	4.1	9	4	4	3	7.5	2.5			56.2		
24	HD2967 (C)	57	35	11.1	6.6	7	3	4	3	7.1	2.5	51.2	26.6	70.0		
25	NW 7049	89	46	13.8	7.2	7	3	4	3	5.6	2.5			37.5		
26	DPW621-50 (C)	78	45	9.1	5.0	9	4	4	2	8.5	2.1	53.1	29.1	44.4		
27	DBW88 (C)	89	46	17.8	7.8	9	4	4	2	8.3	2.4	36.6	17.6	25.0		

28	PBW752(I) (C)	89	46	10.0	4.3	9	4	4	2	6.1	3.3	72.3	36.8	60.0		
29	DBW173 (C)	57	46	6.7	4.3	9	3	4	3	5.7	1.8	68.7	42.3	30.0		
30	WH1021 (C)	89	57	11.7	6.2	7	3	5	3	6.3	2.9	74.4	37.0	30.0		
31	HD3059 (C)	78	46	8.3	4.2	9	3	4	2	6.6	1.8	59.4	37.7	NG		
32	WH1124 (C)	99	46	9.2	5.0	7	3	4	3	7.3	2.3	13.3	4.4	NG		
33	PBW 771*	89	45	9.0	5.9	9	4	4	3	9.1	4.9	34.1	23.6	0.0		
34	HI1620(I) (C)	78	45	11.9	8.1	7	4	4	2	10.2	2.6	45.7	25.6	45.0		
35	PBW 796	89	46	11.0	6.0	5	2	4	3	6.5	1.8			90.0		
36	HI 1628*	99	46	12.1	8.5	7	3	5	3	9.8	2.6	62.3	46.9	30.0		
37	WH1142 (C)	79	36	6.5	3.4	7	3	4	2	11.3	4.7	52.2	24.4	45.0		
38	HD3043 (C)	79	46	12.2	6.5	9	3	4	2	5.6	2.1	33.5	20.9	35.0		
39	PBW644 (C)	79	46	8.1	5.4	9	4	4	2	6.3	3.5	42.9	28.8	65.0		
40	HD3237(I) (C)	78	46	7.8	5.8	7	4	5	3	7.5	2.1	39.6	21.1	22.2		
40A	Infector	89	67	23.2	17.8	9	6	5	4	41.0	26.3					
41	BRW 3806*[#]	79	46	18.0	9.6	7	2	4	2	5.6	2.0	80.0	33.4	65.0		
42	NIAW 3170*	68	46	6.9	4.2	7	2	4	3	6.4	1.6	72.1	46.0	55.0		
43	WH1080 (C)	68	46	8.3	4.8	7	2	4	3	7.8	2.0	65.0	29.8	65.0		
III. North Eastern Plain Zone																
44	HD3249*[#Q]	67	45	12.2	6.0	9	3	4	3	4.3	1.8	26.7	22.6	65.0		
45	HD2733 (C)	89	46	11.1	5.2	9	4	4	2	5.7	1.4	51.3	21.3	38.8		
46	PBW 781	57	45	8.9	3.9	5	3	4	3	7.8	4.6			5.0		
47	DBW 257	79	46	10.0	6.6	5	3	4	3	6.1	1.8			10.0		
48	DBW39 (C)	57	45	17.8	7.6	5	3	5	3	8.3	4.2	70.9	31.1	50.0		
49	HD 3277	77	46	7.1	4.0	3	2	4	2	9.1	2.5			25.0		
50	RAJ 4529	78	45	13.8	7.2	5	2	4	3	4.5	1.1			5.0		
51	DBW187(I) (C)	78	46	6.6	2.5	5	2	4	3	5.9	1.5	53.1	29.2	7.1		
52	WH 1239	68	46	7.5	3.8	7	3	4	2	3.9	1.1			0.0		
53	K0307 (C)	79	45	8.6	5.3	7	3	4	2	4.1	1.4	43.8	29.0	0.0		
54	HD2967 (C)	78	35	13.8	8.6	7	4	4	3	6.0	3.6	38.2	20.6	10.0		
55	K1317 (C)	89	46	6.4	4.3	7	3	4	4	3.5	1.3	66.4	32.3	0.0		
56	HI1612 (C)	69	35	4.5	2.1	5	2	4	2	9.5	6.1	62.0	23.0	0.0		
57	HD 3293	68	35	5.1	1.9	5	2	4	2	8.1	4.9			5.0		
58	HD3171 (C)	68	35	16.7	7.7	7	3	4	3	6.4	3.5	23.7	10.4	5.5		

59	HD2888 (C)	57	46	17.8	11.3	7	5	5	4	7.3	3.5	46.9	27.9	12.5		
60	DBW 252*#	57	45	8.5	4.1	7	3	4	3	11.1	7.4	40.0	26.0	62.5		
60A	Infector	89	67	27.3	19.6	9	5	5	4	28.1	20.9					
61	K8027 (C)	68	45	11.1	7.0	9	4	4	3	7.4	6.8	47.7	20.0	40.0		
62	DBW 273	89	45	4.3	2.3	6	4	4	4	8.9	2.9			35.0		
IV. Central Zone																
63	HI8713(d) (C)	89	46	4.6	2.8	9	4	5	4	9.6	3.0	0	0	25.0		
64	NIDW 1158 (d)	89	46	10.6	4.5	7	3	4	3	5.3	2.1			10.0		
65	HI 8811 (d)	78	46	4.5	2.2	9	4	4	4	4.2	1.1			27.7		
66	HD3343[M]	89	57	13.4	8.4	9	5	5	4	7.5	3.3			50.0		
67	GW322 (C)	89	57	8.3	5.9	9	5	5	3	6.2	2.6	60.9	33.4	45.0		
68	HI1544 (C)	89	56	14.7	4.3	9	5	5	3	29.9	11.4	34.9	13.5	14.2		
69	HI8737(d) (C)	89	46	5.6	2.6	9	5	4	3	8.5	2.1	5.0	1.3	5.0		
70	HI 8812 (d)	89	56	6.7	4.4	9	5	4	3	4.9	1.2			0.0		
71	GW 1348 (d)	89	46	5.7	3.3	7	4	5	4	5.5	2.6			5.0		
72	DDW 49 (d)	89	46	4.7	2.6	9	5	4	3	1.6	0.4			50.0		
73	PBW 822[B]	78	46	5.7	2.8	7	4	5	3	0.5	0.1			5.0		
74	HD 3345[B]	57	35	10.3	4.0	7	3	5	4	5.6	2.4			5.0		
75	DDW 48 (d)	56	35	4.3	1.9	7	3	4	3	6.1	2.2			0.0		
76	HI8627(d) (C)	67	36	8.0	3.6	7	3	5	4	1.1	0.3	10.0	2.5	10.0		
77	DBW110 (C)	89	56	16.2	5.7	7	3	5	4	0.0	0.0	45.0	26.9	15.0		
78	UAS 466(d)*	78	46	9.3	5.4	7	4	5	4	5.6	2.1	18.6	4.7	37.5		
79	MP3288 (C)	79	57	9.1	6.7	7	4	5	3	4.6	2.2			35.0		
80	DBW 277	67	45	13.4	6.4	7	4	4	2	4.3	1.2			60.0		
80A	Infector	89	67	19.6	12.6	9	5	5	4	25.0	18.1					
81	DDW 47(d)*[Q]	57	35	10.3	4.6	3	2	4	4	8.3	2.2	5.0	1.3	7.1		
82	HD2932 (C)	89	56	13.5	4.5	5	3	4	3	4.8	2.1			45.0		
83	HD2864 (C)	79	57	12.2	7.3	7	4	5	3	7.1	2.1			65.0		
84	MP3336 (C)	99	57	10.1	4.2	7	5	5	3	6.6	2.0			65.0		
85	MP4010 (C)	79	57	15.7	9.0	7	5	5	3	5.3	1.7			80.0		
86	CG1029	89	46	14.1	7.4	9	5	5	3	26.1	9.9			90.0		
87	UAS3002	68	46	6.2	3.8	5	3	5	3	9.3	2.3			70.0		
88	HI1633	79	56	13.4	5.5	7	3	5	3	8.6	2.2			60.0		
89	HI1634	89	46	6.1	3.8	5	3	5	5	7.5	2.7			55.0		

90	HI8808 (d)	99	57	16.7	7.3	5	4	4	3	6.3	2.2			70.0		
91	HI8807 (d)	89	56	8.8	3.5	5	3	4	3	1.9	0.5			55.0		
V. Peninsular Zone																
92	PBW 823[B]	99	46	6.8	3.2	6	4	4	4	1.0	0.2			5.0		
93	UAS428 (d) (C)	78	46	10.0	4.2	6	3	4	3	7.1	2.4	45.0	15.0	40.0		
94	DDW 49 (d)	89	56	4.8	2.3	5	3	4	3	1.5	0.4			11.1		
95	UAS 3001	89	46	12.2	5.4	7	4	4	3	2.7	0.7			55.0		
96	MACS3949 (d) (C)	99	46	2.9	1.6	7	4	4	3	5.3	2.4	6.1	5.1	35.0		
97	MACS6222 (C)	78	46	4.5	3.1	5	3	4	2	4.8	1.9	49.3	20.2	5.0		
98	GW 322 (C)	99	57	10.0	6.5	7	3	4	3	5.6	3.7			40.0		
99	DDW 48 (d)	99	57	8.9	4.2	9	4	5	3	5.0	1.3			50.0		
100	MACS6478 (C)	89	46	12.6	6.9	5	3	5	3	4.3	1.7	45.0	25.0	5.0		
100A	Infector	89	68	27.4	22.0	9	6	5	4	34.0	21.9					
101	HD3343[M]	99	56	13.7	9.4	7	4	5	4	4.5	3.4			25.0		
102	WHD 963 (d)	89	56	10.5	4.3	7	3	5	4	0.5	0.1			20.0		
103	HI8807(d)	79	46	5.0	2.8	9	4	4	3	2.1	0.5			10.0		
104	HI1633	79	46	13.3	6.2	7	3	5	3	3.5	1.3			25.0		
105	UAS 3002	89	57	9.1	4.3	7	3	5	3	6.9	1.9			10.0		
106	Raj4083 (C)	99	57	12.2	6.6	5	3	5	2	7.6	1.9			25.0		
107	HD2932 (C)	99	57	17.4	11.0	5	3	5	3	13.6	9.0			22.2		
108	GW509	99	57	12.2	7.9	7	3	4	3	9.1	3.4			10.0		
109	HD3090 (C)	89	57	16.1	9.2	9	3	5	3	14.3	11.0			5.0		
110	NIAW 3170*	89	56	8.5	5.8	7	2	4	3	8.7	2.2			0.0		
111	GW 1346(d)*	89	56	10.0	5.9	7	5	5	3	3.4	0.9	46.6	11.7	15.0		
112	MACS 4058(d)*	58	46	11.1	5.4	7	2	4	3	1.1	0.3	5.0	1.3	10.0		
113	DBW93 (C)	89	46	12.6	4.8	7	3	4	3	13.9	8.6	34.3	23.2	20.0		
114	HI 8805(d)*	89	46	11.7	5.7	7	3	4	2	0.5	0.1	6.3	1.6	0.0		
115	AKDW2997-16(d) (C)	99	57	5.0	2.5	9	5	5	3	1.5	0.4	6.7	3.7	50.0		
116	MACS 6695*	89	56	10.5	6.4	7	3	4	3	1.3	0.4	55.6	26.7	10.0		
117	UAS446(d) (C)	89	56	8.2	4.0	7	3	4	3	3.1	0.8	8.5	3.1	15.0		
118	HI1605 (C)	89	56	8.3	5.2	7	3	5	3	8.3	2.5	68.3	39.0	44.4		
119	MACS 6696*	89	46	9.1	5.0	7	3	5	4	7.3	3.1	95.0	37.8	90.0		

120	NIDW 1149(d)	89	56	4.1	2.4	7	3	4	4	4.1	1.0			66.6		
120A	Infector	89	68	22.1	19.1	9	6	4	4	30.5	21.4					
121	HI 8802(d)*	89	46	2.5	1.4	7	3	5	3	3.5	1.5	9.1	3.6	5.0		
VI. Special Trial (Dicoccum)																
122	DDK1029 (C)	89	56	8.1	5.4	5	2	5	3	2.8	0.7	8.3	2.1	60.0		
123	MACS5052	89	46	9.5	3.2	7	3	5	3	4.6	1.4			60.0		
124	MACS6222 (aest.) (C)	68	46	11.3	3.6	7	2	5	3	4.2	1.2	50.0	15.0	57.1		
125	DDK1056	78	46	12.5	6.6	3	2	5	3	8.3	2.4			30.0		
126	HW1098 (C)	78	46	12.2	6.7	3	2	4	2	3.7	0.9	0	0	55.0		
127	MACS5053	79	57	13.1	5.9	7	3	5	3	3.6	1.4			35.0		
128	DDK1057	89	47	11.3	5.5	5	2	4	2	4.2	1.7			57.1		
VII. Special Trial- SPL-HYPT																
129	HD3317	99	45	12.5	6.2	7	3	4	3	7.5	3.8			20.0		
130	WH1254	89	46	15.0	8.1	5	3	4	3	8.1	2.6			20.0		
131	DBW301	68	46	12.5	3.6	3	2	4	3	7.5	4.7			0.0		
132	WH1270	89	46	11.8	7.7	5	2	5	3	7.6	4.1			45.0		
133	HD2967 (C)	57	35	13.0	7.3	7	3	4	3	5.2	2.5			50.0		
134	PBW824	89	45	9.5	4.6	7	3	4	3	4.3	1.1			78.5		
135	UP3043	78	46	9.6	3.9	5	2	4	2	8.1	3.7			80.0		
136	DBW187	89	46	11.3	3.6	5	2	4	2	6.5	1.8			25.0		
137	HD3086 (C)	89	46	11.5	4.2	5	2	4	3	5.2	1.8			30.0		
138	DBW303	78	46	11.1	5.8	4	2	4	3	4.3	1.2			5.0		
139	DBW304	89	46	9.6	3.2	5	2	4	3	6.5	2.3			80.0		
140	UP3042	89	46	9.5	6.3	4	2	5	3	4.3	2.1			25.0		
140A	Infector	89	57	20.0	18.2	7	5	5	4	30.7	21.0					
141	DBW302	78	46	9.6	5.3	5	2	5	3	8.6	3.4			0.0		
142	PBW825	78	46	12.7	7.7	7	3	4	2	5.3	1.3			10.0		
143	HD3347	79	46	12.5	8.7	3	2	4	4	11.6	7.9			5.0		
VIII. Special Trial (SPL-AST)																
144	WH1223	99	45	9.6	5.7	5	2	4	3	8.3	2.5			0.0		
145	KRL19 (C)	89	46	13.3	5.5	5	3	5	3	6.6	1.9			0.0		
146	Kharchia65 (C)	89	56	28.0	11.6	7	3	4	3	11.4	5.6			65.0		
147	NW 7060	68	46	10.8	7.3	5	2	5	3	6.1	2.0			35.0		

148	KRL210 (C)	68	46	9.6	4.7	5	2	5	4	4.3	1.2			60.0		
149	WH 1228	89	46	11.5	5.8	3	2	5	3	7.6	2.9			80.0		
150	NW 7062	89	46	10.0	6.2	6	3	5	3	8.1	2.7			0.0		
IX. Special Trial (SPL-VLS)																
151	PBW757 (C)	89	46	8.6	2.8	5	3	5	3	7.5	2.9	51.9	28.3	0.0		
152	WR544 (C)	79	57	14.2	6.4	7	3	5	4	6.6	2.1	62.5	27.4	5.0		
153	HD3298	89	46	6.6	3.7	5	3	4	3	3.5	1.2	29.4	20.5	45.0		
154	HD3271	78	46	8.0	5.5	5	2	5	4	8.2	4.9	65.7	42.3	45.0		
155	DBW14 (C)	79	46	13.1	4.9	6	3	5	4	2.5	0.6	33.8	14.1	50.0		
156	DBW71 (C)	89	50	11.5	6.5	5	3	5	4	10.8	3.3	37.8	26.9	25.0		
157	HI1621	89	56	7.5	5.6	5	2	5	3	6.7	2.8	12.6	9.0	40.0		
158	PBW 797	78	45	11.3	5.7	5	2	4	3	5.4	2.2	40.6	20.2	57.1		
158A	Infector	89	67	23.1	17.9	7	5	5	4	37.5	23.2					

Table 1.4. Status of disease resistance in AVT (Final year entries) and check varieties during 2016-17, 2017-18 and 2018-19

S. No.	Entries	Rusts								LB (dd)		PM 0-9		KB %		LS %		FS %		FR %	FHB 0-5	
		South				North																
		Stem rust		Leaf rust		Leaf rust		Stripe														
		HS	ACI	HS	ACI	HS	ACI	HS	ACI	HS	AV	HS	AV	HS	AV	HS	AV	HS	AV.	HS	HS	AV.
II. North Western Plains Zone																						
1	DBW 221																					
	2016-17	80S	46.3	80S	18.9	20S	7.0	40S	11.7													
	2017-18	60S	43.3	80S	22.3	10S	3.0	40S	11.6	68	35	7	5	10.7	5.5	-	-	100.0	47.1	5.0	4	-
	2018-19	60S	40.7	80S	23.7	70S	30.6	40S*	12.0	68	46	7	4	13.0	6.2	73.3	29.7	8.3	3.7	NG	4	2
	Mean	80S	43.4	80S	21.6	70S	13.5	40S	11.8	68	36	7	5	13.0	5.9	73.3	29.7	100.0	25.4	5.0	4	2
2	DBW 222																					
	2016-17	60S	27.3	20S	4.2	10S	2.1	40S	12.8													
	2017-18	40S	30.0	10MS	2.0	10MS	1.4	40S	13.7	57	24	7	3	6.0	2.7	-	-	21.4	6.6	11.1	4	-
	2018-19	40S	20.7	10MS	1.2	10S	2.5	60S	14.6	67	46	7	4	9.1	5.4	14.6	4.9	6.3	2.5	10.0	4	2
	Mean	60S	26.0	20S	2.5	10S	2.0	60S	13.7	67	35	7	4	9.1	4.1	14.6	4.9	21.4	4.6	11.1	4	2
3	PBW 771																					
	2016-17	20S	8.3	30MS	5.2	5S	1.2	5MS	0.7													
	2017-18	10S	5.9	20S	4.1	5R	0.2	40S	7.7	68	34	9	7	14.3	5.9	-	-	62.5	23.5	15.0	5	-
	2018-19	30S	7.5	10R	0.4	5S	0.9	10S	2.4	89	45	9	4	9.0	5.9	34.1	23.6	9.1	4.9	0.0	4	3
	Mean	30S	7.2	30MS	3.2	5S	0.8	40S	3.6	89	35	9	6	14.3	5.9	34.1	23.6	62.5	14.2	15.0	5	3
4	HI 1628																					
	2016-17	30MS	14.7	20S	4.9	TS	0.2	60S	18.4													
	2017-18	10MS	3.2	20S	6.4	5MR	0.3	40S	13.0	67	35	9	4	6.7	4.3	-	-	2.1	0.5	45.0	4	
	2018-19	10MS	5.2	60S*	8.9	20S	5.8	40S	13.5	99	46	7	3	12.1	8.5	62.3	46.9	9.8	2.6	30.0	5	3
	Mean	30MS	7.7	60S*	6.7	20S	2.1	60S	15.0	99	36	9	4	12.1	6.4	62.3	46.9	9.8	1.6	45.0	5	3
5	BRW 3806																					
	2016-17	60S	24.3	40S	8.2	10MR	1.2	40S	20.0													
	2017-18	20MS	11.8	60S	17.9	20S	7.7	40S	17.7	46	24	8	4	9.1	5.8	-	-	52.7	13.2	17.7	3	-
	2018-19	30S	16.0	60S*	14.3	80S*	20.6	60S	25.7	79	46	7	2	18.0	9.6	80.0	33.4	5.6	2.0	65.0	4	2
	Mean	60S	17.4	60S	13.5	80S*	9.8	60S	21.1	79	35	8	3	18.0	7.7	80.0	33.4	52.7	7.6	65.0	4	2
6	NIAW 3170																					
	2016-17	20MS	4.3	10MR	1.1	5S	1.0	30S	11.7													
	2017-18	5S	1.7	5MS	3.0	5MR	0.3	40S	17.9	68	35	7	3	21.7	7.8	-	-	2.9	0.7	30.0	4	-

	2018-19	10MS	3.0	5S	1.6	20S	4.8	60S	17.4	68	46	7	2	6.9	4.2	72.1	46.0	6.4	1.6	55.0	4	3
	Mean	20MS	3.0	5S	1.9	20S	2.0	60S	15.7	68	36	7	3	21.7	6.0	72.1	46.0	6.4	1.2	55.0	4	3
7	WH 1105 (C)																					
	2016-17	40S	11.4	40S	9.5	20S	12.0	60S	25.4	89	56	9	5	33.3	18.5	67.3	31.8	3.2	0.8	7.1	5	2
	2017-18	30S	12.3	60S*	11.3	20S	4.3	40 S	27.1	89	56	6	3	26.4	14.1	57.4	25.8	31.6	7.9	27.8	-	-
	2018-19	30S	11.5	40S	7.5	60S	17.0	40S	12.4	78	46	5	2	13.4	7.2	26.9	15.7	9.3	2.3	NG	4	3
	Mean	40S	11.7	60S*	9.4	60S	11.1	60S	21.6	89	56	9	3	33.3	13.3	67.3	24.4	31.6	3.7	27.8	5	3
8	HD 3226																					
	2016-17	20MS	5.4	30S	7.1	30S	10.0	TR	0.6													
	2017-18	10S	7.6	20S	11.8	10S	3.0	5S	2.9	78	46	3	2	4.6	3.1	45.0	31.1	4.3	1.1	5.3	5	2
	2018-19	30S	7.3	20S	8.7	40S	12.4	20S	4.5	89	46	5	2	6.1	4.4	47.6	30.3	8.1	2.4	NG	4	3
	Mean	30S	6.8	40S	9.2	40S	8.5	20S	2.7	89	46	5	2	6.1	3.8	47.6	30.7	8.1	1.8	5.3	5	3
9	HD 3086 (C)																					
	2016-17	70S	34.7	30S	8.8	20S	11.2	10S	3.3	57	46	9	4	16.3	8.4	14.6	5.0	23.5	10.1	50.0	5	2
	2017-18	60S	37.3	40S*	6.1	20S	10.9	10S	2.9	79	46	5	3	15.2	6.3	31.1	7.8	36.4	11.6	10.0	-	-
	2018-19	40S	26.7	60S*	10.8	40S	28.1	40MS	10.0	78	46	5	2	9.9	5.7	17.8	7.6	7.8	2.2	NG	5	3
	Mean	70S	32.9	60S	8.6	40S	16.7	40MS	5.4	79	46	9	3	16.3	6.8	31.1	6.8	36.4	8.0	50.0	5	3
10	PBW 550 (C)																					
	2016-17	10MR	3.5	10MR	0.9	10S	2.6	80S	46.0	99	68	7	4	13.3	8.2	-	-	4.6	1.9	0.0	5	3
	2017-18	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	2018-19	10MS	4.3	20MS	4.9	5MS	0.8	80S	46.3	68	35	7	3	11.2	6.7	-	-	6.1	3.8	0.0	5	3
	Mean	10MS	3.9	20MS	2.9	10S	1.7	80S	46.2	99	47	7	3	11.2	6.7	-	-	6.1	3.8	0.0	5	3
11	HD 2967 (C)																					
	2016-17	30MS	5.3	20MR	1.3	10S	4.0	80S	51.0	68	25	9	5	23.3	13.7	60.0	25.2	18.2	6.2	30.0	5	2
	2017-18	10MS	3.8	10R	0.3	20MS	3.7	80S	39.9	67	35	6	3	16.1	6.8	61.9	31.4	42.9	14.1	20.0		
	2018-19	30S	8.7	10MS	1.5	30S	6.5	80S	37.5	57	35	7	3	11.1	6.6	51.2	26.6	7.1	2.5	70.0	4	3
	Mean	30S	5.9	10MS	1.0	30S	4.7	80S	42.8	68	35	9	4	23.3	9.0	61.9	27.7	42.9	7.6	70.0		3
12	DPW 621-50																					
	2016-17																					
	2017-18	20S	10.0	20MS	4.0	20S	4.3	80S	45.5	89	46	5	3	16.7	6.8	-	-	10.0	3.3	20.0	-	-
	2018-19	20S	7.6	10MS	3.1	20S	4.7	80S	32.5	78	45	9	4	9.1	5.0	53.1	29.1	8.5	2.1	44.4	4	2
	Mean	20S	10.0	20MS	4.0	20S	4.3	80S	45.5	89	45	9	4	16.7	5.9	53.1	29.1	10.0	2.7	44.4	4	2
13	DBW 88 (C)																					
	2016-17	20MR -MS	6.0	20S	5.5	5S	2.8	80S	37.4	57	45	9	5	17.3	12.9	37.6	22.3	4.0	1.5	35.0	5	2
	2017-18	20MR	8.0	20S	5.3	10S	2.6	80S	35.5	89	46	6	3	8.4	4.4	40.0	35.0	25.0	7.1	36.8	-	-
	2018-19	20S	11.0	10MS	2.4	20S	4.1	80S	36.6	89	46	9	4	17.8	7.8	36.6	17.6	8.3	2.4	25.0	4	2

	Mean	20S	8.3	20S	4.4	20S	3.2	80S	36.5	89	46	9	4	17.8	8.4	40.0	25.0	25.0	3.7	36.8	5	2
14	PBW 752 (I) (C)																					
	2016-17	100S	45.0	40S	18.3	20S	6.6	10MS	0.8													
	2017-18	60S	38.0	40S	8.4	20MS	4.6	10S	2.0	68	46	7	4	25.5	11.3	43.6	26.3	62.5	16.6	5.3	-	-
	2018-19	60S	28.0	20MS	7.3	20S	6.3	10S	1.0	89	46	9	4	10.0	4.3	72.3	36.8	6.1	3.3	60.0	4	2
	Mean	100S	37.0	40S	11.3	20S	5.8	10S	1.3	89	46	9	4	25.5	7.8	72.3	31.6	62.5	10.0	60.0	4	2
15	DBW 173																					
	2016-17	80S*	14.3	10MS	2.4	5S	2.0	60MS*	13.8	99	57	6	3	15.0	5.8	28.6	23.9	5.9	2.9	11.8	5	2
	2017-18	5S	1.3	5MS	1.0	10S	2.6	80S	23.3	78	56	6	3	4.6	3.2	71.7	42.2	14.3	7.3	26.3	-	-
	2018-19	10MS	2.6	20S	3.1	10S	3.6	60S	19.3	57	46	9	3	6.7	4.3	68.7	42.3	5.7	1.8	30.0	4	3
	Mean	80S*	6.1	20S	2.2	10S	2.7	80S	18.8	99	56	9	3	15.0	4.4	71.7	36.1	14.3	4.0	30.0	5	3
16	WH 1021 (C)																					
	2016-17	20S	7.2	20S	5.5	10S	4.8	60S	43.6	79	57	7	5	5.6	2.4	48.8	24.4	5.9	3.4	0.0	5	2
	2017-18	10MR	1.2	40S	9.0	10S	3.8	80S	51.0	69	46	7	5	12.5	5.9	60.0	22.9	37.5	10.8	18.8	-	-
	2018-19	20MS	3.8	40S*	6.7	60S	15.9	80S	46.2	89	57	7	3	11.7	6.2	74.4	37.0	6.3	2.9	30.0	5	3
	Mean	20S	4.1	40S	7.1	60S	8.2	80S	46.9	89	57	7	4	12.5	4.8	74.4	28.1	37.5	5.7	30.0	5	3
17	HD 3059 (C)																					
	2016-17	30MS	11.0	20S	5.7	20S	6.0	80S	43.6	79	46	9	5	16.6	11.4	65.9	30.9	8.9	3.5	17.7	5	2
	2017-18	20S	12.1	20MS	3.9	10S	3.7	80S	40.4	89	46	7	4	7.4	5.4	35.8	28.0	22.2	8.3	20.0		
	2018-19	30S	11.0	5MS	1.2	40S	7.3	80S	35.8	78	46	9	3	8.3	4.2	59.4	37.7	6.6	1.8	NG	4	2
	Mean	30S	11.4	20S	3.6	40S	5.7	80S	39.9	89	46	9	4	16.6	7.0	65.9	32.2	22.2	4.5	20.0	5	2
18	WH 1124 (C)																					
	2016-17	50S	20.0	30S	10.8	10S	4.2	50S	7.7	89	46	9	4	15.8	6.6	11.1	2.8	9.1	3.8	7.7	5	2
	2017-18	40S	26.7	40S	8.5	40S	14.0	10S	1.9	79	47	5	3	12.8	5.5	21.2	8.2	27.3	7.6	15.8		
	2018-19	60S	38.8	60S*	9.6	40S	17.6	20S	6.0	99	46	7	3	9.2	5.0	13.3	4.4	7.3	2.3	NG	4	3
	Mean	60S	28.5	60S	9.6	40S	11.9	50S	5.2	99	46	9	3	15.8	5.7	21.2	5.1	27.3	4.6	15.8	5	3
19	HI 1620																					
	2016-17	40MS	14.4	30S	8.1	20S	5.0	10S	5.1													
	2017-18	40MR	7.7	20MS	3.6	10S	2.7	20S	7.8	78	46	8	4	22.9	10.4	73.3	37.9	16.7	6.4	17.7	-	-
	2018-19	20S	8.6	5S	1.6	10S	3.3	40S	10.6	78	45	7	4	11.9	8.1	45.7	25.6	10.2	2.6	45.0	4	2
	Mean	40MS	10.2	30S	4.4	20S	3.7	40S	7.8	78	46	8	4	22.9	9.3	73.3	31.8	16.7	4.5	45.0	4	2
20	WH 1142 (I) (C)																					
	2016-17	20MR	2.0	40S	8.1	40S*	8.1	5S	1.4	68	46	9	5	22.2	10.9	19.9	11.2	21.3	11.0	75.0	5	2
	2017-18	5S	2.5	60S	15.1	20S	5.6	10S	3.3	78	46	8	5	6.0	3.4	80.5	42.7	15.4	9.1	17.7		
	2018-19	30MS	7.0	60S*	11.6	50S*	11.8	20S	4.9	79	36	7	3	6.5	3.4	52.2	24.4	11.3	4.7	45.0	4	2
	Mean	30MS	3.8	60S	11.6	50S*	8.5	20S	3.2	79	46	9	4	22.2	5.9	80.5	26.1	21.3	8.3	75.0	5	2

21	HD 3043 (C)																				
	2016-17	40S	10.9	20S	7.9	60S	16.9	60S	28.2	68	35	5	3	18.3	6.2	62.5	21.5	15.4	6.0	0.0	5	2
	2017-18	10 MS	4.0	80S*	17.0	20S	12.9	60S	30.0	78	45	6	2	8.8	5.4	-	-	9.1	3.8	0.0		
	2018-19	20MS	4.5	60S*	15.6	100S	28.1	60MS	23.0	79	46	9	3	12.2	6.5	33.5	20.9	5.6	2.1	35.0	4	2
	Mean	40S	6.5	80S*	13.5	100S	19.3	60S	27.1	79	45	9	3	18.3	6.0	62.5	21.2	15.4	4.0	35.0	5	2
22	PBW 644 (C)																					
	2016-17	40MS	16.0	10S	3.8	10S	2.2	40S	17.6	79	46	7	4	17.5	8.2	55.6	22.6	16.7	10.0	10.0	5	2
	2017-18	30S	18.0	20MS	4.6	5S	1.6	60S	31.0	78	46	7	3	6.5	3.0	60.0	26.3	71.4	20.7	33.3		
	2018-19	20S	15.5	10MS	1.3	50S*	10.3	60MS	21.4	79	46	9	4	8.1	5.4	42.9	28.8	6.3	3.5	65.0	4	2
	Mean	40MS	16.5	20MS	3.2	50S*	4.7	60S	23.3	79	46	9	4	17.5	5.5	60.0	25.9	71.4	11.4	65.0	5	2
23	HD 3237																					
	2016-17	40S	15.6	40S	16.3	5S	1.4	5MR	0.6													
	2017-18	20S	14.7	60S	29.0	40S	15.7	10MS	4.1	78	46	7	3	9.5	4.8	46.1	29.6	4.8	1.2	38.9		
	2018-19	40S	24.0	60S	18.6	90S	22.8	10S	4.5	78	46	7	4	7.8	5.8	39.6	21.1	7.5	2.1	22.2	5	3
	Mean	40S	18.1	60S	21.3	90S	13.3	10S	3.1	78	46	7	4	9.5	5.3	46.1	25.4	7.5	1.7	38.9	5	3
24	WH 1080 (C)																					
	2016-17	15MS	4.5	20S	3.2	20S	8.4	10S	2.3	89	46	7	4	14.2	9.2	43.3	21.4	7.4	3.5	21.4	5	2
	2017-18	30MS	12.3	40S*	6.1	20S	7.3	10MS	3.1	89	46	7	4	4.2	2.2	76.6	40.4	20.0	5.0	26.3		
	2018-19	40MS	11.7	20S	4.3	80S*	17.3	30S	7.6	68	46	7	2	8.3	4.8	65.0	29.8	7.8	2.0	65.0	4	3
	Mean	40MS	9.5	40S*	4.5	80S	11.0	30S	4.3	89	46	7	3	14.2	5.4	76.6	30.5	20.0	3.5	65.0	5	3
III. North Eastern Plains Zone																						
25	HD3249*[#Q]																					
	2016-17	30MS	10.5	20S	3.3	TMR	0.1	20MS	5.5													
	2017-18	20MS	7.7	5S	1.0	10S	3.7	40S	14.0	45	34	8	4	25.7	10.7	-	-	33.3	10.2	15.0	4	
	2018-19	10S	4.0	5S	0.8	30S	8.8	20S	6.4	67	45	9	3	12.2	6.0	26.7	22.6	4.3	1.8	65.0	4	3
	Mean	30MS	7.4	20S	1.7	30S	4.2	40S	8.6	67	35	9	4	25.7	8.4	26.7	22.6	33.3	6.0	65.0	4	3
26	DBW 252*[#]																					
	2016-17	30S	14.2	TR	0.1	0	0.0	40S	13.9													
	2017-18	20S	10.4	20S	3.3	10S	1.5	40S	19.6	57	34	5	3	9.1	6.0	-	-	85.7	24.9	0.0	4	
	2018-19	20S	12.0	5MR	0.5	30S	6.9	60S	21.0	57	45	7	3	8.5	4.1	40.0	26.0	11.1	7.4	62.5	4	3
	Mean	30S	12.2	20S	1.3	30S	2.8	60S	18.2	57	35	7	3	9.1	5.1	40.0	26.0	85.7	16.2	62.5	4	3
27	HD 2733 (C)																					
	2016-17	10MR	0.8	60S	14.1	5S	2.0	80S	53.6	67	46	9	5	11.1	4.8	15.0	8.3	32.6	13.4	63.2	5	2
	2017-18	20S	4.7	40S	13.6	70S	18.7	80S	48.8	78	46	9	6	6.0	3.0	65.4	37.8	20.0	10.7	0.0		
	2018-19	20S	4.8	40S*	8.4	60S	21.9	80S	49.3	89	46	9	4	11.1	5.2	51.3	21.3	5.7	1.4	38.8	4	2
	Mean	20S	3.4	60S	12.0	70S	14.2	80S	50.6	89	46	9	5	11.1	4.3	65.4	22.5	32.6	8.5	63.2	5	2
28	DBW39(C)																					

	2016-17	10MR	0.7	20MR	1.2	5S	1.2	60S	38.6	67	46	9	5	20.7	14.1	31.3	11.8	23.1	8.9	0.0	5	2
	2017-18	5MR	0.9	10R	0.3	30MS	6.3	80S	44.0	78	45	5	4	5.0	3.3	61.7	47.1	40.0	11.3	11.1		
	2018-19	5MS	0.7	20S	2.9	5S	2.7	80S	36.2	57	45	5	3	17.8	7.6	70.9	31.1	8.3	4.2	50.0	5	3
	Mean	5MS	0.8	20S	1.5	30MS	3.4	80S	39.6	78	45	9	4	20.7	8.3	70.9	30.0	40.0	8.1	50.0	5	3
29	DBW 187																					
	2016-17	20MS	9.0	10MS	1.8	TS	0.3	10MS	4.4													
	2017-18	20S	8.0	5MS	1.6	20S	4.3	20S	8.9	89	46	5	3	6.7	4.9	45.0	34.9	20.0	8.3	35.0		
	2018-19	30S	10.2	5S	0.7	15S	5.4	20MS	6.5	78	46	5	2	6.6	2.5	53.1	29.2	5.9	1.5	7.1	4	3
	Mean	30S	9.1	10MS	1.4	20S	3.3	20S	6.6	89	46	5	3	6.7	3.7	53.1	32.1	20.0	4.9	35.0	4	3
30	K 0307 (C)																					
	2016-17	80S	18.8	40S	7.8	10S	2.8	60S	39.8	68	46	6	4	34.8	13.0	85.0	31.5	5.9	1.5	7.1	5	2
	2017-18	40S	14.0	40S	10.4	20S	5.7	60S	33.0	89	36	4	3	8.0	5.1	71.4	42.4	9.1	3.3	20.0		
	2018-19	60MR-MS	18.0	60S*	9.4	80S	21.6	60S	27.0	79	45	7	3	8.6	5.3	43.8	29.0	4.1	1.4	0.0	4	2
	Mean	80S	16.9	60S	9.2	80S	10.0	60S	33.3	89	45	7	3	34.8	7.8	85.0	34.3	9.1	2.1	20.0	5	2
31	HD 2967 (C)																					
	2016-17	30MS	5.3	20MR	1.3	10S	4.0	80S	51.0	68	25	9	5	23.3	13.7	60.0	25.2	18.2	6.2	30.0	5	2
	2017-18	20MR	4.2	10MS	1.3	20S	5.1	80S	42.6	67	35	6	3	16.1	6.8	61.9	31.4	42.9	14.1	20.0		
	2018-19	20MS	6.3	5S	1.5	30S	6.5	60S	36.8	78	35	7	4	13.8	8.6	38.2	20.6	6.0	3.6	10.0	4	3
	Mean	30MS	5.2	20MR	1.4	30S	5.2	80S	43.4	78	35	9		23.3	9.7	61.9	25.7	42.9	8.0	20.0	5	3
32	K 1317 (C)																					
	2016-17	30MR	4.9	30S	4.4	10S	2.0	60S	22.9	89	56	9	5	13.2	9.1	81.1	42.0	3.1	1.3	0.0	5	2
	2017-18	40MR	6.2	30S	5.0	10S	3.2	40S	14.0	56	24	4	3	10.4	8.1	62.5	49.0	4.2	1.0	37.5	3	
	2018-19	30MS	9.4	10MS	2.3	60S	15.1	40S	18.7	89	46	7	3	6.4	4.3	66.4	32.3	3.5	1.3	0.0	4	4
	Mean	30MS	6.8	30S	3.9	60S	6.8	60S	18.5	89	46	9	4	13.2	7.2	81.1	41.1	4.2	1.2	37.5	5	3
33	HI 1612 (C)																					
	2016-17	40S	9.1	20MS	3.8	5S	1.0	10S	3.2	57	34	9	5	14.3	9.3	29.7	13.1	15.0	9.5	41.1	5	2
	2017-18	80S	44.0	20MS	3.3	20MS	3.9	10S	6.1	35	13	7	4	22.7	8.8	55.0	38.3	87.5	36.6	31.6	4	
	2018-19	40S	24.3	10MS	1.8	30S	7.8	40MS*	5.4	69	35	5	2	4.5	2.1	62.0	23.0	9.5	6.1	0.0	4	2
	Mean	80S	25.8	20MS	1.9	30S	4.2	40MS	4.9	69	24	9	4	22.7	6.7	62.0	24.8	87.5	17.4	41.1	5	2
34	HD 3171 (C)																					
	2016-17	80S	31.4	40S	11.5	20S	5.0	60S	29.6													
	2017-18	40S	22.0	20MS	5.5	20S	5.7	60S	24.0	45	23	5	3	33.3	10.1	55.0	31.7	21.4	6.7	15.0	4	
	2018-19	20S	14.1	60S*	10.9	80S	31.5	60S	19.9	68	35	7	3	16.7	7.7	23.7	10.4	6.4	3.5	5.5	4	3
	Mean	80S	22.5	60S	9.3	80S	14.1	60S	24.5	68	34	7	3	33.3	8.9	55.0	21.1	21.4	5.1	15.0	4	3
35	HD 2888 (C)																					

	2016-17	5MR	0.4	TMR	0.1	5S	2.0	60S	33.2												
	2017-18	10MS	1.7	20R	0.5	10S	1.4	60S	27.1	36	24	7	4	7.7	5.1	61.7	37.3	72.7	19.4	5.3	5	
	2018-19	5MS	0.8	5S	0.7	20S	6.4	60S	26.5	57	46	7	5	17.8	11.3	46.9	27.9	7.3	3.5	12.5	5	4
	Mean	10MS	1.0	5S	0.4	20S	3.3	60S	28.9	57	35	7	5	17.8	8.2	61.7	32.6	72.7	11.5	12.5	5	4
36	K 8027 (C)																					
	2016-17	20S	4.7	5S	0.8	60S	18.0	60S	32.6												
	2017-18	10MR	0.7	10R	0.3	10S	2.9	60S	35.0	68	24	6	4	14.1	6.8	67.3	44.6	50.0	15.5	0.0	4	
	2018-19	10MS	3.5	10MS	1.5	20S	4.5	60S	32.7	68	45	9	4	11.1	7.0	47.7	20.0	7.4	6.8	40.0	4	3
	Mean	10MS	3.0	10MS	0.9	60S	8.5	60S	33.4	68	35	9	4	14.1	6.9	67.3	32.3	50.0	11.2	40.0	4	3
III. Central Zone																						
37	UAS 466(d)																					
	2016-17	40S	11.4	10MS	1.3	5MR	0.4	5MS	1.9												
	2017-18	5MS	2.3	5S	1.2	10S	1.6	40S	17.3	68	35	6	4	6.1	3.1	-	-	5.4	1.9	15.0	4	
	2018-19	40S*	10.7	10S	1.6	40S*	6.0	60S	13.4	78	46	7	4	9.3	5.4	18.6	4.7	5.6	2.1	37.5	5	4
	Mean	40S	8.1	10S	1.4	40S	2.7	60S	10.9	78	46	7	4	9.3	4.3	18.6	4.7	5.6	2.0	37.5	5	4
38	DDW 47(d)*[Q]																					
	2016-17	60S*	13.4	10MR	0.6	0	0.0	TR	0.1												
	2017-18	10MS	3.7	5MS	1.1	10S	2.0	20MS	5.4	67	34	7	3	8.3	2.8	-	-	3.1	0.8	33.3	3	
	2018-19	40MR	5.8	5S	1.4	5S	0.7	10MS	1.1	57	35	3	2	10.3	4.6	5.0	1.3	8.3	2.2	7.1	4	4
	Mean	60S	7.6	5S	1.0	10S	0.9	20MS	2.2	67	35	7	3	10.3	3.7	5.0	1.3	8.3	1.5	33.3	4	4
39	HI8713(d) (C)																					
	2016-17	5MS	2.3	10MS	1.7	TR	0.0	20S	9.2												
	2017-18	20MS	5.3	5MS	1.6	5MS	0.7	30MS	17.7	68	35	4	3	10.7	6.4	-	-	4.0	1.0	15.0	3	
	2018-19	10MS	1.6	5MR	0.3	10S	3.4	20S	3.9	89	46	9	4	4.6	2.8	0.0	0.0	9.6	3.0	25.0	5	4
	Mean	20MS	3.1	10MS	1.2	10S	1.4	30MS	10.3	89	36	9	4	10.7	4.6	0.0	0.0	9.6	2.0	25.0	5	4
40	GW322 (C)																					
	2016-17	60S	22.7	20S	10.3	5S	1.8	80S	42.9												
	2017-18	30S	14.3	20S	6.4	20MS	3.0	80S	43.6	67	34	5	3	9.0	7.0	68.3	43.4	30.8	12.9	22.2	3	
	2018-19	40S	12.6	40S*	6.8	80S	23.0	80S	44.1	89	57	9	5	8.3	5.9	60.9	33.4	6.2	2.6	45.0	5	3
	Mean	60S	16.5	40S	7.8	80S	9.3	80S	43.5	89	46	9	4	9.0	6.5	68.3	38.4	30.8	7.8	45.0	5	3
41	HI1544 (C)																					
	2016-17	10MS	3.1	20MR	2.3	10S	2.2	80S	55.0												
	2017-18	5MR	0.7	30R	1.3	10S	1.5	100S	63.0	78	46	6	4	9.2	6.0	-	-	85.7	46.5	22.2	3	
	2018-19	10MS	1.4	10R	0.3	40S	7.6	100S	62.7	89	56	9	5	14.7	4.3	34.9	13.5	29.9	11.4	14.2	5	3
	Mean	10MS	1.7	20MR	1.3	40S	3.8	100S	60.2	89	56	9	5	14.7	5.2	34.9	13.5	85.7	29.0	22.2	5	3
42	HI8737(d) (C)																					
	2016-17	30S	15.7	10MS	1.4	TR	0.0	5MS	1.6												

	2017-18	30S	19.6	30S	4.8	5MR	0.3	20MS	6.6	58	35	7	4	22.3	8.3	-	-	5.5	1.4	22.0	3	
	2018-19	40S	11.0	20MS	3.0	20S	3.3	15S	3.0	89	46	9	5	5.6	2.6	5.0	1.3	8.5	2.1	5.0	4	3
	Mean	40S	15.4	30S	3.1	20S	1.2	20MS	3.7	89	36	9	5	22.3	5.5	5.0	1.3	8.5	1.8	22.0	4	3
43	HI8627(d) (C)																					
	2016-17	10MR	0.8	20S	3.7	0	0.0	20MR	3.5													
	2017-18	20MS	3.6	10S	2.7	0	0.0	40S	14.0	79	35	7	4	8.2	3.5	50.0	30.5	3.8	1.0	17.7	4	
	2018-19	30MS	6.5	20MS	3.3	10S	4.7	60S	12.1	67	36	7	3	8.0	3.6	10.0	2.5	1.1	0.3	10.0	5	4
	Mean	30MS	3.6	20S	3.2	10S	1.6	60S	9.9	79	36	7	4	8.2	3.6	50.0	16.5	3.8	0.7	17.7	5	4
44	DBW110 (C)																					
	2016-17	30MS	7.0	20S	4.1	20S	5.2	80S	40.4													
	2017-18	20MS	7.3	30MS	4.2	20S	5.5	80S	43.0	57	24	5	3	8.6	3.9	45.0	29.1	5.3	2.0	33.3	3	
	2018-19	40MS	14.7	10MS	2.3	40S	11.7	80S	41.6	89	56	7	3	16.2	5.7	45.0	26.9	0.0	0.0	15.0	5	4
	Mean	40MS	9.7	30MS	3.5	40S	7.5	80S	41.7	89	45	7	3	16.2	4.8	45.0	28.0	5.3	1.0	33.3	5	4
45	MP3288 (C)																					
	2016-17	20MS	4.1	10S	1.7	5S	1.2	80S	38.0													
	2017-18	20MR	3.5	40R	1.1	0	0.0	80S	31.6	58	36	5	3	6.2	3.3	55.0	30.2	10.0	6.4	0.0	4	
	2018-19	10MS	6.0	10MS	1.5	20S	7.6	80S	35.9	79	57	7	4	9.1	6.7	-	-	4.6	2.2	35.0	5	3
	Mean	20MS	4.5	10S	1.4	20S	2.9	80S	35.2	79	57	7	4	9.1	5.0	55.0	30.2	10.0	4.3	35.0	5	3
46	HD2932 (C)																					
	2016-17	30MS	14.2	20S	6.3	60S	14.2	100S	52.6													
	2017-18	30MR	6.3	80S*	15.1	70S	21.0	90S	58.0													
	2018-19	20MS	8.4	40S	19.4	90S	34.6	80S	55.0	89	56	5	3	13.5	4.5	-	-	4.8	2.1	45.0	4	3
	Mean	30MS	9.6	80S*	13.6	90S	23.2	100S	55.2	89	56	5	3	13.5	4.5	-	-	4.8	2.1	45.0	4	3
47	HD2864 (C)																					
	2016-17	20MS	3.7	30S	5.5	10MR	1.0	100S	59.6													
	2017-18	5MR	0.9	5MS	1.3	30S	4.9	80S	59.0													
	2018-19	10S	2.8	40S*	6.5	20S	6.0	100S	61.8	79	57	7	4	12.2	7.3	-	-	7.1	2.1	65.0	5	3
	Mean	20MS	2.5	40S	4.4	30S	4.0	100S	60.1	79	57	7	4	12.2	7.3	-	-	7.1	2.1	65.0	5	3
48	MP3336 (C)																					
	2016-17																					
	2017-18																					
	2018-19	40S	15.3	40S*	8.1	40S	19.3	100S	53.0	99	57	7	5	10.1	4.2	-	-	6.6	2.0	65.0	5	3
	Mean	40S	15.3	40S*	8.1	40S	19.3	100S	53.0	99	57	7	5	10.1	4.2	-	-	6.6	2.0	65.0	5	3
49	MP4010 (C)																					
	2016-17																					

	2017-18																					
	2018-19	10MS	2.2	5S	0.7	20S	4.8	100S	60.2	79	57	7	5	15.7	9.0	-	-	5.3	1.7	80.0	5	3
	Mean	10MS	2.2	5S	0.7	20S	4.8	100S	60.2	79	57	7	5	15.7	9.0	-	-	5.3	1.7	80.0	5	3
V. Peninsular Zone																						
50	NIAW 3170*																					
	2016-17	20MS	4.3	10MR	1.1	5S	1.0	30S	11.7													
	2017-18	10S	4.7	10MS	3.8	10S	3.4	40S	14.5	68	35	6	3	8.5	3.8	-	-	3.7	1.4	11.8	4	
	2018-19	10MS	4.3	10S	2.5	15S	3.6	40S	14.9	89	56	7	2	8.5	5.8	-	-	8.7	2.2	0.0	4	3
	Mean	20MS	4.4	10S	2.5	15S	2.7	40S	13.7	89	46	7	3	8.5	4.8	-	-	8.7	1.8	11.8	4	3
51	GW 1346(d)*																					
	2016-17	20MS-S	4.4	40S	5.8	TR	0.0	80S	39.9													
	2017-18	20MS	3.9	15R	1.9	40S*	5.9	60S	37.2	78	46	7	4	10.8	5.3	-	-	6.7	1.7	35.7	5	
	2018-19	10S	2.5	5MR	0.3	15S	3.5	100S	33.0	89	56	7	5	10.0	5.9	46.6	11.7	3.4	0.9	15.0	5	3
	Mean	20MS-S	3.6	40S	2.7	40S	3.1	80S	36.7	89	56	7	5	10.8	5.6	46.6	11.7	6.7	1.3	35.7	5	3
52	MACS 4058(d)*																					
	2016-17	40S	12.7	5S	0.9	0	0.0	60S	24.1													
	2017-18	40S	17.7	20S	7.8	10MR	0.7	60S	34.4	78	46	9	5	5.9	2.7	-	-	0.0	0.0	6.3	5	
	2018-19	20MS	7.0	20MS	3.9	20S	5.4	100S	34.8	58	46	7	2	11.1	5.4	5.0	1.3	1.1	0.3	10.0	4	3
	Mean	40S	12.5	20S	4.2	20S	2.0	100S	31.1	78	46	9	4	11.1	4.1	5.0	1.3	1.1	0.2	10.0	5	3
	HI 8805(d)*																					
53	2016-17	10S	3.7	TR	0.1	0	0.0	20S	6.8													
	2017-18	10S	2.8	10MR	2.0	5S	1.0	20MS	4.2	67	35	7	4	6.1	4.0	-	-	0.0	0.0	33.3	4	
	2018-19	5S	1.7	10MS	1.9	40S	8.1	20S	4.2	89	46	7	3	11.7	5.7	6.3	1.6	0.5	0.1	0.0	4	2
	Mean	10S	2.7	10MS	1.3	40S	3.0	20S	5.1	89	46	7	4	11.7	4.9	6.3	1.6	0.5	0.1	33.3	4	2
54	MACS 6695*																					
	2016-17	30MS	11.3	10R	0.5	60S	12.2	80S	50.2													
	2017-18	20MS	6.7	60S	13.1	60S	10.7	80S	62.0	78	35	9	4	9.3	4.6			33.3	14.8	16.7	3	
	2018-19	30S	15.7	60S	22.0	90S	30.6	80S	56.5	89	56	7	3	10.5	6.4	55.6	26.7	1.3	0.4	10.0	4	3
	Mean	30S	11.2	60S	11.9	90S	17.8	80S	56.2	89	56	9	4	10.5	5.5	55.6	26.7	33.3	7.6	16.7	4	3
55	MACS 6696*																					
	2016-17	30MS	12.0	20S	5.1	60S	12.1	80S	46.7													
	2017-18	40MR	13.3	40S	11.5	60S	12.7	80S	60.0	89	35	8	4	7.4	3.7	-	-	33.3	10.2	20.0	3	
	2018-19	40S	15.2	60S	26.9	90S	29.8	80S	48.5	89	46	7	3	9.1	5.0	95.0	37.8	7.3	3.1	90.0	5	4
	Mean	40S	13.5	60S	14.5	90S	18.2	80S	51.7	89	45	8	4	9.1	4.4	95.0	37.8	33.3	6.7	90.0	5	4

56	HI 8802(d)*																					
	2016-17	20MS	4.3	10MS	1.5	5MS	0.8	20MS	3.3													
	2017-18	20MS	9.6	30MS	7.5	20MS	2.6	20S	5.5	78	35	7	4	4.0	1.8			23.5	5.9	16.7	3	
	2018-19	20S	5.0	10MR	1.2	20S	3.2	20S	2.9	89	46	7	3	2.5	1.4	9.1	3.6	3.5	1.5	5.0	5	3
	Mean	20S	6.3	30MS	3.4	20S	2.2	20S	3.9	89	46	7	4	4.0	1.6	9.1	3.6	23.5	3.7	16.7	5	3
57	UAS428 (d) (C)																					
	2016-17	20MR	4.4	10S	1.5	TMR	0.1	5MS	2.4													
	2017-18	20MS	8.1	60S	10.3	10MS	1.1	20S	8.0	68	24	8	4	6.8	3.2	-	-	19.6	4.9	23.5	3	
	2018-19	30MS	4.8	20MR	2.3	10MS	1.9	10S	3.6	78	46	6	3	10.0	4.2	45.0	15.0	7.1	2.4	40.0	4	3
	Mean	30MS	5.8	60S	4.7	10MS	1.0	20S	4.7	78	35	8	4	10.0	3.7	45.0	15.0	19.6	3.7	40.0	4	3
58	MACS3949 (d) (C)																					
	2016-17																					
	2017-18	20MS	7.2	20MS	4.0	TR	0.0	20MS	6.5	68	35	8	3	11.8	5.7	-	-	8.1	2.8	26.3	3	
	2018-19	30S	7.3	20S	5.2	10S	2.3	20MS	3.7	99	46	7	4	2.9	1.6	6.1	5.1	5.3	2.4	35.0	4	3
	Mean	30S	7.3	20S	4.6	10S	1.2	20MS	5.1	99	46	8	4	11.8	3.7	6.1	5.1	8.1	2.6	35.0	4	3
59	MACS6222 (C)																					
	2016-17	30MS	4.7	30MS	4.6	0	0.0	20S	8.4													
	2017-18	20MR	2.1	20S	3.5	20MS	2.3	30S	16.6	67	35	7	4	13.7	6.7	43.9	30.0	27.3	7.9	10.5	5	
	2018-19	10MS	3.0	5S	0.7	10S	1.3	80S	27.4	78	46	5	3	4.5	3.1	49.3	20.2	4.8	1.9	5.0	4	2
	Mean	30MS	3.3	30MS	2.9	20MS	1.2	80S	17.5	78	46	7	4	13.7	4.9	49.3	25.1	27.3	4.9	10.5	5	2
60	GW 322 (C)																					
	2016-17	60S	22.7	20S	10.3	5S	1.8	80S	42.9													
	2017-18	40S	20.3	20MS	7.0	10S	1.6	60S	37.4													
	2018-19	40S	17.0	20S	4.3	40S	15.9	80S	46.1	99	57	7	3	10.0	6.5	-	-	5.6	3.7	40.0	4	3
	Mean	60S	20.0	20S	7.2	40S	6.4	80S	42.1	99	57	7	3	10.0	6.5	-	-	5.6	3.7	40.0	4	3
61	MACS6478 (C)																					
	2016-17	60S	29.7	30S	10.3	10S	2.2	80S	60.6													
	2017-18	60S	40.0	40S	7.1	70S	10.8	80S	65.0	57	24	8	5	9.0	4.9	60.7	30.8	54.6	16.5	5.3	4	
	2018-19	60S	34.7	15MS	6.9	30S	9.9	100S	49.8	89	46	5	3	12.6	6.9	45.0	25.0	4.3	1.7	5.0	5	3
	Mean	60S	34.8	40S	8.1	70S	7.6	100S	58.5	89	46	8	4	12.6	5.9	60.7	27.9	54.6	9.1	5.3	5	3
62	Raj4083 (C)																					
	2016-17	20S	5.8	20S	4.1	10S	2.0	40S	18.7													
	2017-18																					
	2018-19	20MS	6.0	40S	9.3	40S	11.5	40S	16.3	99	57	5	3	12.2	6.6	-	-	7.6	1.9	25.0	5	2
	Mean	20S	5.9	40S	6.7	40S	6.8	40S	17.5	99	57	5	3	12.2	6.6	-	-	7.6	1.9	25.0	5	2
63	HD2932 (C)																					

	2016-17	30MS	14.2	20S	6.3	60S	14.2	100S	52.6												
	2017-18	30MR	6.3	80S	15.1	70S	21.0	90S	58.0												
	2018-19	20S	10.3	60S	16.7	80S	31.6	100S	51.6	99	57	5	3	17.4	11.0	-	-	13.6	9.0	22.2	5	3
	Mean	30MS	10.3	80S	12.7	80S	22.3	100S	54.1	99	57	5	3	17.4	11.0	-	-	13.6	9.0	22.2	5	3
64	HD3090 (C)																				
	2016-17																				
	2017-18																				
	2018-19	40MR	5.7	TR	0.1	10S	3.3	100S	48.4	89	57	9	3	16.1	9.2	-	-	14.3	11.0	5.0	5	3
	Mean	40MR	5.7	TR	0.1	10S	3.3	100S	48.4	89	57	9	3	16.1	9.2	-	-	14.3	11.0	5.0	5	3
65	DBW93 (C)																				
	2016-17	30MS	6.4	30S	7.2	20S	5.0	80S	35.7												
	2017-18	10MR	1.6	20S	10.8	20S	5.6	80S	45.1	46	35	8	4	5.0	3.5	-	-	44.4	17.8	5.6	3	
	2018-19	5MS	2.3	60S*	14.6	40S	15.0	100S	51.5	89	46	7	3	12.6	4.8	34.3	23.2	13.9	8.6	20.0	4	3
	Mean	30MS	3.4	60S	10.8	40S	8.5	100S	44.1	89	46	8	4	12.6	4.2	34.3	23.2	44.4	13.2	20.0	4	3
66	AKDW2997-16(d) (C)																				
	2016-17	60S	25.7	5MS	2.3	10MR	1.0	10S	2.4												
	2017-18	40S	35.0	20S	7.3	40S	7.6	20S	7.9	78	46	9	6	4.4	1.8	51.0	12.8	25.9	7.5	21.1	5	
	2018-19	40S	14.3	10MS	2.3	10S	4.1	30S	8.8	99	57	9	5	5.0	2.5	6.7	3.7	1.5	0.4	50.0	5	3
	Mean	60S	25.0	20S	4.0	40S	4.2	30S	6.4	99	57	9	6	5.0	2.2	51.0	8.3	25.9	4.0	50.0	5	3
67	UAS446(d) (C)																				
	2016-17	20MS	4.7	10S	1.6	0	0.0	10MS	2.3												
	2017-18	20S	5.5	20S	6.3	20S	4.9	10S	3.9	67	24	7	5	5.6	2.2	65.0	25.3	5.3	1.3	25.0	5	
	2018-19	20S	7.7	10S	1.5	10S	2.3	10MR	1.2	89	56	7	3	8.2	4.0	8.5	3.1	3.1	0.8	15.0	4	3
	Mean	20S	6.0	20S	3.1	20S	2.4	10S	2.5	89	56	7	4	8.2	3.1	65.0	14.2	5.3	1.1	25.0	5	3
68	HI1605 (C)																				
	2016-17																				
	2017-18	20MS	7.3	20MS	12.2	20S	3.6	40S	27.0	78	35	7	4	10.0	5.8	-	-	5.6	1.4	45.0	3	
	2018-19	20S	7.6	40S	13.2	40S	16.5	40S	22.4	89	56	7	3	8.3	5.2	68.3	39.0	8.3	2.5	44.4	5	3
	Mean	20S	7.5	40S	12.7	40S	10.1	40S	24.7	89	56	7	4	10.0	5.5	68.3	39.0	8.3	2.0	45.0	5	3

Table 1.5: Adult plant respons of NIVT entries against rusts under disease epiphytotic conditions at hot spot locations in field during 2018-19

S. No.	Entries	Rusts							
		Stem		Leaf				Stripe	
		South		South		North		North	
		HS	ACI	HS	ACI	HS	ACI	HS	ACI
NIVT-1A									
1	NW7060	40S	23.7	20S	4.6	10S	3.9	10S	4.2
2	DBW282	80S	22.7	20S	3.5	20S	5.1	10S	2.3
3	HD3086 (C)	80S	36.3	40MS	8.7	60S	25.6	15S	5.7
4	HD3318	40S*	10.3	20S	5.6	40S	11.9	40S	16.1
5	HD2967 (C)	40S*	10.2	40S	10.4	40S	11.3	60S	32.4
6	Raj4539	40S*	10.7	20S	3.2	15S	4.9	20S	9.7
7	NABIMG 09	60S	22.7	10S	1.6	10S	2.1	60S	32.5
8	HD3323	80S	29.3	30MR	4.9	20S	4.0	10S	4.5
9	UP3028	40S	12	60S*	11.5	40S	11.8	20S	9.7
10	K1801	20S	10.7	60S*	11.2	40S	10.7	60S	22.1
11	WH1256	20MR-MS	4	40S*	5.8	10S	2.7	5S	1.1
12	HUW 833	20S	5.7	5S	1.3	10S	3.2	20S	10.8
13	UP3026	60S	22.7	40S	10.2	10S	2.9	10S	2.3
14	WH1257	40S	11	10MS	3.6	20S	9.4	20S	6.7
15	HD3319	20S	5.2	10S	2.6	20S	7.0	10MS	1.7
16	HD3320	60S	24	40S	14.3	70S	27.5	40S	11.8
17	DBW281	80S	42.7	40S	8.3	80S	21.9	40MS	9.4
18	HD3322	80S	45	10S	3.9	70S	13.0	20S	3.7
19	NABIMG 11	60S	29	60S*	12.9	40S*	12.1	60S	19.8
20	DBW284	80S	31.3	40S*	10.4	60S*	10.8	20S	5.7
20A	Infector	100S	76.7	100S	80.0	100S	75.0	100S	70.0
21	Raj4537	40S	13.4	20S	4.6	20S	4.7	30MS	9.6
22	PBW803	60S	27.6	30MS	5.3	20S	5.1	10S	3.4
23	UP3025	60S	34.8	80S*	24.9	80S	22.6	10S	1.6
24	HD3321	60S	17	20S	4.0	15S	3.1	10S	3.9
25	WH1255	80S	18	40S*	7.1	20S	4.0	40MS	9.6
26	DBW283	80S	20.1	40S*	5.7	40S*	7.7	10S	2.5
27	NABIMG 10	80S	29.7	10S	2.6	15S	2.3	40S	17.6
28	PBW805	60S	25.5	80S*	20.6	40S	25.0	10S	5.3
29	NW7067	40S	18.7	10S	1.5	20S	7.3	40S	16.8
30	UP3027	40S*	11	40S*	7.1	5S	2.4	20S	10.9
31	PBW802	80S	20.1	40S*	7.3	60S	15.1	20S	2.6
32	WH1258	60S	19.3	40S*	5.8	60S*	11.0	10MS	2.3
33	PBW804	10S	3.3	40S	8.6	20S	4.1	20MR	3.9
34	K1006 (C)	40S	15.4	60S*	10.5	80S	15.9	60S	27.5
35	Raj4538	40S*	12	40S*	6.3	20S	5.1	20S	10.7
36	DBW88 (C)	60S*	15.4	20S	4.1	10S	2.6	60S	37.8
NIVT-1B									
37	HD2967 (C)	40S	12.3	20MS	3.9	15S	5.4	60S	31.6
38	HD3326	60MS	11.7	40S*	7.4	15S	5.3	20MS	4.9
39	HUW834	10S	3	20S	6.6	70S	19.6	40S	11.1
40	K1803	60S*	18	20S	7.1	60S	16.6	60S	20.0
40A	Infector	100S	70	100S	80.0	100S	75.0	100S	69.1

41	DBW286	20MS	4.7	20S	3.5	20S	3.3	40MS	6.7
42	DBW287	10MS	3.3	60S*	9.8	20S	4.1	10S	3.5
43	UP3029	20S	5.5	20MS	4.0	10S	3.8	10S	2.8
44	Raj4540	10MS	3.3	10MS	1.4	15S	2.5	40S*	7.8
45	DBW88 (C)	40S	15.4	10S	1.5	40S	7.8	60S	29.9
46	NW7064	40S	19	20S	4.6	20S	5.8	10S	3.0
47	UP3031	60S	26.7	20MS	5.6	30S	11.3	10S	3.9
48	PBW807	10S	5	60S	15.9	50S	11.8	40MR	6.1
49	BRW3829	40S*	8.8	20S	5.3	40MS	12.3	60S	26.0
50	NWS2106	40S	23.4	40S	14.0	40S	14.0	60S	21.0
51	WH1259	80S	28.4	60S*	14.1	20S	5.1	5S	1.6
52	HUW835	40S	11.3	10MS	2.5	15S	5.9	40S	19.2
53	Raj4541	40S	13.7	10S	2.2	20S	5.0	40S	14.8
54	PBW808	40S	17.3	20S	4.9	20S	3.2	20MS	4.6
55	DBW305	60S	24.7	10S	3.7	20S	8.0	60S	15.6
56	HD3327	20MS	7.1	10S	2.7	15S	2.6	10S	3.5
57	BRW3838	20S	7	40S*	7.8	40S	11.5	60S	19.0
58	HD3328	40S*	11.3	10S	2.0	40S	6.3	20S	10.7
59	NW7057	40S	13.5	20MS	3.7	15S	1.9	10S	6.0
60	DBW288	60S	39.3	10MS	3.1	15S	2.1	20S	5.9
60A	Infector	100S	70	100S	81.7	100S	73.8	100S	77.3
61	HD3086 (C)	60S	34.1	20MS	4.3	30S	10.1	40S	7.5
62	NW7075	60S	29.3	20MS	4.2	80S*	24.3	60S	40.0
63	K1006 (C)	60MS	25.3	60S*	9.9	80S*	14.4	60S	35.2
64	K1804	20MS	7.3	80S*	25.7	40S	18.1	40S	25.1
65	WH1260	60S	31.5	20S	4.8	10S	2.6	30S	6.2
66	HD3325	40S	20	20S	4.7	20S	6.1	30S	6.3
67	UP3030	20S	6.3	10MS	1.2	15S	3.1	40S	12.9
68	DBW285	80S	34.7	20S	4.1	20S	8.1	40S	12.8
69	K1805	40S	15.3	40S*	12.0	20S	2.7	10S	2.9
70	HD3324	60S*	15.2	20S	8.6	15S	3.0	5S	0.7
71	KRL429	80S	34.7	10S	3.4	10S	3.3	40S	22.8
72	KRL423	5S	2.3	60S*	9.6	30S	7.6	10S	3.8
NIVT-2									
73	MP3522	80S*	18.7	10MS	1.2	40S*	5.2	40S	13.2
74	NIAW3592	20S	3.8	5S	0.7	40S*	8.1	60S	39.3
75	DBW289	40S	10.7	20MS	2.9	20S	10.0	80S	44.6
76	NIAW3584	30S	7.3	40S*	7.0	50S*	11.3	60S	30.8
77	WH1262	20MS	4.4	20S	3.1	10S	4.1	20MS	4.0
78	HI1636	5MS	0.7	TMR	0.1	40S*	7.4	80S	60.9
79	HI1637	10S	2	0	0.0	10S	1.9	80S	50.9
80	HI1638	10S	3	5S	0.8	10S	2.4	80S	42.5
80A	Infector	100S	70	100S	82.9	100S	73.8	80S	71.8
81	TAW155	40S	20	20S	6.0	10S	3.2	10S	6.6
82	HI1640	10S	3.3	20S	2.9	20S	4.3	80S	57.6
83	HI1639	20MS	5.3	20S	3.2	20S	4.4	80S	54.9
84	HW 1904	5MS	0.7	5MS	0.6	15S	3.1	60S	34.9
85	MP3521	5S	1.8	10MS	1.9	20S	7.5	80S	44.5
86	RVW4265	60S*	12	10MS	1.9	15S	2.1	20S	3.8
87	MP1359	40S*	11.7	20S	5.5	40S	17.5	40S	17.9
88	MP1361	40S*	9	10S	1.7	10S	2.2	15S	5.2
89	GW322 (C)	40S*	11.7	60S*	9.3	50S*	15.2	60S	32.6

90	UAS3006	60S*	11.7	5S	0.8	15S	7.4	60S	40.9
91	MP1360	40S*	6.8	60S*	9.4	60S*	9.2	60S	10.7
92	MACS6742	10S	2.7	10S	1.5	20S	6.1	60S	44.2
93	MACS6745	20S	6	5MS	0.9	15S	4.1	80S	55.8
94	NWS2118	60MS	20	10MS	2.0	50S	18.1	60S	25.0
95	CG1031	60S	26	20MS	2.9	30S	14.4	40S	11.7
96	RVW4266	10S	3	20S	3.6	60S*	8.8	80S	40.5
97	TAW153	40S*	10.3	5MS	0.9	30S	6.3	40S	13.8
98	PBW810	60S	22.1	5S	2.0	20S	9.6	40S	13.3
99	UP3032	20S	4	TR	0.0	15S	3.1	15S	7.2
100	Raj4542	40S	13.7	10S	2.7	10S	1.9	40S*	7.4
100A	Infector	100S	65	100S	65.7	100S	77.5	100S	70.9
101	UAS3005	80S	19.4	10S	3.1	20S	6.4	80S	48.2
102	NWS2108	80S	29.3	60S*	11.4	20S	5.3	80S	41.7
103	GW513	20S	4.3	TR	0.0	20S	4.8	80S	58.0
104	GW514	40S*	9.3	0	0.0	5S	1.4	80S	48.9
105	MACS6747	40S*	8.3	10MS	1.2	10S	1.9	60S	31.3
106	MACS6222 (C)	20S	4	5S	0.7	5S	0.7	50S	21.8
107	MACS6478 (C)	80S	33	20MS	4.3	20S	4.4	80S	48.3
108	HI1544 (C)	20S	4	TR	0.1	10S	2.5	80S	49.0
NIVT-3A									
109	UP3033	10S	2.4	40S*	5.8	20S	4.9	40S	10.4
110	WH1264	60S	19.7	20S	3.9	10S	3.2	20S	6.6
111	PBW811	60S	21.5	60S*	11.4	20S	8.9	20S	5.5
112	UP3035	40S	11.4	40S*	8.3	40S	13.9	40S	16.2
113	WH1263	80S	23.3	TMS	0.3	20S	8.4	10S	4.3
114	PBW814	80S	26.3	10MS	2.7	40S*	5.6	10S	4.0
115	JKW267	40S*	8.7	40S*	7.6	15S	3.4	15S	3.3
116	DBW173 (C)	30S	5.7	TR	0.0	10S	2.3	40S	12.6
117	HD3329	60S	19.7	60S*	16.0	40S*	6.6	20S	7.5
118	HD3330	60S	21.3	40S*	6.1	60S	15.3	10S	4.8
119	JAUW 673	40S*	8.5	40S*	5.7	20S	4.4	10S	2.0
120	HD3059 (C)	60S*	16	10MR	0.6	15S	1.9	60S	29.0
120A	Infector	100S	73.3	100S	80.0	100S	71.3	100S	71.8
121	HD3334	40S*	9.1	5S	0.8	30S	9.6	20S	5.9
122	Raj4544	60MS	12.5	20S	4.9	10S	2.3	60S*	10.5
123	DBW292	20S	7.7	60S*	10.9	20MS	6.4	20S	7.4
124	K1808	80S	29.7	10S	3.3	30S	8.4	30S	9.5
125	UP3034	40S	17	60S*	11.1	30S	7.3	30S	6.7
126	JKW261	60S	31.3	5MR	0.4	15S	1.9	30S	8.8
127	WH1266	40S*	9.4	20S	9.9	40S	8.3	10MS	2.6
128	DBW291	60S	29.3	10S	1.6	20S	6.0	5S	1.0
129	DBW107 (C)	80S	30.7	60S	11.5	20MS	3.5	10S	3.9
130	JKW268	80S	33.5	30MS	9.4	40S	10.6	20S	7.6
131	DBW294	40S*	9.2	0	0.0	10S	1.3	20S	5.6
132	HD3332	60S	34.7	20S	5.9	20S	5.3	20S	5.9
133	NW7062	80S	28.8	5R	0.1	5S	1.5	40S	14.7
134	HD3333	80S	24.3	60S*	12.6	50S	9.1	60S	21.1
135	DBW290	80S	26	10S	2.6	10S	2.5	20S	6.5
136	WH1265	60S	27.3	10MS	1.1	20S	8.5	30S	5.4
137	PBW812	60S	28.2	30S	9.7	20S	4.8	10S	2.8
138	PBW813	80S	46	60S*	13.5	5S	1.9	5R	0.2

139	DBW293	80S	44	80S*	16.0	50S*	14.5	30S	9.5
140	HD3331	60S	34	60S*	12.0	30S	6.8	60S*	8.6
140A	Infector	100S	73.3	100S	81.4	100S	72.5	100S	73.6
141	NW7053	60S	22	TMS	0.1	5S	0.8	40S	11.7
142	HI1563 (C)	60MR	6.3	TR	0.0	10S	1.9	80S	49.7
143	Raj4543	60MR	5.2	60S*	8.7	40S	11.8	60S	25.6
144	K1807	20S	6.5	20MS	3.0	20S	12.4	60S	27.5
NIVT-3B									
145	CG1032	40MR	4.3	0	0.0	15S	4.1	80S	51.8
146	GW518	40MR	6.3	TMR	0.1	20S	5.5	80S	59.3
147	MACS6749	20S	5.4	0	0.0	15S	3.5	80S	48.9
148	NIAW3578	10S	5	80S*	13.6	20S	5.0	80S	51.6
149	UAS 3008	40S	20	5S	0.9	20S	7.5	60S	30.0
150	DBW295	40S	8.3	0	0.0	20S	3.1	10S	6.1
151	MP3514	40MR	4.7	60S*	8.7	40S*	9.9	60S	21.4
152	HI1641	20S	4.7	TR	0.0	40S*	7.4	80S	58.9
153	MACS6752	10S	3	10R	0.3	20S	5.0	80S	55.5
154	MP3516	40S	18.7	60S*	11.5	20S	7.6	60S	33.0
155	Lok75	60MR	9	5S	1.0	10S	3.6	80S	58.9
156	AKAW 4927	40MS	12	20MS	3.2	10S	1.3	80S	31.5
157	MP1362	40S*	13.4	20MS	3.3	40S	11.0	10S	5.9
158	RVW4281	60S	35.3	20S	9.4	40S	18.1	60S	21.7
159	WH1267	80MS	37	20S	5.0	20S	10.0	40S	11.1
160	GW519	60S	16	20S	3.2	30S	5.2	80S	55.6
160A	Infector	100S	73.3	100S	80.0	100S	73.8	100S	71.8
161	HD3344	60S	18.1	5S	1.4	20S	5.1	60S	29.4
162	RVW4276	5S	2.2	0	0.0	10S	3.1	60S	28.4
163	HI1642	60MR	6	0	0.0	30S	6.9	80S	56.5
164	NIAW3583	5S	1.7	0	0.0	5MS	0.5	60S	21.6
165	HD2932 (C)	40S	11.3	40S*	14.3	40S	28.1	60S	43.0
166	HD2864 (C)	40S	10.9	TR	0.0	40S	11.9	80S	50.7
167	PBW815	60S*	11.7	TMR	0.1	20S	3.7	30S	7.8
168	HI1646	40S	12	60S	18.0	80S	30.0	60S	49.1
169	TAW154	40S	13	20MS	4.0	20S	6.8	40S	20.5
NIVT-4									
170	UAS470	40S	13.7	10MS	1.2	10MS	1.7	10S	2.7
171	GW1351	40S	12.9	10MS	2.9	40S	5.6	40MS*	7.4
172	HI8737 (C)	40S	12.4	5S	0.8	10S	1.3	10S	2.7
173	MPO1364	20MS	9.7	10R	0.3	15S	2.0	10MS	1.2
174	DDW51	40S*	12.2	10S	2.4	20S	4.8	20MS	1.9
175	GW1352	20S	5	10R	0.6	10MS	1.8	10S	2.9
176	HI8822	5S	1.5	TR	0.0	20S	3.0	10S	1.7
177	UAS471	40S*	9.5	20MS	4.0	10S	2.4	10S	1.6
178	PDW356	40S*	11.7	20MR	3.7	40S*	9.5	10S	1.5
179	DDW50	60S*	13.3	20R	0.6	20S	3.2	40S*	7.1
180	MPO1366	20S	6.7	5MS	3.2	20MS	5.4	20MR	1.2
180A	Infector	100S	70	100S	80.0	100S	73.8	100S	70.0
181	HI8820	40S*	7.5	20S	4.6	30S	5.5	50S*	8.2
182	NIDW1316	60S*	15.7	40MS	6.3	40S	9.5	10S	2.3
183	WHD964	40S	13.8	20MS	5.5	20MS	3.8	20MS	3.6
184	MACS4091	40S	12	5S	1.7	20MS	4.4	20S	4.9

185	MACS3949 (C)	40S*	8.5	10S	2.9	10S	2.5	10S	2.5
186	HI8819	40S*	8.3	5S	1.9	20S	4.0	10MS	2.9
187	HI8713 (C)	20S	4.7	10S	2.2	10S	2.1	20S	4.2
188	NIDW1302	20S	3.7	20S	3.3	10S	1.4	5R	0.1
189	HI8821	20S	6.7	20MS	4.0	10MS	2.3	30S	3.9
190	RKD339	20S	5.3	10S	2.3	5MR	0.4	40S*	6.9
191	NIDW1293	10S	2.7	20MR	2.6	10S	3.7	20MS	5.8
192	MACS4090	20S	7.7	10S	3.1	10S	3.3	40S	11.3
193	MPO1365	40S*	8.8	20MR	2.1	5S	1.5	10S	3.5
194	HI8818	20S	4	10S	1.9	5S	0.8	10S	2.2
NIVT-5A									
195	BRW3847	80S	34	20MR	2.9	50S	9.4	40S	11.5
196	UP3037	60S	28	10MS	2.4	30S	5.9	20S	7.1
197	DBW298	80S	39.3	20MS	4.9	70S	20.7	10S	2.8
198	DBW297	60S	30	10MS	2.1	5S	1.8	10S	3.6
199	K1317 (C)	60S	23.5	10MS	2.3	40S	7.1	40S	15.4
200	DBW296	20S	6.7	20S	3.0	15S	4.4	10S	2.4
200A	Infector	100S	73.3	100S	82.9	100S	71.3	100S	74.5
201	JAUW672	40S	20.1	20S	6.7	40S	8.9	10S	3.7
202	WH1268	80S	27.7	60S*	11.3	30S	11.5	30S	5.7
203	DBW299	20MR	6	20S	5.9	20S	5.9	20S	3.0
204	WH1269	60S	23.3	10MS	2.6	10S	1.3	10S	3.0
205	PBW817	60S	25	20MS	5.4	50S	17.4	20S	3.3
206	NW7069	80S	27.3	10MS	3.9	60S*	12.8	60S	16.0
207	HD2888 (C)	10S	3.3	10MS	1.2	20S	3.0	60S	26.4
208	HD3339	60S	26.7	20S	6.3	50S	15.9	30S	9.7
209	HUW838	20S	6	10MS	2.1	15S	2.3	20S	7.5
210	K1810	40S	16.7	10MS	1.4	30S	4.5	40S	12.6
211	HD3337	20S	8.3	20S	3.5	15S	3.1	10S	3.2
212	K1809	30S	12.7	10MS	1.4	15S	3.6	40S	17.6
213	HD3336	60S	38	10S	4.0	80S*	21.1	20S	4.5
214	UP3036	80S	44	20MS	2.8	20S	4.9	10S	4.1
215	WH1142 (C)	40S*	10.1	60S*	11.5	40S	17.0	20S	5.5
216	PBW644 (C)	40S	20.7	20S	3.5	70S	19.9	60S	20.2
217	HD3338	20S	10.3	20S	2.9	30S	3.9	20S	5.6
218	HD3335	60S	24.7	20S	8.9	80S	21.6	40S	16.2
219	PBW816	60S	30.7	20MS	7.1	30S	6.5	20S	6.6
NIVT-5B									
220	MACS6736	40MS	12	40S	22.3	80S	35.0	80S	41.7
220A	Infector	100S	70	100S	82.9	100S	73.8	100S	70.9
221	MACS4087(d)	40S	13	10S	1.9	20S	4.4	40S	13.9
222	MPO1357(d)	10S	4	10S	2.5	20S	2.8	5S	1.6
223	GW520	5MS	1.7	5MR	0.3	15S	2.9	60S	35.3
224	GW1353(d)	10S	2.7	TR	0.0	20S	6.1	80S	45.1
225	UAS472(d)	40MS	11	10MS	2.8	20S	3.0	40S*	6.9
226	HI1605 (C)	40S*	8.2	40MS	9.0	40S	14.1	40S	14.8
227	HI8627(d) (C)	40S*	8	10MR	0.9	20S	3.8	20S	2.6
228	HI1645	20S	4	0	0.0	15S	2.9	80S	36.3
229	UAS446(d) (C)	40S	10.5	5S	1.8	10S	2.5	20S	4.5
230	UAS3009	80S	28	10MS	1.6	5S	1.5	60S	24.5
231	UAS3010	60S	18.8	40S	14.0	30S	13.8	60S	23.5
232	DBW110 (C)	60MS	23.4	10MS	2.8	40S	9.9	60S	41.1

233	CG1033	40S	11	10MS	1.4	30S	6.4	80S	58.2
234	HI1643	5S	1.8	5MR	0.3	20S	4.4	80S	60.9
235	HI1644	10MS	1.8	TMR	0.1	20S	3.9	80S	60.5
236	NIAW3643	60MS	12.5	20S	2.9	20S	3.6	80S	62.0
237	NIAW3624	10MS	2.8	20MS	2.6	20S	5.3	80S	62.7
238	HI8823(d)	10MS	2	10MS	1.9	30S	4.0	30S	6.5
239	HI8824(d)	20S	5.3	10MS	1.9	20S	3.4	30S	6.3
240	DBW300	40S	11.3	10MS	1.2	20S	4.2	40S	14.5
240A	Infector	100S	73.3	100S	82.9	100S	76.3	100S	70.9
241	DDW52(d)	40S*	8	20S	4.6	10S	2.5	20S	5.1
242	MP3512	80MR-MS	20.4	40S	20.6	70S	36.3	60S	46.5
243	MP1356	60S	18.1	60S*	10.5	10S	4.8	60S	28.5
244	MP1358	60S*	14.2	10S	2.4	10S	2.5	10S	3.2
IVT (NHZ)									
245	HPW462	40S*	9.8	60S*	10.4	20MS	2.8	10S	4.3
246	HPW466	60S	19.3	80S*	17.1	40S	11.3	20S	6.0
247	VL2038	40MS*	6.3	10S	1.6	20S	7.5	20S	4.7
248	VL2037	60S*	16.7	5S	0.9	5S	1.5	15S	2.7
249	HS507 (C)	60MS*	10.1	5MS	0.9	15S	4.5	20S	8.1
250	UP3038	60S	36.3	60S*	12.4	70S	24.6	50S	26.1
251	VL2035	80S	32	20MS	3.0	50S*	10.5	20S	7.0
252	HS667	60MS	17.7	20MS	4.8	20S	4.9	20MR	1.6
253	HS668	40S	13	60S*	14.0	40S*	8.6	20S	5.8
254	HS669	60MS*	9.3	5MR	0.3	10S	2.5	10S	4.8
255	UP3039	60MS	19.7	80S*	11.6	20S	5.1	5S	1.7
256	HS562 (C)	80S	38	60S*	12.3	30S	7.6	40S*	6.1
257	VL2036	40S	18.7	20S	5.1	20S	5.4	10S	3.2
258	HPW464	20S	12	20S	6.9	15S	3.6	10S	3.5
259	HPW463	20S	6.4	60S*	9.1	10S	2.5	20S	6.2
260	HD3340	20S	7.3	60S*	10.9	40S	15.3	40MS	8.2
260A	Infector	100S	76.7	100S	85.7	100S	73.8	100S	71.8

PROGRAMME 2. RUSTS: BROWN, YELLOW AND BLACK

2.1 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:
Yellow rust and brown rust (under controlled conditions): Flowerdale, Shimla (Table 2.1, 2.2, 2.3)
Yellow rust – Ludhiana and New Delhi (Table 2.4)
Brown rust - New Delhi and Ludhiana (Table 2.4)
Black rust (under controlled conditions): Indore and Mahabaleshwar (Table 2.5)
Data of Pune were not considered due to low disease development. and Powarkheda (used mixture of races).

Race specific Adult Plant Resistance (APR) in AVT entries (2018-19) at IIWBR, RS, Shimla
AVT accessions (158 lines) were evaluated for identifying adult plant resistance. Four pathotypes, two each of yellow and brown rust pathogens, were used in this study. Optimum conditions for infection of rust and growth of wheat material were provided. Entry VL3021 showed APR to both the pathotypes of yellow and brown rust pathogens.

Sixteen entries (DBW277, DBW39 (C), DBW49 (D), HD3237 (C)(I), HI1612 (C), HPW468, MACS4058 (D), MACS6222 (C), MACS6696, PBW796, PBW797, UP3043, VL3019, WH1223) of advanced wheat material were observed to carry APR to both the pathotypes of yellow rust pathogen. Fourteen entries possessed APR to pathotype 46S119 and fifteen to 110S119 (Table 2.1).

Table 2.1: Race specific adult plant resistance (APR) in advanced wheat material to pathotypes of yellow rust pathogen (2018-19)

Pathotype	No. of lines	Detail of lines
46S119	14	DBW277, DBW39 (C), DBW49 (D), HD3237 (C)(I), HI1612 (C), HPW468, MACS4058 (D), MACS6222 (C), MACS6696, PBW796, PBW797, UP3043, VL3019, WH1223
110S119	15	DBW187, DBW304, GW1348 (D), HD3226 (C) (I), HD3298, HI1628, HI8811 (D), HI8812, HS490 (C), MACS3949 (D)(C), NIDW1149, NW7049, PBW820 , UAS466 (D), WHD963 (D)
46S119 and 110S119	16	AKDW2997-16 (D) (C), DBW257, DBW273, DDW47 (D), HD3249 (C), HI1621, HI8627 (D)(C), HI8805 (D), HPW349 (C), HS673, UAS428 (D) (C), UAS446 (D)(C), UP3041, VL3021, WH1080 (C), WH1270
Total	**45**	

Eight entries of AVT (DBW39, DBW110, HD2733, HI1612, GW1346, HPW467, K1317, VL3021) were resistant to both pathotypes (77-9 and 104-2) of brown rust pathogen at adult plant stage (Table 2.2). Nine entries of AVT showed APR to pathotype 77-9 and twenty entries to pathotype 104-2.

Table 2.2: Race specific adult plant resistance (APR) in advanced wheat material to pathotypes of brown rust pathogen (2018-19)

Pathotypes	No. of lines	Wheat Lines
Both 77-9 (121R60-1) and 104-2 (21R55)	8	DBW39, DBW110, HD2733, HI1612, GW1346, HPW467, K1317, VL3021
77-9 (121R60-1)	20	DBW173, DBW187, DBW252, DPW621-50, HD2967, HD3059, HD3226, HD3249, HI1628, HPW349, HS490, K0307, MACS6478, NIAW3170, PBW752, PBW825, VL907, WH1021, WH1080, WH1105
104-2 (21R55)	9	DDK1029, HD3086, HD3171, HD3237, HW1098, MACS6695, PBW644, UP3041, WH1124
Total	**37**	

Table 2.3: Race specific Adult Plant Resistance (APR) in AVT against selective pathotypes of yellow and leaf rust at IIWBR, RS, Shimla during 2018-19

S. No.	Entries	Yellow rust		Leaf rust	
		46S119	110S119	77-9	104-2
1.	HPW349 (C)	TMR	TR	0	0
2.	VL907 (C)	5MR	10S	0	-
3.	HS507 (C)	5MS	5S	TR	0
4.	HS652	TMR	0	20MS	10MR
5.	HS562 (C)	TMR	TR	10MS	0
6.	VL892 (C)	5MR	5MS	10MS	0
7.	HS490 (C)	10MS	0	TR	TR
8.	HPW468	5R	TMS	-	0
9.	HS673	10MR	5MR	-	0
10.	VL3020	TMS	10S	5MR	0
11.	UP3041	0	0	20S	5MR
12.	HPW467	TMS	TMS	TR	0
13.	HS674	5S	5MS	40S	0
14.	VL3019	0	5MS	10S	0
15.	VL3021	0	TR	20MR	5R
16.	WH1105 (C)	10S	10S	TR	0
17.	HD3226 (I)(C)	TS	TMR	0	0
18.	HD 3086 (C)	10MS	5MS	T	0
19.	PBW820	10S	TR	0	-
20.	DBW221	10S	5SMS	20MR	10MS
21.	DBW222	10S	5S	0	0
22.	PBW550 (C)	20S	20S	0	0
23.	PBW821	TR	TR	0	0
24.	HD2967 (C)	30MS	20S	TMS	0
25.	NW7049	-	TMR	TR	0
26.	DDW621-50 (C)	10S	20S	TMR	0
27.	DBW88 (C)	10S	20S	TMS	0
28.	PBW752 (I)(C)	0	TR	TR	0
29.	DBW173 (C)	5S	20S	TR	0
30.	WH1021 (C)	10S	80S	10R	0
31.	HD 3059 (C)	20S	80S	TR	TR
32.	WH1124 (C)	5S	5MS	TMR	5R
33.	PBW771	TMR	TR	0	0
34.	HI1620 (I) (C)	TMS	5MS	0	0
35.	PBW796	TMR	TMS	TR	0
36.	HI1628	5S	TR	TMS	0
37.	WH1142	TMS	5MS	10MS	-
38.	HD3043(C)	40S	20S	TMS	0
39.	PBW644 (C)	20MS	20S	TMS	0
40.	HD3237 (C)(I)	TMR	5MS	10MS	5MR
41.	BRW 3806	5MS	TMS	TR	0
42.	NIAW3170	10MS	5S	TR	0
43.	WH1080 (C)	TMR	0	TMR	-
44.	HD3249(C)	TMR	TMR	0	0
45.	HD2733 (C)	5MS	40S	TR	0
46.	PBW781	0	0	0	0
47.	DBW257	0	TR	10R	0
48.	DBW39 (C)	0	40S	TR	0

49.	HD3277	5MS	10MR	0	0
50.	RAJ4529	10S	20MS	0	0
51.	DBW187 (I) (C)	5MS	10MS	0	0
52.	WH1239	5MS	5MS	0	0
53.	K0307 (C)	10MS	20MS	0	0
54.	HD2967 (C)	20MS	60S	0	0
55.	K1317 (C)	20S	5MS	0	0
56.	HI1612 (C)	5MR	5MS	TS	0
57.	HD3293	5MS	10S	0	0
58.	HD3171 (C)	5S	10SMS	TMRMS	0
59.	HD2888 (C)	10S	10MS	0	0
60.	DBW252	TMS	40S	TR	0
61.	K8027 (C)	TS	20S	0	-
62.	DBW 273	0	0	0	0
63.	HI8713 (d) (C)	5MR	TMS	-	0
64.	NIDW1158(d)	0	0	TR	0
65.	HI8811 (d)	-	0	TR	0
66.	HD3343	TMS	60S	TMS	-
67.	GW322 (C)	10S	40S	5S	TR
68.	HI1544 (C)	40S	80S	0	0
69.	HI8737 (C)(d)	5MSS	20MR	TR	0
70.	HI8812 (d)	5MS	10MR	TR	0
71.	GW1348 (d)	5MRS	10MR	0	-
72.	DDW49 (d)	5S	20MS	0	0
73.	PBW822	0	0	TMS	0
74.	HD3345	40S	20S	TR	-
75.	DDW48(d)	10S	20S	TR	-
76.	HI8627 (d) (C)	TR	TR	TS	-
77.	DBW110(C)	5S	60S	TR	0
78.	UAS466 (d)	0	TR	5R	-
79.	MP3288 (C)	TMS	20S	0	-
80.	DBW277	0	10S	0	0
81.	DDW47 (d)	0	0	TR	0
82.	HD2932 (C)	10S	40S	5MR	0
83.	HD2864 (C)	20S	40S	0	-
84.	MP3336 (C)	5S	80S	TMR	0
85.	MP4010 (C)	10S	80S	0	TR
86.	CG1029	20S	80S	0	0
87.	UAS3002	60S	80S	20S	0
88.	HI1633	40S	40S	0	0
89.	HI1634	20MS	40S	0	0
90.	HI8808 (d)	-	10MS	0	0
91.	HI8807 (d)	5MS	10S	0	0
92.	PBW823	TR	O	0	0
93.	UAS 428 (d) (C)	0	0	0	0
94.	DDW49 (d)	10MS	TMS	TS	-
95.	UAS3001	40S	60S	20S	0
96.	MACS3949(d)(C)	0	TR	0	-
97.	MACS 6222 (C)	0	-	0	0
98.	GW322 (C)	20MS	5S	5MS	-
99.	DDW48 (d)	10MS	20MS	0	-
100.	Macs6478	20S	40S	0	-
101.	HD3343	5S	40S	TS	-

102.	WHD 963 (d)	TR	0	0	0
103.	HI8807(d)	TS	5MS	0	-
104.	HI 1633	10S	30MS	TR	0
105.	UAS3002	10S	20S	10S	0
106.	Raj4083(d)	10S	20S	TR	0
107.	HD2932 (C)	40S	40S	10S	0
108.	GW509	40S	60S	-	0
109.	HD3090 (C)	40S	60S	-	0
110.	NIAW3170	10MSS	20S	0	-
111.	GW1346(d)	40S	10MSS	TR	0
112.	MACS 4058(d)	5MR	5MS	TMS	0
113.	DBW93 (C)	20S	10MS	-	0
114.	HI8805 (d)	TR	TR	0	0
115.	AKDW2997-16 (d) (C)	TR	0	0	0
116.	Macs6695	-	-	5S	0
117.	UAS446 (d)(C)	0	TMR	0	0
118.	HI1605 (C)	10S	10S	0	-
119.	Macs 6696	0	20S	5S	-
120.	NIDW1149 (d)	TMS	0	-	-
121.	HI8802 (d)	0	0	-	-
122.	DDK1029 (C)	40S	40S	5R	TR
123.	MACS5052	20S	40S	0	0
124.	MACS6222 (C)	10MR	10MS	0	0
125.	DDK1056	40S	40S	20R	0
126.	HW1098(C)	-	40S	5R	10R
127.	Macs 5053	20S	40S	TR	0
128.	DDK1057	20S	60S	10R	0
129.	HD3317	5S	10S	20MS	TR
130.	WH1254	5S	10MS	0	0
131.	DBW301	0	0	TMR	-
132.	WH1270	TMR	0	0	-
133.	HD2967	5MS	-	0	-
134.	PBW824	10S	-	0	0
135.	UP3043	0	5MS	0	-
136.	DBW187	10S	5MR	TS	0
137.	PBW825	5MS	10S	0	0
138.	DBW303	10MS	5S	0	0
139.	DBW304	10MR	TR	0	-
140.	UP3042	10S	20S	TR	0
141.	DBW302	5MS	5MR	5R	-
142.	PBW825	10S	10S	5MR	0
143.	HD3347	10S	10S	0	0
144.	WH1223	TR	5MR	0	-
145.	KRL 19 (C)	10S	0	80S	0
146.	Kharchia 65	40S	60S	0	0
147.	NW7060	5MS	10S	5MS	-
148.	KRL 210(C)	5S	10S	0	0
149.	WH1228	10MS	TMS	-	0
150.	NW7062	20S	20S	0	0
151.	PBW 757 (C)	0	0	0	0
152.	WR544 (C)	10S	-	TR	-
153.	HD3298	-	TMR	0	-
154.	HD3271	0	5MR	TR	-

155.	DBW 14 (C)	10S	10MS	0	-
156.	DBW71 (C)	5MS	5S	-	-
157.	HI1621	TR	TR	-	-
158.	PBW 797	TMR	5MR	-	-

Table 2.4: Race Specific APR in AVT entries (NHZ, NWPZ and NEPZ) against selective pathotypes of yellow and leaf rust at Ludhiana and Delhi centres during 2018-19.

S. No.	Entries	Yellow rust pathotypes				Leaf rust pathotypes		
		110S119		46S119		77-5		77-9
		Ludhiana	Delhi	Ludhiana	Delhi	Ludhiana	Delhi	Ludhiana
I. Northern Hill Zone								
1	HPW349 (C)	5S	10S	20MS	10S	0	5MR	40S
2	VL907 (C)	40S	10S	40S	10S	0	0	40S
3	HS507 (C)	5MS	5MR	10S	10MS	0	0	5S
4	HS652	40S	10MS	40S	10MS	0	10MR	40S
5	HS562 (C)	0	15S	5S	20S	5S	10S	10S
6	VL892 (C)	60S	40S	60S	10MR	0	5MR	5S
7	HS490 (C)	40S	40S	40S	10MR	0	5MS	10S
8	HPW468	20S	10S	40S	10MR	0	5MR	40S
9	HS673	5S	0	10S	10S	40S	10MS	40S
10	VL3020	40S	10MS	40S	5S	0	0	10S
11	UP3041	10S	10S	10S	5MS	0	0	10S
12	HPW467	40S	15S	40S	5MS	0	0	40S
13	HS674	40S	10S	40S	10S	0	10MR	60S
14	VL3019	40S	10S	20S	5S	10S	5MR	10S
15	VL3021	5S	5S	5S	5S	0	10MR	10S
II. North Western Plain Zone								
16	WH1105 (C)	60S	40S	60S	40S	0	5MR	40S
17	HD3226(I) (C)	5S	TR	5S	TR	0	5MS	5S
18	HD3086 (C)	0	5MS	10S	10S	60S	5S	40S
19	PBW820^{M}	5S	TR	5S	5MS	0	TR	0
20	DBW 221*	10S	40S	40S	40S	40S	15S	40S
20A	Infector	-	100S	-	100S	-	100S	-
21	DBW 222*	20S	10MR	40S	5MR	0	0	10S
22	PBW550 (C)	60S	80S	80S	60S	0	0	0
23	PBW821^{M}	0	0	0	0	0	0	0
24	HD2967 (C)	60S	80S	60S	80S	0	5MR	0
25	NW 7049	40S	10MS	40S	20S	0	5MR	10S
26	DPW621-50 (C)	60S	80S	60S	80S	0	5MR	10S
27	DBW88 (C)	60S	60S	60S	80S	0	TR	10S
28	PBW752(I) (C)	0	10S	0	0	5S	10MS	10S
29	DBW173 (C)	60S	60S	60S	60S	0	5MR	0

30	WH1021 (C)	40S	80S	60S	80S	0	TR	5S
31	HD3059 (C)	60S	80S	60S	80S	0	5MR	10MS
32	WH1124 (C)	0	5S	40S	10MS	60S	5S	40S
33	PBW 771*	0	0	10S	0	0	0	20S
34	HI1620(I) (C)	40S	30S	40S	20S	0	TS	10S
35	PBW 796	5S	10S	5S	10S	0	5S	20S
36	HI 1628*	0	40S	40S	30S	0	5S	5S
37	WH1142 (C)	5MS	5S	20S	5S	5S	5S	TS
38	HD3043 (C)	40S	40S	60S	30S	60S	10S	60S
39	PBW644 (C)	40S	60S	60S	40S	0	5S	5S
40	HD3237(I) (C)	10MS	10MR	5S	10MR	60S	5S	60S
40A	Infector	-	100S	-	100S	-	100S	-
41	BRW 3806*#	40S	40S	40S	30S	0	TR	40S
42	NIAW 3170*	10S	40S	40S	30S	0	5MR	0
43	WH1080 (C)	TS	40S	20S	30S	TS	5MS	60S
III. North Eastern Plain Zone								
44	HD3249*#Q	20S	30S	5S	30S	0	5S	40S
45	HD2733 (C)	60S	80S	60S	80S	0	5MR	5S
46	PBW 781	0	0	0	0	10S	TS	20S
47	DBW 257	0	20S	5S	20S	10S	5MR	10S
48	DBW39 (C)	60S	80S	60S	80S	0	5MR	10S
49	HD 3277	TS	TR	5S	5MS	0	0	0
50	RAJ 4529	20MS	50S	20S	30S	60S	5MR	40S
51	DBW187(I) (C)	20MS	50S	20MS	30S	10S	5S	0
52	WH 1239	5MS	40S	20MS	20S	5S	5MR	10S
53	K0307 (C)	40S	80S	60S	60S	0	5MR	5S
54	HD2967 (C)	40S	80S	60S	80S	0	5MR	0
55	K1317 (C)	20S	40S	20MS	20S	10S	5S	20S
56	HI1612 (C)	10S	5MR	5S	20S	0	5R	0
57	HD 3293	20MS	10MS	40S	10S	40S	5R	40S
58	HD3171 (C)	40MS	20S	40S	20S	40S	5MS	20S
59	HD2888 (C)	40S	60S	60S	30S	0	0	TS
60	DBW 252*#	60S	60S	60S	40S	0	5R	5S
60A	Infector	-	100S	-	100S	-	100S	-
61	K8027 (C)	60S	60S	60S	30S	0	TR	20S
62	DBW 273	20S	40S	40S	30S	5S	5S	TS

Table 2.5: Race Specific APR in AVT entries (CZ and PZ) against selective pathotypes of stem rust at Indore and Mahabaleshwar centers during 2018-19.

S. No.	Entries	Stem rust pathotypes			
		40A		117-6	
		Indore	Mahabaleshwar	Indore	Mahabaleshwar
IV. Central Zone					
63	HI8713(d) (C)	10R	10MR	20S	TR
64	NIDW 1158 (d)	5MS	TR	20S	TMR
65	HI 8811 (d)	5MS	5MR	30S	10S
66	HD3343[M]	10MS	5R	5MR	TMR
67	GW322 (C)	5S	10MS	10S	30S
68	HI1544 (C)	5R	TMR	0	10MR
69	HI8737(d) (C)	TMR	10MR	40S	TMR
70	HI 8812 (d)	TMS	5MR	10S	TMR
71	GW 1348 (d)	5S	5MR	20S	TMR
72	DDW 49 (d)	10S	10S	60S	30S
73	PBW 822[B]	TMR	5MR	5MR	10MR
74	HD 3345[B]	TMS	20S	TMS	20S
75	DDW 48 (d)	5S	5R	40S	TMR
76	HI8627(d) (C)	0	5MR	10S	TMR
77	DBW110 (C)	0	TR	0	20MS
78	UAS 466(d)*	5S	TMR	40S	TMR
79	MP3288 (C)	0	5MR	0	5MR
80	DBW 277	0	20S	TMS	20S
81	DDW 47(d)*[Q]	0	5MR	20S	20MS
82	HD2932 (C)	0	20S	5MR	20S
83	HD2864 (C)	5R	5R	5MR	10MR
84	MP3336 (C)	10S	10S	10MS	30S
85	MP4010 (C)	10MR	10MR	5R	20MS
86	CG1029	10R	5MR	5R	10MR
87	UAS3002	5MR	5MR	5MR	20S
88	HI1633	5R	TMR	0	20MS
89	HI1634	10R	5MS	TMR	20MR
90	HI8808 (d)	10S	5MR	20S	TMR
91	HI8807 (d)	5S	5MR	20S	TMR
V. Peninsular Zone					
92	PBW 823[B]	10R	5R	0	TR
93	UAS428 (d) (C)	5S	TMR	20S	10MS
94	DDW 49 (d)	20S	10S	40S	20S
95	UAS 3001	0	TMS	TMS	10MR
96	MACS3949 (d) (C)	10S	5MR	40S	5MR
97	MACS6222 (C)	5R	TMR	0	TR
98	GW 322 (C)	5S	20S	0	20S
99	DDW 48 (d)	10S	10S	40S	10S
100	MACS6478 (C)	5S	20S	TMS	10MS

101	HD3343^{M}	TS	20S	5MR	TMS
102	WHD 963 (d)	TMR	TMR	20S	TR
103	HI8807(d)	10MR	10MR	10S	TR
104	HI1633	10MR	TR	0	10MR
105	UAS 3002	10MR	TMR	5S	5R
106	Raj4083 (C)	20MS	20S	5MR	20S
107	HD2932 (C)	20S	20S	5MR	10S
108	GW509	20MR	TR	0	TR
109	HD3090 (C)	10R	TR	0	TR
110	NIAW 3170*	10R	10S	10MR	10MS
111	GW 1346(d)*	10S	TMR	20S	10MR
112	MACS 4058(d)*	10S	10MR	40S	5MR
113	DBW93 (C)	10MR	TMR	5MR	5MR
114	HI 8805(d)*	0	TMR	10S	5MR
115	AKDW2997-16(d) (C)	5S	5R	20S	10S
116	MACS 6695*	20S	10S	5MR	20S
117	UAS446(d) (C)	5S	10MR	40S	TMS
118	HI1605 (C)	10MS	5R	0	30S
119	MACS 6696*	10MS	20S	5MR	30S
120	NIDW 1149(d)	0	5R	10S	TMS
121	HI 8802(d)*	0	10MR	5S	10MR

2.2 Identification of Slow Ruster Lines in AVT Material 2018-19

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.

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 – 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:

Stripe Rust

A. Karnal

AUDPC	Entries
0	PBW821[M], UAS446(d) (C), DBW301, WH1270, KRL210 (C) and WH 1228
0.1 – 100	HS652, HS562 (C), UP3041, VL3021, WH1105 (C), DBW 221*, PBW752(I) (C), WH1142 (C), HD3237(I) (C), HD3249*[#Q], PBW 781, DBW 257, HD 3277, HI1612 (C), HI8713(d) (C), NIDW 1158 (d), HI 8811 (d), HI8737(d) (C), HI 8812 (d), PBW 822[B], PBW 823[B], UAS428 (d) (C), MACS3949 (d) (C), HI8807(d), Raj4083 (C), HI 8805(d)*, NIDW 1149(d), HI 8802(d)*, HD3317, WH1254, UP3043, DBW187, HD3086 (C), DBW302, PBW825, HD3347, WH1223, NW 7060, PBW757 (C), HD3298, HD3271, DBW14 (C), DBW71 (C), HI1621 and PBW 797
100.1 - 200	HPW349 (C), HD3226(I) (C), HD3086 (C), PBW820[M], NW 7049, PBW 771*, PBW 796, WH1080 (C), RAJ 4529, DBW187(I) (C), WH 1239, HD 3293, DDW 49 (d), DDW 48 (d), HI8627(d) (C), UAS 466(d)*, DDW 47(d)*[Q], I8808 (d), HI8807 (d), DDW 49 (d), WHD 963 (d), NIAW 3170*, AKDW2997-16(d) (C), DDK1029 (C), MACS6222 (aest.) (C), DBW303, DBW304 and UP3042

B. Ludhiana

AUDPC	Entries
0	PBW 781, PBW 822[B] and DBW301
0.1 – 100	WH1270, NIDW 1158 (d), HS562 (C), PBW752(I) (C), PBW 771*, DBW 257 and PBW 823[B]
100.1 - 200	WH 1239, WH 1228, KRL210 (C), WH1124 (C), PBW 796, WH1223, HS673, NIDW 1149(d), HI 8802(d)*, HI1612 (C), DBW 273, PBW821M, DBW187, HI1621, HD 3277, UAS428 (d) (C) and PBW 797

Stem Rust

A. Indore

AUDPC	Entries
0	VL907 (C), HPW467, VL3019, HD3043 (C), DBW39 (C), HI1544 (C), HI 8802(d)*, DDK1029 (C), DDK1056, HW1098 (C), MACS5053 and WH1270
0.1 – 100	HS507 (C), HS652, HPW468, VL3020, HD3226(I) (C), PBW820[M], PBW550 (C), DPW621-50 (C), DBW173 (C), WH1021 (C), HI1620(I) (C), WH1142 (C), NIAW 3170*, HD2733 (C), HD2888 (C), K8027 (C), HI8713(d) (C), NIDW 1158 (d), HI 8812 (d), PBW 822[B], HI8627(d) (C), DDW 47(d)*[Q], HD2864 (C), MP4010 (C), CG1029, HI1633, HI1634, HI8807 (d), PBW 823[B], UAS428 (d) (C), WHD 963 (d), HI8807(d), HI1633, Raj4083 (C), HD2932 (C), GW509, HD3090 (C), DBW93 (C), HI 8805(d)*, HI1605 (C), MACS5052, MACS6222 (aest.) (C), DDK1057, HD3317, WH1254 and NW 7062
100.1 - 200	VL892 (C), HS490 (C), UP3041, HS674, WH1105 (C), PBW821[M], HD2967 (C), NW 7049, DBW88 (C), HD3059 (C), PBW 771*, HI 1628*, WH1080 (C), DBW 257, HD 3277, DBW187(I) (C), HD2967 (C), K1317 (C), HI 8811 (d), HD 3345[B], MP3288 (C), DBW 277, HD2932 (C), UAS3002, HI8808 (d), MACS3949 (d) (C), MACS6222 (C), UAS 3002, NIAW 3170*, GW 1346(d)*, MACS 6695*, NIDW 1149(d), PBW824, PBW825, WH 1228, PBW757 (C) and WR544 (C)

COOPERATORS:

NAME	CENTRE
Sudheer Kumar, D.P. Singh, Prem Lal Kashyap	Karnal
S.G. Sawashe, N.V. Savant, M.A. Gud	Mahabaleshwar
Jaspal Kaur	Ludhiana
T.L. Prakasha	Indore

2.3 Seedling Resistance Test against Pathotypes of Wheat Rusts

A. Flowerdale, Shimla

a. Rust resistance

To identify rust resistant lines and characterize rust resistance genes in wheat, 158 advanced accessions (AVTI&II) were evaluated at seedling stage using an array of pathotypes of *Puccinia graminis* f. sp. *tritici* (black rust), *P. triticina* (brown rust) and *P. striiformis* f. sp. *tritici* (yellow rust) possessing different avirulence/virulence structures. Four lines, PBW821, PBW822, PBW823, and PBW757 were resistant to all the rusts. Detailed information on the genetics of rust resistance of the advanced wheat lines is given below:

Rust resistance in AVT lines

Rust resistance to all the pathotypes of black, brown and yellow rust pathogens was observed in four entries (PBW821, PBW822, PBW823, PBW757) of advanced wheat material. Four lines, CG1029, HD2864, K8027, and MACS6222 were found resistant to brown and black rusts (Table 2.6). Entries NIDW1158, PBW752 and PBW781 were resistant to yellow rust only. Twelve entries (DBW110, DBW303, HD3226, HD3237, HD3277, HD3298, HI1628, NW7049, RAJ4529, PBW825, WH1105 and WH1223) showed resistance to all the pathotypes of black rust pathogen only. Fourteen entries (DDW47, DDW48, DDK1057, HD3090, HI1633, HI1634, HS562, MACS3949, PBW550, PBW797, PBW820, PBW824, UAS446, UAS466) were resistant to all pathotypes of brown rust pathogen only, whereas, five entries which possessed *Lr24,* were also resistant to brown rust. All the entries carrying *Sr*31, were resistant to black rust.

Table 2.6: Rust resistance in advanced wheat material (AVT: 2018-19)

Rusts	No. of lines	Wheat lines
Brown , Black and Yellow	4	PBW821, PBW822, PBW823, PBW757*
Brown & Black	4	CG1029, HD2864, K8027*, MACS6222
Brown	14	DDW47, DDW48, DDK1057, HD3090, HI1633, HI1634, HS562*, MACS3949, PBW550, PBW797, PBW820, PBW824, UAS446, UAS466*
Black	12	DBW110, DBW303, HD3226, HD3237, HD3277, HD3298*, HI1628, NW7049, RAJ4529, PBW825, WH1105, WH1223*
Yellow	3	NIDW1158, PBW752, PBW781

*= These entries were susceptible to three rusts in previous year (2017-18) except PBW757 which was resistant to yellow rust. This year (2018-19) entries indicated by asterisk (*), were found resistant to one, two or three rusts. On comparing the infection types of same lines from both the years, we found different infection types. Therefore, the seed lots of these entries are different to that of previous year.

b. Rust resistance genes in AVT lines (Gene postulation)

Wheat rust resistance genes (*Lr, Sr, Yr*) were characterized using gene matching technique. Rust resistance genes were characterized only in the lines where differential host-pathogen interaction was present. In addition, linked characters, 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**

In advanced wheat material, 4 *Yr*-genes (*Yr9*, *2*, *18* and *A*) were characterized in 91 entries (Table 2.7). Among these, *Yr2* was characterized in 57 lines. *Yr9*, alone or in combination, was postulated in 25 lines. *YrA* was characterized in 09 lines. Gene combinations *Yr9+A+* and *Yr9+18+* were inferred in 03 and 01 lines, respectively.

Table 2.7: *Yr-genes* in AVT entries during 2018-19

***Yr* gene**	**No. of lines**	**Detail of lines**
Yr2+	57	BRW3806, DBW273, DBW110(C), DBW14 (C), DBW187 (I) (C), DBW221, DBW257, DBW277, DBW304, DDK1056, GW1348 (d), GW322 (C), HD3059 (C), HD3086 (C), HD2864 (C), HD2888 (C), HD2967 (C), HD3171 (C), HD3226 (I)(C), HD3237 (C)(I), HD3249(C), HD3277, HD3293, HD3298, HD3343, HI1544 (C), HI1605 (C), HI1612 (C),, HI1628, HI8627 (d) (C), HI8737 (C)(d), HI8812 (d), HPW349 (C), HPW468, HW1098(C), K0307 (C), K8027 (C),, KRL210(C), MACS3949 (d)(C), MACS5053, MACS6478, MP3288 (C), MP4010 (C), NW7049, NW7060, PBW644 (C), PBW824, PBW825, RAJ4083 (d), UP3042, VL3021, WH1105 (C), WH1124 (C), WH1223, WH1228, WH1254, WH1270
Yr9+	21	DBW222, DBW302, DBW39 (C), DBW93 (C), HD3090 (C), HD3317, HI1633, HI1634, HS507 (C), HS673, NW7062, PBW550 (C), PBW771, PBW820, UAS3001, UAS3002, VL3019, VL3020, VL907 (C), WH1021 (C), WH1142
Yr9+A+	03	DBW173 (C), HD3043(C), K1317 (C)
Yr9+18+	01	HD2733 (C)
YrA+	09	DBW252, DBW303, DBW88 (C), HI1620 (I) (C), HPW467, HS490 (C), HS674, VL892 (C), WH1239
Total	91	

***Lr*-genes**

Eleven *Lr*-genes (*Lr1*, *Lr2a*, *Lr3*, *Lr10*, *Lr13*, *Lr18*, *Lr19*, *Lr23*, *Lr24*, *Lr26* and *Lr34*) were characterized in 119 lines (Table 2.8). Genes were postulated alone or in combination. *Lr13* and *Lr23* were the most common resistance genes postulated in advanced wheat material. Both were characterized either alone or in combination, were characterized in 47 lines (39.5 %) each followed by *Lr10* in 34 lines. Resistance gene *Lr26* (linked with *Sr31* and *Yr9*) was postulated in 25 entries. *Lr13* is known to confer high temperature resistance. Therefore, in most wheat growing areas in India, lines possessing *Lr13* will show less terminal disease severity as the temperature rises towards the maturity. Brown rust effective resistance gene *Lr24* (linked with *Sr24*), was postulated in GW509, HD2888, HI1544, MP3288 and MP4010. Another effective gene *Lr19* was characterized in WH1254. Other brown rust resistance genes *Lr3, Lr2a, Lr18* and *Lr34* were characterized only in four, two, two and one entries, respectively.

Table 2.8: *Lr-genes* in AVT entries during 2018-19

Lr gene	**No. of lines**	**Lines/Varieties**
Lr10+	1	BRW3806
Lr13+	27	DBW110, DBW221, DBW303, DDK1029, GW1346, GW1348, HD3059, HD2932, HD3345, HI1605, HI1621, HI1627, HI8713, HI8811, HI8812, HPW467, KRL19, MACS6695, MACS6696, MP3336, RAJ 4083, RAJ4529, UP3043, WH1080, WH1105, WH1223, WH1228
Lr13+1+	3	GW322, PBW644, WR544
Lr13+3+	1	HD3237
Lr13+10+	12	DBW252, DPW621-50, HD3086, HD3249, HD3293, HI1628, HPW349, NIAW3170, PBW752, VL892, WH1124, WH1239
Lr13+10+3+	2	DBW88, HI1620
Lr18+	2	DDW49, HW1098
Lr19+	1	WH1254
Lr23+	21	AKDW2997-16, DBW14, DBW301, DBW304, HD2967, HD3271, HD3298, HD3347, HD8737, HI1612, HI8505, HI8802, HI8807, HS490,KRL210, MACS4058, NIDW 1149, NIDW1158, PBW825,

		WH1272, WHD963
Lr23+1+	3	K0307, MACS6478, NW7060
Lr23+2a+	1	UP3042
Lr23+10+	13	DBW187, DBW257, DBW273, HD3226, HD3277, HD3343, HPW468, HS652, HS674,NW7049, PBW781, PBW796, UP3041
Lr23+13+	1	VL3021
Lr23+13+10+	1	HD3171
Lr24+	5	GW509, HD2888, HI1544, MP3288, MP4010
Lr26+	11	DBW93, HD3090, HD3317, HI1633, HI1634, HS673, NW7062, PBW550, PBW820, UAS3001, VL907
Lr26+1+	3	HS507,K1317, WH1021
Lr26+10+	2	USS3002, VL3019
Lr26+10+3+	1	DBW173
Lr26+23+	2	DBW222, HD3043
Lr26+23+1+	2	PBW771, VL3020
Lr26+23+2a+	1	DBW302
Lr26+23+10+	2	DBW39, WH1142
Lr26+34+	1	HD2733
Total	**119**	

***Sr*-genes**

Fourteen *Sr* genes (*Sr2*, *Sr5*, *Sr7b*, *Sr8a*, *Sr8b*, *Sr9b*, *Sr9e*, *Sr11*, *Sr13*, *Sr24*, *Sr25*, *Sr28* and *Sr31*) were characterized in 125 lines (Table 2.9). Genes were postulated alone or in combinations. *Sr2*, whose postulation is based on characteristic micro-flecking, was postulated in 81 lines (64.5 %) followed by *Sr11* in 34 lines. *Sr31* is linked with *Lr26* and *Yr9*, was observed in 25 lines. Entries DBW252 and KRL19 possessed a combination of four genes.

Table 2.9: *Sr genes* in AVT entries during 2018-19

Postulated genes	Number of lines	Detail of lines
Sr31+5+2+	01	NW7062
Sr31+5+	02	DBW173 (C), UAS3002
Sr31+2+	12	DBW302, DBW39 (C), DBW93 (C), HD2733 (C), HD3043(C), HD3090 (C), K1317 (C), PBW550 (C), PBW820, VL907 (C), WH1021 (C), WH1142
Sr31+	10	DBW222, HD3317, HI1633, HI1634, HS507 (C), HS673, PBW771, UAS3001, VL3019, VL3020
Sr25+	01	WH1254
Sr24+2+	05	GW509, HD2888 (C), HI1544 (C), MP3288 (C), MP4010 (C)
Sr30+8a+2+	01	HD3345
Sr30+5+2+	02	DBW304, UP3042
Sr30+5+	01	NW7060
Sr30+11+	01	VL892 (C)
Sr30+	01	HS674
Sr28+8a+2+	01	WR544 (C)
Sr28+5+	02	BRW3806, DBW257
Sr28+9b+	01	HS490 (C)
Sr28+11+2+	01	DBW14 (C)
Sr28+2+	02	PBW824, WH1228
Sr28+	02	HI1621, MACS6478
Sr8a+5+11+2+	01	DBW252
Sr8a+9b+2+	01	HS562 (C)
Sr8a+11+2+	01	HD2967 (C)

Sr8b+9b+11+2+	01	KRL19 (C)
Sr5+8a+	01	DBW277
Sr5+11+	02	DBW187 (I) (C), HI1605 (C)
Sr5+	01	HD3237 (C)(I)
Sr9e+2+	04	HI8627 (d) (C), HI8713 (d) (C), HI8737 (C)(d), WH1080 (C)
Sr9e+	02	DBW273, MACS6696
Sr9b+11+2+	01	PBW796
Sr9b+11+	02	HPW468, UP3041
Sr13+11+2+	02	HI8805 (d), VL3021
Sr13+2+	02	HD3343, HI8802 (d)
Sr13+	03	DDK1057, HD3293, WH1270
Sr11+7b+2+	03	DDW47 (d), HD3171 (C), PBW797
Sr11+7b+	01	HI1620 (I) (C)
Sr11+2+	12	DBW88 (C), GW322 (C), HD 3059 (C), HD3249 (C), HD3271, HI8811 (d), HW1098(C), MP3336 (C), NIDW1149 (d), PBW644 (C), RAJ4083(d), UAS466 (d) (C)
Sr11+	06	DBW301, DDK1029 (C), HD2932 (C), MACS4058(d), MACS5053, PBW781
Sr7b+2+	17	AKDW2997-16 (d) (C), DBW221, DDK1056, DDW48 (d), DDW49 (d), GW1346(d), HD3086 (C), HI1612 (C), HI8807 (d), HI8808 (d), HI8812 (d), HPW349 (C), KRL210(C), MACS3949(d)(C), NIDW1158(d), WH1124 (C), WHD963 (d)
Sr7b+	05	DDW49 (d), GW1348 (d), Kharchia65, UAS428 (d) (C), WH1239
Sr2+	11	DDW621-50 (C), HD3226 (I)(C), HI1628, HS652, K0307 (C), NIAW3170, NW7049, PBW757 (C), PBW823, PBW825, UP3043
Total	**125**	

OP Gangwar, Pramod Prasad, S.C. Bhardwaj and Subodh Kumar
Regional Station, ICAR-IIWBR
Flowerdale, Shimla-171 002

B. Mahabaleshwar

AVT entries of CZ & PZ and NIVT (NIVT-4 and NIVT-5B) were tested against selective pathotypes of stem and leaf rusts under glass house condition. These were tested at seedling stage against 12 pathotypes of stem rust and 10 pathotypes of leaf rust. The entries found resistant in seedling resistance test are depicted in Table 2.10 as detailed below.

Pathotypes used:
Stem Rust: 11, 24A, 40, 40A, 42, 42B, 117A, 117-2, 117-3, 117-6, 122, and 295.
Leaf Rust: 12-2, 12-4, 12-5, 17, 77-4, 77-9, 104, 104B, 104-1 and 104-2.

Table 2.10. Resistant entries from AVT and NIVT trial against selective pathotypes at seedling stage under glass house condition.

	Stem rust	Leaf rust
AVT	NIDW 1158 (d), HI 8811 (d), HI1544 (C), PBW 822^{B}, DDW 48 (d), DBW110 (C), UAS 466(d)*, MP3288 (C), DDW 47(d)*^{Q}, HD2864 (C), UAS3002, HI1633, HI1634, UAS428 (d) (C), UAS 3001, MACS6222 (C), WHD 963 (d), HI1633, UAS 3002, GW509, HD3090 (C), NIAW 3170*, GW 1346(d)* and HI 8802(d)*	HI 8812 (d), PBW 822^{B}, HD2864 (C), CG1029, UAS3002, HI1634, MACS6222 (C), HI8807(d), HI1633, GW509 and HD3090 (C)
NIVT	GW1351, MPO1366, HI8820, NIDW1302, NIDW1293, MACS4090, MPO1365, GW520, HI1645, UAS446(d) (C), DBW110 (C), HI1643, HI1644, NIAW3624 and HI8823(d)	HI8822, GW1353(d), HI1645 and HI1643

PROGRAMME 3. LEAF BLIGHT

3.1. LEAF BLIGHT SCREENING NURSERY (LBSN), 2018-19

The disease is causing leaf spot on foliar parts and mainly prevalent in north eastern plains zone (NEPZ) and Peninsular zone (PZ). In recent years, the incidence in NWPZ is increasing as the temperature during crop season rises above 25^{o}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.

This nursery was planted at 13 centres listed below:

Zone	Test locations
NEPZ	Faizabad, Varanasi, Pusa(IARI), Coochbehar, Shillongani, Kalyani, Ranchi, Murshidabad (8)
NWPZ	Karnal, Pantnagar, Ludhiana, Hisar, (4)
PZ	Dharwad (1)

The nursery was planted at 13 centers cited as above, the disease severity remained very low at Dharwar hence data not included.

The entries were planted in one row each of 1m length and a row of a highly susceptible entry Raj 4015 was repeatedly 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 first digit indicates the score of blight on flag leaf (F) and second digit represents the score of flag-1 leaf (F-1) and the disease score scale (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 hard dough stage was most distinct in terms of giving clear comparison between resistant and susceptible stage and therefore data at hard dough stage was used for final categorization of resistance of test entries. The data of AVT entries is also presented in Table 1.5 of chapter 1. Center wise data of leaf blight score of different entries at hard dough growth stage is given in Table 3.

Source of resistance

The entries from AVTs which showed the moderate level of resistance within average score below 35 and the HS of 57 are DDW 47(d)*^{Q}, DDW 48 (d), HD 3345^{B}, HD2967 (C), HD2967 (C), HPW 349 (C), HS 652 and VL 907 (C). The entries HD 3293, HD 2967 (C), HD 3171 (C), HI 1612 (C), HPW 467, HS 562 (C), PBW 550 (C) and VL 3021also showed moderate resistance to leaf blight with average score upto 35 but the highest score exceeded 57 due to high disease at one locations.

Among entries previously identified moderately resistant, PBW 800 again showed moderate resistance to leaf blight with average score below 35 and the HS of 57 whereas entry HPW 451 and VL 1014 showed average score up to 35 but highest score exceeded more than 57 due to high score at one location.

Table 3.1 Center wise data of leaf blight score of different entries at hard dough growth stage 2018-19

S. No.	Entry	Leaf Blight Score (0-9dd) IIIrd (Hard dough) stage													
		Shillongani	Kalyani	Pantnagar	Hisar	Karnal	Faizabad	Coochbhear	Murshidabad	Varanasi	Ludhiana	IARI Pusa	Ranchi	HS	AV.
I. Northern Hill Zone															
1	HPW349 (C)	36	25	56	23	24	47	45	35	47	11	45	15	56	35
2	VL907 (C)	36	35	46	12	56	47	56	35	47	11	35	23	56	35
3	HS507 (C)	25	45	47	67	46	35	45	46	89	03	35	24	89	46
4	HS652	37	45	46	23	46	25	45	45	35	25	23	24	46	35
5	HS562 (C)	24	45	58	24	47	35	25	46	47	11	34	24	58	35
6	VL892 (C)	36	45	36	46	58	36	34	34	47	27	45	34	58	36
7	HS490 (C)	57	56	78	56	57	36	56	24	57	24	35	13	78	46
8	HPW468	56	35	67	67	57	46	56	25	68	47	35	23	68	46
9	HS673	57	45	58	45	35	46	78	57	47	47	35	24	78	46
10	VL3020	57	46	47	13	46	35	36	56	68	16	34	24	68	36
11	UP3041	37	56	37	36	46	34	56	57	24	47	34	23	57	46
12	HPW467	57	45	35	24	46	NG	35	58	36	11	23	13	58	35
13	HS674	57	45	46	13	56	36	56	46	79	11	23	24	79	45
14	VL3019	58	35	35	12	68	57	56	46	79	13	23	23	79	45
15	VL3021	57	56	34	45	35	46	67	45	47	01	34	13	67	35
II. North Western Plain Zone															
16	WH1105 (C)	57	56	57	46	68	46	34	35	78	36	34	23	78	46
17	HD3226(I) (C)	47	35	78	57	57	57	67	36	89	15	35	24	89	46
18	HD3086 (C)	46	45	47	56	57	36	78	46	78	11	35	24	78	46
19	PBW820^{M}	57	45	67	67	57	57	45	46	47	12	34	23	67	46
20	DBW 221*	57	35	46	68	58	36	56	45	68	22	35	24	68	46
20A	Infector	78	56	78	78	79	47	67	57	78	78	46	46	79	67
21	DBW 222*	36	57	45	67	46	25	45	45	57	34	35	24	67	46
22	PBW550 (C)	37	35	35	45	57	24	34	36	68	25	34	23	68	35
23	PBW821^{M}	37	35	36	78	57	26	34	35	78	16	23	24	78	46
24	HD2967 (C)	24	45	46	57	46	25	34	24	26	11	23	13	57	35
25	NW 7049	57	45	57	67	46	25	67	24	89	17	34	24	89	46
26	DPW621-50 (C)	36	45	58	46	57	24	67	24	78	11	34	23	78	45
27	DBW88 (C)	37	45	67	45	68	24	56	46	89	23	23	23	89	46
28	PBW752(I) (C)	37	35	58	57	35	35	24	46	89	11	45	34	89	46
29	DBW173 (C)	57	36	47	56	57	46	46	46	47	35	34	23	57	46
30	WH1021 (C)	36	56	78	78	68	57	67	46	89	78	35	13	89	57
31	HD3059 (C)	37	57	57	78	68	36	67	35	57	15	34	24	78	46
32	WH1124 (C)	37	45	78	35	46	68	56	36	99	14	34	23	99	46
33	PBW 771*	36	45	34	67	35	46	35	56	89	13	35	23	89	45

34	HI1620(I) (C)	57	46	45	36	35	57	46	46	78	22	23	23	78	45
35	PBW 796	57	47	58	23	35	47	25	45	89	67	34	03	89	46
36	HI 1628*	36	35	57	25	35	46	35	36	99	89	35	23	99	46
37	WH1142 (C)	37	35	48	35	36	46	45	56	79	25	23	24	79	36
38	HD3043 (C)	57	35	68	45	46	24	45	46	79	35	34	24	79	46
39	PBW644 (C)	57	36	79	45	46	46	35	35	47	34	34	24	79	46
40	HD3237(I) (C)	37	45	78	67	35	46	36	46	25	78	35	23	78	46
40A	Infector	78	56	56	89	79	57	67	67	89	78	45	36	89	67
41	BRW 3806*#	57	58	57	45	57	36	35	46	79	24	45	13	79	46
42	NIAW 3170*	57	47	58	36	35	46	45	35	68	25	34	25	68	46
43	WH1080 (C)	37	46	68	67	35	46	67	46	47	57	34	23	68	46
III. North Eastern Plain Zone															
44	HD3249*#Q	47	45	57	56	24	35	35	46	24	67	35	24	67	45
45	HD2733 (C)	47	35	67	46	46	24	34	35	89	25	34	25	89	46
46	PBW 781	46	45	45	45	35	24	45	45	47	57	34	35	57	45
47	DBW 257	57	56	79	57	35	35	45	46	48	22	23	24	79	46
48	DBW39 (C)	57	57	45	45	46	26	56	46	35	11	23	25	57	45
49	HD 3277	36	45	56	35	46	47	45	56	37	77	23	24	77	46
50	RAJ 4529	36	45	68	45	58	36	34	45	78	23	34	23	78	45
51	DBW187(I) (C)	37	24	56	46	46	36	35	35	47	78	34	24	78	46
52	WH 1239	37	56	58	47	46	35	45	56	68	15	23	34	68	46
53	K0307 (C)	37	24	47	35	57	35	34	35	79	55	23	24	79	45
54	HD2967 (C)	57	24	46	23	35	24	45	35	78	11	23	24	78	35
55	K1317 (C)	56	35	58	36	58	25	45	45	89	57	34	24	89	46
56	HI1612 (C)	36	45	46	23	35	13	56	45	69	13	23	24	69	35
57	HD 3293	37	45	48	25	46	13	45	35	68	22	34	24	68	35
58	HD3171 (C)	36	45	57	26	46	26	34	46	68	11	23	23	68	35
59	HD2888 (C)	25	46	45	57	57	36	45	35	57	47	23	24	57	46
60	DBW 252*#	36	46	56	56	57	36	45	35	46	35	34	33	57	45
60A	Infector	78	46	89	78	79	67	67	46	78	89	45	46	89	67
61	K8027 (C)	57	56	67	56	46	35	45	57	68	12	13	23	68	45
62	DBW 273	57	45	35	34	46	46	45	56	89	24	23	23	89	45
IV. Central Zone															
63	HI8713(d) (C)	36	56	57	45	35	89	56	57	89	57	34	35	89	46
64	NIDW 1158 (d)	36	67	35	67	36	89	34	57	57	89	35	34	89	46
65	HI 8811 (d)	57	67	46	35	46	89	45	46	68	78	35	23	78	46
66	HD3343M	57	67	79	68	68	78	45	46	89	57	23	34	89	57
67	GW322 (C)	56	45	68	67	79	78	56	35	89	47	23	35	89	57
68	HI1544 (C)	36	35	89	56	68	78	34	67	68	78	23	35	89	56
69	HI8737(d) (C)	36	45	57	36	35	68	56	57	89	78	35	13	89	46
70	HI 8812 (d)	57	45	56	35	35	68	45	67	89	78	34	25	89	56
71	GW 1348 (d)	57	36	56	34	36	68	56	46	89	78	34	23	89	46
72	DDW 49 (d)	36	35	47	35	47	58	67	56	89	57	34	34	89	46
73	PBW 822B	57	24	35	34	47	46	56	45	78	47	35	23	78	46

74	HD 3345[B]	57	36	46	36	35	46	45	45	35	57	35	12	57	35
75	DDW 48 (d)	36	56	37	23	36	36	35	45	47	24	35	23	56	35
76	HI8627(d) (C)	36	57	48	34	24	68	34	67	37	47	35	24	67	36
77	DBW110 (C)	25	67	57	46	46	46	67	68	89	78	34	23	89	56
78	UAS 466(d)*	37	67	56	23	68	57	56	78	38	78	34	24	78	46
79	MP3288 (C)	56	67	68	36	57	67	34	67	79	78	35	35	79	57
80	DBW 277	57	56	45	34	58	14	56	67	35	13	34	36	67	45
80A	Infector	78	46	67	89	79	37	67	68	78	89	45	46	89	67
81	DDW 47(d)*[Q]	36	46	56	25	35	35	35	57	27	45	35	23	57	35
82	HD2932 (C)	36	57	89	67	46	35	56	56	35	79	45	13	89	56
83	HD2864 (C)	37	48	46	78	68	57	67	46	78	79	35	23	79	57
84	MP3336 (C)	56	57	79	67	68	89	35	46	99	89	35	34	99	57
85	MP4010 (C)	36	56	69	68	68	78	56	68	36	79	35	34	79	57
86	CG1029	36	45	89	68	46	58	35	57	36	89	23	23	89	46
87	UAS3002	56	45	68	58	46	48	34	56	47	47	35	23	68	46
88	HI1633	57	56	45	56	57	68	25	67	79	78	34	23	79	56
89	HI1634	36	45	46	45	68	68	45	46	89	78	34	24	89	46
90	HI8808 (d)	36	67	37	56	57	78	34	58	99	79	34	23	99	57
91	HI8807 (d)	36	67	47	23	58	78	56	67	89	78	35	23	89	56
V. Peninsular Zone															
92	PBW 823[B]	37	68	34	24	36	58	67	67	99	78	34	13	99	46
93	UAS428 (d) (C)	36	67	57	23	35	78	56	68	78	78	34	23	78	46
94	DDW 49 (d)	57	46	57	46	46	78	45	57	89	67	35	23	89	56
95	UAS 3001	57	45	68	23	35	78	35	58	89	57	45	23	89	46
96	MACS3949 (d) (C)	46	35	56	35	35	78	25	46	99	78	45	23	99	46
97	MACS6222 (C)	46	46	45	23	35	37	56	68	38	78	35	24	78	46
98	GW 322 (C)	57	47	69	35	46	78	34	46	99	78	35	35	99	57
99	DDW 48 (d)	57	68	68	38	46	78	34	56	99	78	34	13	99	57
100	MACS6478 (C)	46	67	57	35	57	35	46	79	89	25	35	23	89	46
100A	Infector	78	58	78	78	79	36	56	67	89	89	45	57	89	68
101	HD3343[M]	57	57	47	45	46	35	45	68	99	78	35	24	99	56
102	WHD 963 (d)	57	67	35	24	46	78	45	68	89	78	35	23	89	56
103	HI8807(d)	36	68	47	23	46	78	56	56	79	79	35	23	79	46
104	HI1633	36	67	36	45	57	68	67	46	78	79	23	24	79	46
105	UAS 3002	57	68	58	56	57	68	56	57	47	89	34	24	89	57
106	Raj4083 (C)	36	46	68	57	36	78	67	56	99	89	23	25	99	57
107	HD2932 (C)	57	56	79	56	57	37	45	57	99	78	35	23	99	57
108	GW509	37	68	68	57	57	78	35	68	99	89	23	23	99	57
109	HD3090 (C)	36	68	46	57	36	36	35	68	89	89	35	23	89	57
110	NIAW 3170*	36	67	47	56	68	36	25	67	78	89	34	24	89	56
111	GW 1346(d)*	56	46	57	45	57	89	56	46	46	89	35	35	89	56
112	MACS 4058(d)*	57	58	56	46	46	89	56	57	48	NG	35	23	58	46
113	DBW93 (C)	36	57	79	45	24	68	45	46	46	89	45	24	89	46

114	HI 8805(d)*	37	68	35	25	46	68	45	68	36	89	35	24	89	46
115	AKDW2997-16(d) (C)	37	56	69	56	58	68	45	46	99	89	45	23	99	57
116	MACS 6695*	58	57	89	35	35	45	56	25	89	89	34	23	89	56
117	UAS446(d) (C)	57	47	78	45	35	57	56	35	89	89	35	13	89	56
118	HI1605 (C)	24	45	89	45	68	34	45	45	78	89	23	23	89	56
119	MACS 6696*	36	57	57	35	35	37	35	46	78	89	34	24	89	46
120	NIDW 1149(d)	37	68	45	23	68	78	67	68	47	89	34	23	89	56
120A	Infector	78	67	57	78	68	68	67	78	78	89	46	47	89	68
121	HI 8802(d)*	36	56	46	34	24	79	45	67	37	89	35	24	89	46
VI. Special Trial (Dicocum)															
122	DDK1029 (C)	25	45	57	45	68	36	45	57	78	89	34	34	89	56
123	MACS5052	24	46	47	23	68	47	56	56	37	89	34	23	89	46
124	MACS6222 (aest.) (C)	36	67	46	45	36	57	56	67	47	68	23	33	68	46
125	DDK1056	57	68	57	36	46	46	45	78	36	68	34	23	78	46
126	HW1098 (C)	57	67	68	45	46	24	34	78	36	68	34	24	78	46
127	MACS5053	36	68	79	46	57	37	45	68	36	78	35	35	79	57
128	DDK1057	37	69	68	23	68	57	35	56	47	89	34	35	89	47
VII. Special Trial- SPL-HYPT															
129	HD3317	24	69	45	24	24	34	34	68	99	89	23	22	99	45
130	WH1254	36	46	35	46	35	24	45	56	47	89	34	23	89	46
131	DBW301	57	35	56	57	35	35	56	45	48	68	23	13	68	46
132	WH1270	36	45	56	35	35	24	56	45	78	89	34	24	89	46
133	HD2967 (C)	25	45	47	35	46	35	45	45	36	57	23	23	57	35
134	PBW824	37	45	56	23	46	24	45	46	67	89	23	23	89	45
135	UP3043	36	45	45	25	35	25	25	57	78	68	34	23	78	46
136	DBW187	57	57	47	35	35	46	45	68	68	89	35	13	89	46
137	HD3086 (C)	57	45	67	24	24	68	67	56	78	89	34	14	89	46
138	DBW303	36	46	56	23	35	36	56	46	78	78	34	23	78	46
139	DBW304	37	35	47	35	46	36	56	36	47	89	45	24	89	46
140	UP3042	57	45	45	34	35	25	67	46	47	89	23	23	89	46
140A	Infector	57	45	47	78	47	46	56	67	78	89	45	46	89	57
141	DBW302	36	67	46	36	24	35	45	46	47	78	23	24	78	46
142	PBW825	24	45	45	57	35	47	45	56	68	78	35	23	78	46
143	HD3347	24	45	79	35	46	57	67	35	78	NG	34	23	79	46
VIII. Special Trial (SPL-AST)															
144	WH1223	24	35	68	34	13	35	45	35	99	89	34	23	99	45
145	KRL19 (C)	36	45	89	46	24	47	45	46	68	89	45	23	89	46
146	Kharchia65 (C)	24	58	89	45	24	58	56	67	57	89	35	23	89	56
147	NW 7060	56	67	56	56	35	35	34	68	25	57	35	23	68	46
148	KRL210 (C)	57	45	58	47	35	57	67	57	47	68	34	23	68	46
149	WH 1228	37	57	46	46	13	46	45	67	36	89	34	23	89	46
150	NW 7062	37	58	58	57	46	25	34	57	35	89	23	34	89	46
IX. Special Trial (SPL-VLS)															

151	PBW757 (C)	57	68	14	35	13	24	67	68	79	89	34	25	89	46
152	WR544 (C)	57	67	79	46	68	79	67	56	78	78	35	23	79	57
153	HD3298	36	68	47	34	57	46	56	46	78	89	23	25	89	46
154	HD3271	37	67	46	36	24	36	25	57	78	47	34	23	78	46
155	DBW14 (C)	56	45	34	23	46	46	45	46	79	78	35	25	79	46
156	DBW71 (C)	36	56	36	35	13	46	56	45	89	79	34	25	89	50
157	HI1621	57	45	46	45	35	35	56	45	78	89	45	24	89	56
158	PBW 797	57	35	45	34	35	14	45	35	78	78	23	25	78	45
X. Resistant : (Av. Score 14-35, HS upto 57)															
From AVTs 2017-18															
159	VL 1015	24	68	57	36	36	25	67	68	68	25	34	23	68	46
160	HPW 451	24	69	45	23	35	24	45	67	35	13	34	25	69	35
160A	Infector	57	67	57	78	79	67	56	68	89	89	45	35	89	67
161	VL 1014	24	46	36	23	12	24	78	46	36	23	35	23	78	35
162	PBW 800	24	45	48	35	24	24	45	46	24	45	35	25	48	35

COOPERATORS:

NAME	**CENTRE**
SATYAJIT HEMBRAM	COOCHBEHAR
S. P. SINGH, J. VERMA	FAIZABAD
R. S. BENIWAL	HISAR
SUNITA MAHAPATRA, DHIMAN MUKHERJEE	KALYANI, MURSHIDABAD
JASPAL KAUR, RITU BALA	LUDHIANA
DEEPSHIKHA, K. SRIVASTAVA	PANTNAGAR
H.C. LAL	RANCHI
R. CHAKRABARTY	SHILLONGANI
S.S. VAISH	VARANASI
A.K. GUPTA	PUSA (IARI)
P.V. PATIL, GURUDATT M. HEGDE	DHARWAD
SUDHEER KUMAR, P.L. KASHYAP AND D.P. SINGH	KARNAL

PROGRAMME 4. KARNAL BUNT

4.1 KARNAL BUNT SCREENING NURSERY (KBSN) 2018-2019

Wheat entries along with checks were evaluated for resistance to Karnal bunt at multilocations (Pantnagar, Ludhiana, New Delhi, Hisar, Jammu and Dhaulakuan) during 2018-19 crop season under artificially inoculated conditions. The disease intensity was very low at Dhaulakuan and Pantnagar hence data were not included.

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. Entries showing response of upto 5 per cent coefficient of infection (average) were rated as resistant. KB incidence of AVT entries and checks of all centres is given in Table 4.1 and average KB incidence of all centres is also given in Table 1.5. The resistant entries identified are listed below:

AVTs 2018-19
Free from infection:
Nil

Resistant (average incidence upto 5%):

AKDW2997-16(d) (C), DBW 252*[#], DBW 273, DBW14 (C), DBW173 (C), DBW187, DBW187(I) (C), DBW301, DBW304, DBW93 (C), DDW 47(d)*[Q], DDW 48 (d), DDW 48 (d), DDW 49 (d), DDW 49 (d), DPW621-50 (C), GW 1348 (d), HD 3277, HD 3293, HD 3345[B], HD2932 (C), HD3059 (C), HD3086 (C), HD3226(I) (C), HD3298, HI 8802(d)*, HI 8811 (d), HI 8812 (d), HI1544 (C), HI1612 (C), HI1634, HI8627(d) (C), HI8713(d) (C), HI8737(d) (C), HI8807 (d), HI8807(d), HS507 (C), HS673, K1317 (C), KRL210 (C), MACS 6696*, MACS3949 (d) (C), MACS5052, MACS6222 (aest.) (C), MACS6222 (C), MP3336 (C), NIAW 3170*, NIDW 1149(d), NIDW 1158 (d), PBW 781, PBW 822[B], PBW 823[B], PBW752(I) (C), PBW757 (C), PBW820[M], PBW821[M], PBW824, UAS 3002, UAS3002, UAS428 (d) (C), UAS446(d) (C), UP3041, UP3043, VL3019, VL3021, WH 1239, WH1080 (C), WH1124 (C), WH1142 (C) and WHD 963 (d)

Table 4.1: Karnal bunt incidence in KBSN entries evaluated under artificially inoculated conditions at multilocations during 2018-19

S. No.	Entry	Karnal bunt incidence (%)					
		Hisar	Ludhiana	New Delhi	Jammu	HS	Avg.
I. Northern Hill Zone							
1	HPW349 (C)	6.6	8.5	15.7	5.9	15.7	9.2
2	VL907 (C)	8.3	0.0	11.4	10.0	11.4	7.4
3	HS507 (C)	7.1	0.0	2.5	4.3	7.1	3.5
4	HS652	9.1	5.2	2.9	10.9	10.9	7.0
5	HS562 (C)	6.5	4.4	11.1	6.0	11.1	7.0
6	VL892 (C)	8.1	4.8	4.5	9.0	9.0	6.6
7	HS490 (C)	9.3	2.0	6.7	9.1	9.3	6.8
8	HPW468	8.3	5.7	4.0	3.4	8.3	5.3
9	HS673	7.5	0.0	3.3	5.1	7.5	4.0
10	VL3020	6.6	7.3	8.6	2.7	8.6	6.3
11	UP3041	5.0	2.0	3.3	1.5	5.0	2.9

12	HPW467	4.3	2.4	4.0	12.2	12.2	5.7
13	HS674	5.0	0.0	13.3	10.1	13.3	7.1
14	VL3019	8.6	0.0	2.9	1.7	8.6	3.3
15	VL3021	5.0	5.7	2.5	4.1	5.7	4.3
II. North Western Plain Zone							
16	WH1105 (C)	6.6	3.9	5.0	13.4	13.4	7.2
17	HD3226(I) (C)	5.0	3.2	3.3	6.1	6.1	4.4
18	HD3086 (C)	6.6	4.2	2.0	9.9	9.9	5.7
19	PBW820[M]	5.0	3.1	5.0	3.7	5.0	4.2
20	DBW 221*	5.0	4.3	2.5	13.0	13.0	6.2
20A	Infector	14.3	18.4	12.2	21.3	21.3	16.6
21	DBW 222*	5.3	4.9	9.1	2.2	9.1	5.4
22	PBW550 (C)	7.5	2.4	5.8	11.2	11.2	6.7
23	PBW821[M]	6.7	2.9	4.4	2.2	6.7	4.1
24	HD2967 (C)	6.3	3.6	5.6	11.1	11.1	6.6
25	NW 7049	7.5	0.0	7.5	13.8	13.8	7.2
26	DPW621-50 (C)	9.1	1.0	3.3	6.4	9.1	5.0
27	DBW88 (C)	7.6	0.0	5.7	17.8	17.8	7.8
28	PBW752(I) (C)	5.4	0.0	10.0	1.6	10.0	4.3
29	DBW173 (C)	6.6	1.3	2.5	6.7	6.7	4.3
30	WH1021 (C)	7.5	0.0	5.6	11.7	11.7	6.2
31	HD3059 (C)	8.3	0.0	3.3	5.2	8.3	4.2
32	WH1124 (C)	9.2	2.0	6.7	2.2	9.2	5.0
33	PBW 771*	8.3	5.7	9.0	0.5	9.0	5.9
34	HI1620(I) (C)	9.5	6.6	11.9	4.6	11.9	8.1
35	PBW 796	6.2	5.9	11.0	1.1	11.0	6.0
36	HI 1628*	8.5	3.5	10.0	12.1	12.1	8.5
37	WH1142 (C)	6.5	0.0	5.0	2.0	6.5	3.4
38	HD3043 (C)	8.3	0.0	12.2	5.6	12.2	6.5
39	PBW644 (C)	5.0	3.9	4.5	8.1	8.1	5.4
40	HD3237(I) (C)	4.5	7.8	7.7	3.2	7.8	5.8
40A	Infector	16.6	17.2	14.3	23.2	23.2	17.8
41	BRW 3806*[#]	5.6	5.2	-	18.0	18.0	9.6
42	NIAW 3170*	6.9	2.9	4.7	2.2	6.9	4.2
43	WH1080 (C)	8.3	4.8	4.0	2.1	8.3	4.8
III. North Eastern Plain Zone							
44	HD3249*[#Q]	9.1	0.0	2.9	12.2	12.2	6.0
45	HD2733 (C)	6.5	0.0	3.3	11.1	11.1	5.2
46	PBW 781	8.9	4.0	0.0	2.8	8.9	3.9
47	DBW 257	4.3	7.9	10.0	4.4	10.0	6.6
48	DBW39 (C)	4.5	2.0	6.0	17.8	17.8	7.6
49	HD 3277	5.2	1.0	7.1	2.6	7.1	4.0
50	RAJ 4529	6.5	13.8	4.0	4.7	13.8	7.2
51	DBW187(I) (C)	6.6	0.0	1.8	1.7	6.6	2.5
52	WH 1239	7.5	3.9	1.8	2.2	7.5	3.8
53	K0307 (C)	8.6	4.3	0.0	8.2	8.6	5.3
54	HD2967 (C)	8.3	12.3	0.0	13.8	13.8	8.6
55	K1317 (C)	5.3	0.0	5.5	6.4	6.4	4.3
56	HI1612 (C)	4.5	3.2	0.0	0.8	4.5	2.1
57	HD 3293	5.1	0.0	0.0	2.6	5.1	1.9
58	HD3171 (C)	5.0	9.1	0.0	16.7	16.7	7.7
59	HD2888 (C)	6.6	17.8	8.9	11.7	17.8	11.3

60	DBW 252*#	8.5	3.9	0.0	4.2	8.5	4.1
60A	Infector	16.6	27.3	11.4	23.3	27.3	19.6
61	K8027 (C)	9.5	11.1	5.0	2.2	11.1	7.0
62	DBW 273	3.3	1.5	0.0	4.3	4.3	2.3
IV. Central Zone							
63	HI8713(d) (C)	3.5	0.0	3.0	4.6	4.6	2.8
64	NIDW 1158 (d)	2.5	10.6	5.0	0.0	10.6	4.5
65	HI 8811 (d)	4.5	0.0	0.0	4.1	4.5	2.2
66	HD3343[M]	7.6	8.7	4.0	13.4	13.4	8.4
67	GW322 (C)	8.3	5.6	2.5	7.1	8.3	5.9
68	HI1544 (C)	1.6	1.0	0.0	14.7	14.7	4.3
69	HI8737(d) (C)	1.3	0.0	5.6	3.5	5.6	2.6
70	HI 8812 (d)	2.5	6.3	6.7	2.2	6.7	4.4
71	GW 1348 (d)	2.5	5.7	0.0	5.1	5.7	3.3
72	DDW 49 (d)	3.6	0.0	2.2	4.7	4.7	2.6
73	PBW 822[B]	3.5	0.0	5.7	2.1	5.7	2.8
74	HD 3345[B]	2.5	2.0	1.1	10.3	10.3	4.0
75	DDW 48 (d)	2.3	1.0	0.0	4.3	4.3	1.9
76	HI8627(d) (C)	5.5	0.0	8.0	0.9	8.0	3.6
77	DBW110 (C)	1.3	5.3	0.0	16.2	16.2	5.7
78	UAS 466(d)*	2.5	2.0	7.7	9.3	9.3	5.4
79	MP3288 (C)	5.6	4.3	8.0	9.1	9.1	6.7
80	DBW 277	4.5	7.5	0.0	13.4	13.4	6.4
80A	Infector	18.3	0.0	12.5	19.6	19.6	12.6
81	DDW 47(d)*[Q]	3.3	0.0	10.3	4.7	10.3	4.6
82	HD2932 (C)	4.5	0.0	0.0	13.5	13.5	4.5
83	HD2864 (C)	5.6	8.0	3.3	12.2	12.2	7.3
84	MP3336 (C)	6.6	0.0	0.0	10.1	10.1	4.2
85	MP4010 (C)	8.3	8.2	4.0	15.7	15.7	9.0
86	CG1029	7.5	4.8	3.3	14.1	14.1	7.4
87	UAS3002	4.3	4.8	0.0	6.2	6.2	3.8
88	HI1633	4.5	0.0	4.0	13.4	13.4	5.5
89	HI1634	3.6	5.5	0.0	6.1	6.1	3.8
90	HI8808 (d)	2.5	5.9	16.7	3.9	16.7	7.3
91	HI8807 (d)	1.6	1.0	8.8	2.7	8.8	3.5
V. Peninsular Zone							
92	PBW 823[B]	6.8	1.7	3.6	0.5	6.8	3.2
93	UAS428 (d) (C)	3.5	1.1	10.0	2.2	10.0	4.2
94	DDW 49 (d)	3.3	4.8	0.0	1.2	4.8	2.3
95	UAS 3001	2.5	0.0	7.0	12.2	12.2	5.4
96	MACS3949 (d) (C)	2.5	2.9	0.0	1.1	2.9	1.6
97	MACS6222 (C)	4.5	0.0	4.3	3.8	4.5	3.1
98	GW 322 (C)	5.6	4.0	10.0	6.4	10.0	6.5
99	DDW 48 (d)	2.3	0.0	8.9	5.8	8.9	4.2
100	MACS6478 (C)	8.5	0.0	6.7	12.6	12.6	6.9
100A	Infector	18.3	27.3	15.0	27.4	27.4	22.0
101	HD3343[M]	8.3	13.7	NG	6.1	13.7	9.4
102	WHD 963 (d)	10.5	2.0	0.0	4.9	10.5	4.3
103	HI8807(d)	3.5	0.0	5.0	2.7	5.0	2.8
104	HI1633	2.5	5.8	3.3	13.3	13.3	6.2
105	UAS 3002	9.1	0.0	0.0	8.2	9.1	4.3
106	Raj4083 (C)	9.5	4.8	0.0	12.2	12.2	6.6

107	HD2932 (C)	10.5	17.4	5.0	11.2	17.4	11.0
108	GW509	11.3	0.0	8.0	12.2	12.2	7.9
109	HD3090 (C)	7.6	6.5	6.7	16.1	16.1	9.2
110	NIAW 3170*	8.5	7.4	3.3	3.8	8.5	5.8
111	GW 1346(d)*	2.5	4.8	10.0	6.4	10.0	5.9
112	MACS 4058(d)*	2.6	0.0	11.1	7.8	11.1	5.4
113	DBW93 (C)	6.6	0.0	0.0	12.6	12.6	4.8
114	HI 8805(d)*	4.5	0.0	11.7	6.7	11.7	5.7
115	AKDW2997-16(d) (C)	5.0	3.2	0.0	1.7	5.0	2.5
116	MACS 6695*	10.5	9.8	0.0	5.2	10.5	6.4
117	UAS446(d) (C)	3.5	1.0	3.3	8.2	8.2	4.0
118	HI1605 (C)	8.3	3.9	5.0	3.5	8.3	5.2
119	MACS 6696*	9.1	2.2	0.0	8.6	9.1	5.0
120	NIDW 1149(d)	3.5	2.0	0.0	4.1	4.1	2.4
120A	Infector	18.6	17.7	18.0	22.1	22.1	19.1
121	HI 8802(d)*	2.3	1.0	0.0	2.5	2.5	1.4
VI. Special Trial (Dicocum)							
122	DDK1029 (C)	5.5	1.2	6.7	8.1	8.1	5.4
123	MACS5052	9.5	0.0	0.0	3.2	9.5	3.2
124	MACS6222 (aest.) (C)	11.3	1.0	0.0	2.2	11.3	3.6
125	DDK1056	12.5	0.0	5.9	8.0	12.5	6.6
126	HW1098 (C)	11.6	3.2	0.0	12.2	12.2	6.7
127	MACS5053	10.6	0.0	0.0	13.1	13.1	5.9
128	DDK1057	11.3	2.0	0.0	8.6	11.3	5.5
VII. Special Trial- SPL-HYPT							
129	HD3317	12.5	9.1	0.0	3.4	12.5	6.2
130	WH1254	13.3	0.0	15.0	4.1	15.0	8.1
131	DBW301	12.5	0.0	0.0	1.9	12.5	3.6
132	WH1270	11.8	8.4	0.0	10.7	11.8	7.7
133	HD2967 (C)	8.3	8.0	0.0	13.0	13.0	7.3
134	PBW824	9.5	4.7	0.0	4.2	9.5	4.6
135	UP3043	9.6	4.8	0.0	1.2	9.6	3.9
136	DBW187	11.3	0.0	3.0	0.0	11.3	3.6
137	HD3086 (C)	11.5	2.9	0.0	2.2	11.5	4.2
138	DBW303	11.1	1.3	1.7	9.1	11.1	5.8
139	DBW304	9.6	1.0	1.4	0.8	9.6	3.2
140	UP3042	9.5	5.6	3.8	6.4	9.5	6.3
140A	Infector	19.3	20.0	15.5	17.8	20.0	18.2
141	DBW302	9.6	5.0	0.0	6.6	9.6	5.3
142	PBW825	11.3	4.7	2.0	12.7	12.7	7.7
143	HD3347	12.5	5.1	5.7	11.7	12.5	8.7
VIII. Special Trial (SPL-AST)							
144	WH1223	9.6	0.0	5.0	8.2	9.6	5.7
145	KRL19 (C)	13.3	0.0	5.3	3.5	13.3	5.5
146	Kharchia65 (C)	12.5	28.0	1.4	4.6	28.0	11.6
147	NW 7060	10.8	3.3	10.0	5.1	10.8	7.3
148	KRL210 (C)	9.6	7.0	2.0	0.1	9.6	4.7
149	WH 1228	11.5	4.8	5.0	2.0	11.5	5.8
150	NW 7062	9.3	0.0	10.0	5.6	10.0	6.2
IX. Special Trial (SPL-VLS)							
151	PBW757 (C)	8.6	2.0	0.0	0.5	8.6	2.8
152	WR544 (C)	9.1	0.9	1.3	14.2	14.2	6.4

153	HD3298	6.6	2.2	0.0	6.1	6.6	3.7
154	HD3271	5.0	3.9	8.0	5.2	8.0	5.5
155	DBW14 (C)	4.5	2.0	0.0	13.1	13.1	4.9
156	DBW71 (C)	6.3	11.5	0.0	8.3	11.5	6.5
157	HI1621	7.5	4.8	4.0	6.2	7.5	5.6
158	PBW 797	8.3	11.3	0.0	3.1	11.3	5.7
158A	Infector	16.6	19.3	12.5	23.1	23.1	17.9

COOPERATORS:

NAME	**CENTRE**
RITU BALA	LUDHIANA
DEEPSHIKHA, K. SRIVASTAVA	PANT NAGAR
AKHILESH SINGH	DHAULAKUAN
M.S. SAHARAN AND RASHMI AGGARWAL	DELHI
R. S. BENIWAL	HISAR
M. K. PANDEY	JAMMU
SUDHEER KUMAR, P.L. KASHYAP AND D.P. SINGH	KARNAL

PROGRAMME 5. LOOSE SMUT

5.1 Evaluation of AVT material (2017-18) 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 AVTs (2017-18), were inoculated with local isolates of loose smut pathogen using 'Go go' method at hot spot locations like Hisar, Ludhiana, Durgapura, and Almora. The inoculated seeds were sown again during 2018-19 crop season at these locations of NWPZ and NHZ for expression of disease. 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 highest and average disease score was taken for each entry. The detailed data are presented in Table 5.1. The promising entries in AVTs are:

AVTs year, 2017-18

Free (No infection at any location):
HI 8713 (d) (C) and HW 1098 (C)

Resistant (Average score: 0.1-5.0 % infection):
AKDW 2997-16 (d)(C), DBW 222, DDK 1029 (C), DDK 1054, DDW 47 (d), GW 1339 (d), HI 8627 (d) (C), HI 8737 (d) (C), HI 8802 (d), HI 8805 (d), HS 660, HS 664, HW 4101, MACS 4058 (d), MACS 4059 (d), MACS 5051, MPO 1343 (d), UAS 446 (d) (c), UAS 465 (d), UAS 466 (d) and WH 1124 (C)

Table 5.1. Per cent loose smut infection in the entries of AVTs of year 2017-18 expressed during 2018-19 crop season

S. No.	Entry	Loose smut incidence (%)					
		Hisar	Durgapura	Almora	Ludhiana	HS	AV
I. Northern Hill Zone							
1	HS 542 (C)	35.0	11.8	18.0	32.3	35.0	24.3
2	HS 666	65.0	23.4	29.0	7.8	65.0	31.3
3	HS 665	45.0	13.3	14.0	7.6	45.0	20.0
4	VL 1015	36.6	17.1	18.0	28.0	36.6	24.9
5	HPW 450	85.6	3.7	39.0	23.0	85.6	37.8
6	HS 664	10.0	0.0	0.0	0.0	10.0	2.5
7	HPW 451	23.3	1.6	31.0	72.7	72.7	32.2
8	VL 1016	76.7	12.3	69.0	6.9	76.7	41.2
9	UP 3016	45.0	80.0	39.0	46.4	80.0	52.6
10	VL 1014	24.0	6.9	23.0	34.0	34.0	22.0
11	VL 829 (C)	32.5	10.9	27.0	14.5	32.5	21.2
12	HPW 251 (C)	35.0	7.4	24.0	14.0	35.0	20.1
13	HPW 349 (C)	76.6	6.4	29.0	27.4	76.6	34.9
14	HS 634	81.1	4.8	35.0	37.8	81.1	39.7
15	VL 907 (C)	73.3	7.5	38.0	40.5	73.3	39.8
16	HS 507 (C)	75.0	9.2	24.0	20.0	75.0	32.1
17	HPW 441	71.1	4.3	15.0	23.5	71.1	28.5
18	HPW 442	74.7	17.3	34.0	10.3	74.7	34.1

19	HS 562 (C)	65.0	8.7	61.0	12.9	65.0	36.9
20	VL 3017	85.0	14.1	9.0	11.4	85.0	29.9
20A	Sonalika(C)	93.7	58.3	24.0	34.3	93.7	52.6
21	UP 3017	52.5	14.6	65.0	34.6	65.0	41.7
22	VL 3016	53.3	62.8	96.0	38.6	96.0	62.7
23	HS 662	62.3	11.3	63.0	37.2	63.0	43.4
24	HS 490 (C)	75.0	15.6	22.0	9.6	75.0	30.5
25	VL 892 (C)	46.6	8.0	49.0	16.4	49.0	30.0
26	HS 661	35.0	8.1	72.0	0.0	72.0	28.8
27	HS 660	N.S.	0.0	8.0	5.1	8.0	4.4
28	VL 3018	46.6	22.2	46.0	100.0	100.0	53.7
29	HPW 459	25.0	7.3	4.0	17.4	25.0	13.4
II. North Western Plain Zone							
30	UP 2981	N.S.	56.9	48.3	38.0	56.9	47.7
31	DBW 221	73.3	9.7	35.7	0.0	73.3	29.7
32	DPW 621-50 (C)	38.6	15.1	53.1	9.8	53.1	29.1
33	DBW 222	14.6	0.0	NG	0.0	14.6	4.9
34	BRW 3792	73.5	13.9	23.2	42.3	73.5	38.2
35	PBW 763	68.2	51.0	34.7	14.0	68.2	42.0
36	PBW 766	14.3	10.7	52.7	16.1	52.7	23.4
37	HD 3086 (C)	12.5	0.0	0.0	17.8	17.8	7.6
38	DBW 233	31.2	1.0	21.1	21.6	31.2	18.7
39	HD 3226*	23.3	12.3	37.8	47.6	47.6	30.3
40	HD 2967 (C)	35.0	0.0	51.2	20.0	51.2	26.6
40A	Sonalika(C)	85.0	55.2	32.5	37.5	85.0	52.5
41	PBW 801	56.6	12.0	62.0	13.0	62.0	35.9
42	DBW 88 (C)	36.6	16.5	0.0	17.2	36.6	17.6
43	PBW 800	23.3	1.7	15.6	18.9	23.3	14.9
44	WH 1105	12.5	15.9	7.6	26.9	26.9	15.7
45	PBW 771	34.1	28.2	18.8	13.1	34.1	23.6
46	WH 1124 (C)	NG	0.0	0.0	13.3	13.3	4.4
47	DBW 90 (C)	24.7	0.0	0.0	0.0	24.7	6.2
48	HD 3059 (C)	46.6	9.7	59.4	35.0	59.4	37.7
49	WH 1021 (C)	74.4	20.8	31.6	21.3	74.4	37.0
50	PBW 752*	72.3	24.2	40.0	10.6	72.3	36.8
51	DBW 173 (I) (C)	68.7	23.3	38.6	38.5	68.7	42.3
52	PBW 773	57.7	12.7	36.4	12.2	57.7	29.8
53	DBW 237	74.3	12.9	29.7	33.9	74.3	37.7
54	WH 1142 (C)	12.5	9.0	52.2	23.9	52.2	24.4
55	BRW 3806	80.0	22.4	19.7	11.5	80.0	33.4
56	WH 1080 (C)	65.0	10.1	26.6	17.7	65.0	29.8
57	HD 3237*	24.1	7.7	39.6	13.1	39.6	21.1
58	HI 1620*	32.3	8.6	45.7	16.7	45.7	25.8
59	PBW 644 (C)	28.6	10.4	42.9	33.3	42.9	28.8
60	HD 3043 (C)	23.3	5.8	33.5	NI	33.5	20.9
60A	Sonalika(C)	80.0	41.3	60.5	32.0	80.0	53.4
61	DBW 252	NG	28.9	53.1	53.9	53.9	45.3
62	HI 1628	60.0	9.8	62.3	55.6	62.3	46.9
63	NIAW 3170	35.0	18.2	72.1	58.8	72.1	46.0
III. North Eastern Plain Zone							
64	DBW 233	12.5	9.2	12.6	4.6	12.6	9.7
65	HD 3249	24.6	17.1	21.9	26.7	26.7	22.6
66	HD 3254	13.3	12.5	9.8	12.8	13.3	12.1

67	K 1006 (C)	45.0	6.1	8.4	28.9	45.0	22.1
68	HD 2733 (C)	NG	12.7	51.3	0.0	51.3	21.3
69	DBW 221	32.1	27.4	44.6	26.0	44.6	32.5
70	K 1601	13.3	42.9	15.3	21.2	42.9	23.2
71	PBW 769	15.0	11.7	8.8	13.1	15.0	12.1
72	DBW 39 (C)	42.6	2.6	70.9	8.4	70.9	31.1
73	HD 2967 (C)	NG	4.4	38.2	19.3	38.2	20.6
74	K 0307 (C)	34.5	10.5	43.8	27.2	43.8	29.0
75	DBW 187*	23.3	12.5	53.1	28.0	53.1	29.2
76	DBW 223	57.7	12.2	72.5	24.6	72.5	41.8
77	PBW 762	64.0	24.4	61.6	31.6	64.0	45.4
78	WH 1218	75.0	3.6	35.7	18.5	75.0	33.2
79	HD 2888 (C)	23.3	38.1	46.9	3.2	46.9	27.9
80	HI 1612 (I) (C)	14.3	15.8	62.0	0.0	62.0	23.0
80A	Sonalika(C)	76.0	43.1	57.3	57.8	76.0	58.5
81	WH 1235	15.0	7.2	51.2	0.0	51.2	18.4
82	BRW 3806	12.5	18.6	33.3	45.5	45.5	27.5
83	K 1317 (C)	10.0	27.1	66.4	25.8	66.4	32.3
84	DBW 252	9.1	33.3	40.0	21.5	40.0	26.0
85	K 8027 (C)	11.1	13.3	47.7	8.0	47.7	20.0
86	HD 3171 (C)	12.5	0.0	5.5	23.7	23.7	10.4
87	HI 1628	73.3	5.4	68.0	40.0	73.3	46.7
IV. Central Zone							
88	GW 1339 (d)	12.5	0.0	0.0	0.0	12.5	3.1
89	AKAW 4924	62.5	28.2	26.3	21.3	62.5	34.6
90	GW 322 (C)	34.1	60.9	38.6	0.0	60.9	33.4
91	HI 8713 (d) (C)	NG	0.0	0.0	0.0	0.0	0.0
92	HI 8737 (d) (C)	5.0	0.0	0.0	0.0	5.0	1.3
93	HI 1544 (C)	12.5	0.0	6.7	34.9	34.9	13.5
94	GW 495	14.7	1.4	23.2	7.3	23.2	11.6
95	UAS 465 (d)	5.0	0.0	2.6	0.0	5.0	1.9
96	MPO 1343 (d)	6.7	0.0	0.0	0.0	6.7	1.7
97	DBW 110 (C)	45.0	22.6	29.2	10.6	45.0	26.9
98	DDW 47 (d)	5.0	0.0	0.0	0.0	5.0	1.3
99	MP 1331	85.0	3.9	63.0	18.2	85.0	42.5
100	MP 3288 (C)	71.1	5.2	29.4	57.1	71.1	40.7
100A	Sonalika(C)	90.0	47.1	63.6	40.0	90.0	60.2
101	HI 8627 (d) (C)	10.0	0.0	0.0	0.0	10.0	2.5
102	UAS 466 (d)	18.6	0.0	0.0	0.0	18.6	4.7
103	NIAW 3170	15.0	14.1	53.7	40.6	53.7	30.9
V. Peninsular Zone							
104	AKAW 4924	23.3	28.9	48.3	27.5	48.3	32.0
105	GW 491	38.1	33.9	48.4	22.2	48.4	35.6
106	GW 493	34.3	8.2	31.5	20.9	34.3	23.7
107	DBW 235	80.0	20.3	44.7	23.5	80.0	42.1
108	HI 1624	75.0	6.1	1.6	26.8	75.0	27.4
109	MACS 6222 (C)	12.5	15.1	49.3	3.8	49.3	20.2
110	DBW 168 (I) (C)	15.0	9.0	10.8	25.7	25.7	15.1
111	GW 495	18.6	3.0	10.3	22.2	22.2	13.5
112	MP 1338	23.3	2.3	54.2	15.0	54.2	23.7
113	MACS 3949 (d) (C)	4.5	6.1	5.1	4.9	6.1	5.1
114	HI 8800 (d)	6.7	16.9	1.2	1.5	16.9	6.6
115	MACS 6478 (C)	45.0	0.0	15.6	39.5	45.0	25.0

116	MACS 6709	34.1	0.0	68.9	28.1	68.9	32.8
117	HI 1625	35.0	22.0	66.3	26.5	66.3	37.4
118	UAS 428 (d) (C)	45.0	15.0	0.0	0.0	45.0	15.0
119	PBW 770	35.0	0.0	19.7	10.0	35.0	16.2
120	GW 492	12.5	40.4	18.0	11.1	40.4	20.5
120A	Sonalika(C)	90.0	44.3	45.5	24.4	90.0	51.0
121	GW 1346 (d)	46.6	0.0	0.0	0.0	46.6	11.7
122	HI 1605 (C)	68.3	18.0	53.7	16.0	68.3	39.0
123	AKDW 2997-16 (d)(C)	6.7	0.0	2.4	5.6	6.7	3.7
124	MPO 1336 (d)	8.1	2.5	21.7	0.0	21.7	8.1
125	UAS 446 (d) (c)	8.5	1.0	3.1	0.0	8.5	3.1
126	HI 8805 (d)	6.3	0.0	0.0	0.0	6.3	1.6
127	MACS 4058 (d)	5.0	0.0	0.0	0.0	5.0	1.3
128	MACS 6696	95.0	6.8	28.2	21.4	95.0	37.8
129	MACS 4059 (d)	6.7	0.0	0.0	0.0	6.7	1.7
130	NIAW 3170	28.6	7.3	49.4	29.5	49.4	28.7
131	DBW 93 (c)	34.3	9.5	31.3	17.7	34.3	23.2
132	MACS 6695	31.1	7.0	55.6	13.1	55.6	26.7
133	HI 8802 (d)	NG	9.1	1.7	0.0	9.1	3.6
VI. Special Trial (Dicoccum)							
134	DDK 1029 (C)	8.3	0.0	0.0	0.0	8.3	2.1
135	MACS 6222 (Ae.) (C)	5.0	4.9	50.0	0.0	50.0	15.0
136	MACS 5051	4.7	0.0	0.0	0.0	4.7	1.2
137	HW 4101	5.0	0.0	0.0	1.1	5.0	1.5
138	DDK 1054	5.0	0.0	0.0	0.0	5.0	1.3
139	HW 1098 (C)	NG	0.0	0.0	0.0	0.0	0.0
VII. Special Trial- Very Late Sown							
140	WR 544 (C)	62.5	9.3	19.1	18.6	62.5	27.4
140A	Sonalika(C)	83.3	40.7	76.1	27.3	83.3	56.9
141	HD 3271	12.5	52.2	65.7	38.9	65.7	42.3
142	DBW 71 (C)	14.6	22.9	37.8	32.3	37.8	26.9
143	PBW 797	35.0	5.2	40.6	0.0	40.6	20.2
144	PBW 757*	24.3	13.3	51.9	23.5	51.9	28.3
145	DBW 278	35.0	7.0	25.9	23.5	35.0	22.9
146	HI 1621	12.5	1.9	8.9	12.6	12.6	9.0
147	DBW 14 (C)	15.0	7.8	33.8	0.0	33.8	14.1
148	PBW 777	36.6	33.0	75.9	32.4	75.9	44.5
149	HD 3298	24.3	6.3	29.4	21.9	29.4	20.5

COOPERATORS:

NAME	**CENTRE**
RITU BALA	LUDHIANA
K .K. MISHRA	ALMORA
R.S. BENIWAL	HISAR
P.S. SHEKHAWAT AND NITIN CHAWLA	DURGAPURA
SUDHEER KUMAR, P.L. KASHYAP AND D.P. SINGH	KARNAL (COORDINATING UNIT)

PROGRAMME 6. POWDERY MILDEW

6.1: POWDERY MILDEW SCREENING NURSERY (PMSN)

Powdery mildew caused by *Blumeria graminis* (DC.) Speer f. sp. *tritici* is emerging as an important disease of wheat in NWPZ and NHZ during cool years and may cause heavy losses in susceptible varieties. Keeping in view the importance of powdery mildew, during 2018-19 crop season, 165 entries of AVTs and promising entries were screened against powdery mildew at hot spot locations in NHZ and NWPZ. The data of six locations, viz., Almora, Dhaulakuan, Shimla, Pantnagar, Jammu and Malan were taken into consideration. The data from Bajaura was not considered due to very less disease intensity. 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. The disease scores of AVT entries along with check varieties have been presented in Table 6.1. The entries found promising against powdery mildew are:

AVTs 2018-19

Resistant Entries (Av. score 0-3, highest score upto 5)**:**

DBW 257, DBW187 , DBW187(I) (C), DBW301, DBW302, DBW303, DBW304, DBW39 (C), DBW71 (C), DDK1029 (C), DDK1056, DDK1057, DDW 47(d)*[Q], DDW 49 (d), HD 3277, HD 3293, HD2932 (C), HD2932 (C), HD3086 (C), HD3086 (C), HD3226(I) (C), HD3271, HD3298, HD3347, HI1612 (C), HI1621, HI1634, HI8807 (d), HPW 451, HS 660, HS 662, HS507 (C), HS674, HW1098 (C), K 1601, KRL19 (C), KRL210 (C), MACS6222 (C), MACS6478 (C), NW 7060, PBW 766, PBW 781, PBW 796, PBW 797, PBW757 (C), RAJ 4529, Raj4083 (C), UAS3002, UP3042 , UP3043, VL 1014, VL3021, WH 1228, WH1105 (C), WH1223, WH1254 and WH1270

Table 6.1 Powdery Mildew Screening Nursery, 2018-19

S. No.	Entry	Powdery mildew Score (0-9)							
		Pantnagar	Malan	Dhaulakuan	Almora	Shimla	Jammu	HS	AV
I. Northern Hill Zone									
1	HPW349 (C)	0	3	1	1	5	9	9	3
2	VL907 (C)	0	4	1	1	5	7	7	3
3	HS507 (C)	0	2	1	1	5	4	5	2
4	HS652	4	3	1	1	7	3	7	3
5	HS562 (C)	0	3	1	3	7	4	7	3
6	VL892 (C)	0	3	0	1	5	7	7	3
7	HS490 (C)	0	1	0	1	7	7	7	3
8	HPW468	0	1	0	1	5	7	7	2
9	HS673	0	2	0	1	7	4	7	2
10	VL3020	0	1	0	1	5	6	6	2
11	UP3041	0	2	0	3	7	3	7	3
12	HPW467	6	2	0	1	9	6	9	4
13	HS674	0	3	0	1	3	3	3	2
14	VL3019	4	2	1	3	7	5	7	4
15	VL3021	5	1	0	1	3	5	5	3
II. North Western Plain Zone									
16	WH1105 (C)	0	2	0	1	5	3	5	2
17	HD3226(I) (C)	1	2	0	1	5	4	5	2
18	HD3086 (C)	0	2	0	1	5	5	5	2
19	PBW820[M]	5	3	1	0	7	5	7	4
20	DBW 221*	0	4	6	3	7	5	7	4

20A	PBW 343 (Check)	6	4	4	1	7	9	9	5
21	DBW 222*	5	3	0	1	7	7	7	4
22	PBW550 (C)	0	3	0	1	7	7	7	3
23	PBW821[M]	0	4	0	3	9	5	9	4
24	HD2967 (C)	0	2	0	1	7	5	7	3
25	NW 7049	1	2	0	0	7	7	7	3
26	DPW621-50 (C)	0	2	1	1	9	9	9	4
27	DBW88 (C)	3	3	1	1	9	9	9	4
28	PBW752(I) (C)	0	4	6	3	9	3	9	4
29	DBW173 (C)	0	3	0	1	9	4	9	3
30	WH1021 (C)	0	3	1	1	7	5	7	3
31	HD3059 (C)	1	2	0	0	9	7	9	3
32	WH1124 (C)	0	2	1	1	7	4	7	3
33	PBW 771*	4	4	0	1	9	4	9	4
34	HI1620(I) (C)	0	3	1	3	7	7	7	4
35	PBW 796	0	3	0	0	5	5	5	2
36	HI 1628*	0	2	0	1	7	5	7	3
37	WH1142 (C)	0	4	0	0	7	5	7	3
38	HD3043 (C)	0	3	2	1	5	9	9	3
39	PBW644 (C)	0	3	1	3	7	9	9	4
40	HD3237(I) (C)	0	3	6	1	7	4	7	4
40A	PBW 343 (Check)	5	4	6	3	9	9	9	6
41	BRW 3806*[#]	0	3	0	1	7	3	7	2
42	NIAW 3170*	0	2	0	0	7	5	7	2
43	WH1080 (C)	0	2	0	1	7	3	7	2
III. North Eastern Plain Zone									
44	HD3249*[#Q]	0	2	0	3	9	4	9	3
45	HD2733 (C)	0	2	5	5	9	5	9	4
46	PBW 781	0	3	1	3	5	3	5	3
47	DBW 257	0	3	0	3	5	5	5	3
48	DBW39 (C)	0	3	2	5	3	2	5	3
49	HD 3277	0	2	0	1	3	3	3	2
50	RAJ 4529	0	2	0	3	5	4	5	2
51	DBW187(I) (C)	0	2	0	1	5	5	5	2
52	WH 1239	0	2	2	1	7	3	7	3
53	K0307 (C)	0	3	2	1	5	7	7	3
54	HD2967 (C)	0	3	6	1	7	5	7	4
55	K1317 (C)	0	3	4	1	7	5	7	3
56	HI1612 (C)	0	2	0	3	5	2	5	2
57	HD 3293	0	2	1	1	5	2	5	2
58	HD3171 (C)	0	3	1	1	7	7	7	3
59	HD2888 (C)	5	4	4	3	7	5	7	5
60	DBW 252*[#]	0	2	2	1	5	7	7	3
60A	PBW 343 (Check)	3	4	6	3	7	9	9	5
61	K8027 (C)	0	4	2	1	9	5	9	4
62	DBW 273	0	3	6	3	5	5	6	4
IV. Central Zone									
63	HI8713(d) (C)	2	2	5	3	9	4	9	4
64	NIDW 1158 (d)	0	2	6	1	7	3	7	3
65	HI 8811 (d)	0	3	5	5	9	2	9	4
66	HD3343[M]	9	3	4	3	5	7	9	5
67	GW322 (C)	9	3	4	3	5	5	9	5
68	HI1544 (C)	9	4	1	5	7	5	9	5

69	HI8737(d) (C)	4	4	5	3	9	5	9	5
70	HI 8812 (d)	5	3	6	1	9	5	9	5
71	GW 1348 (d)	5	2	4	3	7	5	7	4
72	DDW 49 (d)	4	2	4	3	9	7	9	5
73	PBW 822[B]	3	2	4	5	7	4	7	4
74	HD 3345[B]	0	2	1	0	7	5	7	3
75	DDW 48 (d)	0	2	4	1	7	3	7	3
76	HI8627(d) (C)	0	1	2	3	7	5	7	3
77	DBW110 (C)	0	2	0	3	7	7	7	3
78	UAS 466(d)*	0	3	6	5	7	5	7	4
79	MP3288 (C)	0	4	1	5	7	5	7	4
80	DBW 277	0	2	2	5	5	7	7	4
80A	PBW 343 (Check)	1	4	6	5	7	9	9	5
81	DDW 47(d)*[Q]	0	3	1	1	3	3	3	2
82	HD2932 (C)	0	4	1	3	5	5	5	3
83	HD2864 (C)	4	3	1	7	7	3	7	4
84	MP3336 (C)	7	4	2	5	7	5	7	5
85	MP4010 (C)	5	4	4	0	7	7	7	5
86	CG1029	7	4	2	5	9	5	9	5
87	UAS3002	0	3	2	5	5	5	5	3
88	HI1633	0	2	1	5	5	7	7	3
89	HI1634	0	3	2	5	5	5	5	3
90	HI8808 (d)	4	3	2	3	5	5	5	4
91	HI8807 (d)	0	1	5	1	5	5	5	3
V. Peninsular Zone									
92	PBW 823[B]	4	3	6	1	5	3	6	4
93	UAS428 (d) (C)	0	2	6	1	3	4	6	3
94	DDW 49 (d)	0	1	1	5	5	5	5	3
95	UAS 3001	2	1	4	5	3	7	7	4
96	MACS3949 (d) (C)	4	2	2	3	7	5	7	4
97	MACS6222 (C)	2	2	1	5	5	5	5	3
98	GW 322 (C)	3	1	1	3	7	5	7	3
99	DDW 48 (d)	0	1	1	5	9	5	9	4
100	MACS6478 (C)	0	3	1	3	5	5	5	3
100A	PBW 343 (Check)	4	3	6	5	7	9	9	6
101	HD3343[M]	0	3	1	5	7	7	7	4
102	WHD 963 (d)	0	1	1	5	7	5	7	3
103	HI8807(d)	1	1	4	5	9	3	9	4
104	HI1633	0	2	1	1	7	5	7	3
105	UAS 3002	0	3	2	1	5	7	7	3
106	Raj4083 (C)	0	3	1	1	5	5	5	3
107	HD2932 (C)	0	2	1	3	5	5	5	3
108	GW509	7	1	1	1	3	7	7	3
109	HD3090 (C)	0	3	0	3	5	9	9	3
110	NIAW 3170*	0	1	0	1	5	7	7	2
111	GW 1346(d)*	5	4	0	7	7	6	7	5
112	MACS 4058(d)*	0	4	0	0	7	3	7	2
113	DBW93 (C)	0	2	1	3	5	7	7	3
114	HI 8805(d)*	0	2	1	3	7	7	7	3
115	AKDW2997-16(d) (C)	9	3	2	1	5	7	9	5
116	MACS 6695*	0	2	1	5	5	7	7	3
117	UAS446(d) (C)	3	2	1	3	7	4	7	3
118	HI1605 (C)	0	2	1	1	7	7	7	3

119	MACS 6696*	0	3	1	1	7	3	7	3
120	NIDW 1149(d)	0	3	2	3	7	3	7	3
120A	PBW 343 (Check)	4	3	6	5	7	9	9	6
121	HI 8802(d)*	0	1	0	1	7	7	7	3
VI. Special Trial (Dicoccum)									
122	DDK1029 (C)	0	1	0	3	1	5	5	2
123	MACS5052	0	2	0	1	7	5	7	3
124	MACS6222 (aest.) (C)	0	2	0	1	7	4	7	2
125	DDK1056	0	2	0	3	3	3	3	2
126	HW1098 (C)	0	2	0	3	3	2	3	2
127	MACS5053	0	2	0	3	7	5	7	3
128	DDK1057	0	1	0	5	0	3	5	2
VII. Special Trial- SPL-HYPT									
129	HD3317	0	2	0	3	7	3	7	3
130	WH1254	0	2	0	5	5	3	5	3
131	DBW301	0	1	1	3	3	1	3	2
132	WH1270	0	1	0	1	5	3	5	2
133	HD2967 (C)	0	2	0	3	7	6	7	3
134	PBW824	0	3	0	1	7	5	7	3
135	UP3043	0	2	0	3	5	3	5	2
136	DBW187	0	2	0	1	5	1	5	2
137	HD3086 (C)	0	2	0	1	5	2	5	2
138	DBW303	0	1	0	3	3	4	4	2
139	DBW304	0	1	0	1	5	5	5	2
140	UP3042	0	1	0	1	3	4	4	2
140A	PBW 343 (Check)	4	4	6	1	7	7	7	5
141	DBW302	0	2	0	1	5	4	5	2
142	PBW825	0	1	0	5	7	4	7	3
143	HD3347	0	2	0	1	3	3	3	2
VIII. Special Trial (SPL-AST)									
144	WH1223	0	2	0	1	3	5	5	2
145	KRL19 (C)	3	2	0	3	3	5	5	3
146	Kharchia65 (C)	1	3	0	3	7	6	7	3
147	NW 7060	0	1	0	3	5	2	5	2
148	KRL210 (C)	0	2	0	3	5	2	5	2
149	WH 1228	0	2	0	3	3	2	3	2
150	NW 7062	0	2	2	3	5	6	6	3
IX. Special Trial (SPL-VLS)									
151	PBW757 (C)	0	2	2	3	5	5	5	3
152	WR544 (C)	1	2	0	5	5	7	7	3
153	HD3298	0	2	0	3	5	5	5	3
154	HD3271	0	1	2	1	3	5	5	2
155	DBW14 (C)	0	1	5	1	5	6	6	3
156	DBW71 (C)	0	2	4	3	5	5	5	3
157	HI1621	0	1	0	1	5	5	5	2
158	PBW 797	0	2	2	1	5	2	5	2
Resistant Entries (AVT-2017-18 Av. Score 0-3, Highest Score up to 5)									
159	HPW 451	0	2	4	1	5	4	5	3
160	VL 1014	0	1	0	1	3	3	3	1
160A	PBW 343 (Check)	4	3	6	3	5	9	9	5
161	HS 662	0	2	0	1	5	3	5	2
162	HS 660	0	2	0	3	5	2	5	2

163	PBW 766	0	1	0	1	5	5	5	2
164	K 1601	0	2	0	1	5	4	5	2
165	MPO 1343 (d)	0	1	6	1	5	2	6	3

COOPERATORS:

NAME	**CENTRE**
K. K. MISHRA	ALMORA
S.C. BHARDWAJ, O.P.GANGWAR, PARMOD PARSAD	SHIMLA
AKHILESH SINGH	DHAULAKUAN
SACHIN	MALAN
DEEPSHIKHA, K SRIVASTAVA	PANTNAGAR
RAKESH DEVLASH	BAJAURA
SUDHEER KUMAR, PL KASHYAPAND D.P. SINGH	IIWBR, KARNAL (COORDINATING UNIT)

PROGRAMME 7. REGION SPECIFIC DISEASES OF LIMITED IMPORTANCE

7.1 FUSARIUM HEAD BLIGHT (FHB) OR HEAD SCAB

AVT entries along with checks were evaluated under artificially inoculated conditions at Gurdaspur, Delhi and Dhaulakuan. Disease scoring scale (0-5) has been used. A total 158 entries were evaluated and entry-wise reaction of AVTs entries (2018-2019) has been given in Tables 7.1. On the basis of highest score, none of the genotype was found resistant or moderately resistant. However on the basis of average score the follow found moderately resistant (average score 2).

BRW 3806*#, DBW 221*, DBW 222*, DBW 277, DBW187, DBW88 (C), DDK1057, DPW621-50 (C), HD 3277, HD 3293, HD2733 (C), HD3043 (C), HD3059 (C), HI 8805(d)*, HI1612 (C), HI1620(I) (C), HS652, HW1098 (C), K0307 (C), MACS6222 (C), PBW644 (C), PBW752(I) (C), PBW825, Raj4083 (C), UP3043, VL907 (C), WH 1239 and WH1142 (C)

Table7.1. Performance of AVTs material against head scab (% incidence) under multilocational testing during 2018-19

S. No.	Entries	Disease score (0-5)				
		Delhi	Dhaulakuan	Gurdaspur	HS	AV
I. Northern Hill Zone						
1	HPW349 (C)	4	4	0	4	3
2	VL907 (C)	3	4	0	4	2
3	HS507 (C)	4	4	0	4	3
4	HS652	3	4	0	4	2
5	HS562 (C)	3	5	0	5	3
6	VL892 (C)	5	7	2	7	5
7	HS490 (C)	5	4	2	5	4
8	HPW468	5	4	2	5	4
9	HS673	4	4	0	4	3
10	VL3020	4	4	0	4	3
11	UP3041	4	4	0	4	3
12	HPW467	3	4	1	4	3
13	HS674	3	5	1	5	3
14	VL3019	3	4	1	4	3
15	VL3021	4	4	NG	4	4
II. North Western Plain Zone						
16	WH1105 (C)	4	4	0	4	3
17	HD3226(I) (C)	3	4	2	4	3
18	HD3086 (C)	3	5	1	5	3
19	PBW820^{M}	3	4	1	4	3
20	DBW 221*	3	4	0	4	2
20A	Infector	4	4	3	4	4
21	DBW 222*	3	4	0	4	2
22	PBW550 (C)	3	5	0	5	3
23	PBW821^{M}	3	4	2	4	3
24	HD2967 (C)	3	4	2	4	3
25	NW 7049	3	4	2	4	3
26	DPW621-50 (C)	3	4	0	4	2
27	DBW88 (C)	3	4	0	4	2
28	PBW752(I) (C)	3	4	0	4	2
29	DBW173 (C)	4	4	0	4	3

30	WH1021 (C)	3	5	0	5	3
31	HD3059 (C)	3	4	0	4	2
32	WH1124 (C)	3	4	2	4	3
33	PBW 771*	3	4	2	4	3
34	HI1620(I) (C)	3	4	0	4	2
35	PBW 796	4	4	0	4	3
36	HI 1628*	3	5	1	5	3
37	WH1142 (C)	3	4	0	4	2
38	HD3043 (C)	1	4	0	4	2
39	PBW644 (C)	2	4	0	4	2
40	HD3237(I) (C)	5	4	0	5	3
40A	Infector	5	4	3	5	4
41	BRW 3806*[#]		4	0	4	2
42	NIAW 3170*	3	4	2	4	3
43	WH1080 (C)	3	4	1	4	3
III. North Eastern Plain Zone						
44	HD3249*[#Q]	4	4	2	4	3
45	HD2733 (C)	3	4	0	4	2
46	PBW 781	3	4	3	4	3
47	DBW 257	4	4	0	4	3
48	DBW39 (C)	3	5	1	5	3
49	HD 3277	3	4	0	4	2
50	RAJ 4529	3	4	2	4	3
51	DBW187(I) (C)	3	4	2	4	3
52	WH 1239	3	4	0	4	2
53	K0307 (C)	3	4	0	4	2
54	HD2967 (C)	4	4	2	4	3
55	K1317 (C)	4	4	3	4	4
56	HI1612 (C)	3	4	0	4	2
57	HD 3293	3	4	0	4	2
58	HD3171 (C)	4	4	1	4	3
59	HD2888 (C)	3	5	3	5	4
60	DBW 252*[#]	3	4	1	4	3
60A	Infector	5	4	3	5	4
61	K8027 (C)	4	4	2	4	3
62	DBW 273	4	4	3	4	4
IV. Central Zone						
63	HI8713(d) (C)	5	4	3	5	4
64	NIDW 1158 (d)	3	4	3	4	3
65	HI 8811 (d)	4	4	3	4	4
66	HD3343[M]	3	5	3	5	4
67	GW322 (C)	3	5	0	5	3
68	HI1544 (C)	3	5	0	5	3
69	HI8737(d) (C)	NG	4	2	4	3
70	HI 8812 (d)	3	4	3	4	3
71	GW 1348 (d)	5	4	3	5	4
72	DDW 49 (d)	3	4	2	4	3
73	PBW 822[B]	3	5	2	5	3
74	HD 3345[B]	3	5	4	5	4
75	DDW 48 (d)	4	4	1	4	3
76	HI8627(d) (C)	5	5	2	5	4
77	DBW110 (C)	5	5	2	5	4
78	UAS 466(d)*	5	5	3	5	4

79	MP3288 (C)	4	5	1	5	3
80	DBW 277	3	4	0	4	2
80A	Infector	4	5	3	5	4
81	DDW 47(d)*[Q]	4	4	3	4	4
82	HD2932 (C)	4	4	1	4	3
83	HD2864 (C)	5	5	0	5	3
84	MP3336 (C)	4	5	0	5	3
85	MP4010 (C)	3	5	0	5	3
86	CG1029	3	5	0	5	3
87	UAS3002	4	5	0	5	3
88	HI1633	3	5	1	5	3
89	HI1634	4	5	NG	5	5
90	HI8808 (d)	4	4	2	4	3
91	HI8807 (d)	4	4	2	4	3
V. Peninsular Zone						
92	PBW 823[B]	4	4	3	4	4
93	UAS428 (d) (C)	4	4	2	4	3
94	DDW 49 (d)	4	4	2	4	3
95	UAS 3001	3	4	3	4	3
96	MACS3949 (d) (C)	4	4	2	4	3
97	MACS6222 (C)	3	4	0	4	2
98	GW 322 (C)	3	4	2	4	3
99	DDW 48 (d)	5	3	2	5	3
100	MACS6478 (C)	5	4	0	5	3
100A	Infector	5	4	3	5	4
101	HD3343[M]	5	5	1	5	4
102	WHD 963 (d)	5	4	3	5	4
103	HI8807(d)	4	4	2	4	3
104	HI1633	4	5	0	5	3
105	UAS 3002	3	5	1	5	3
106	Raj4083 (C)	1	5	0	5	2
107	HD2932 (C)	5	4	0	5	3
108	GW509	4	4	0	4	3
109	HD3090 (C)	3	5	0	5	3
110	NIAW 3170*	4	4	0	4	3
111	GW 1346(d)*	4	5	0	5	3
112	MACS 4058(d)*	4	4	0	4	3
113	DBW93 (C)	3	4	1	4	3
114	HI 8805(d)*	1	4	1	4	2
115	AKDW2997-16(d) (C)	5	4	1	5	3
116	MACS 6695*	4	4	0	4	3
117	UAS446(d) (C)	4	4	0	4	3
118	HI1605 (C)	3	5	0	5	3
119	MACS 6696*	5	5	1	5	4
120	NIDW 1149(d)	4	4	3	4	4
120A	Infector	4	4	3	4	4
121	HI 8802(d)*	4	5	1	5	3
VI. Special Trial (Dicoccum)						
122	DDK1029 (C)	5	4	1	5	3
123	MACS5052	5	4	0	5	3
124	MACS6222 (aest.) (C)	5	5	0	5	3
125	DDK1056	5	4	0	5	3

126	HW1098 (C)	3	4	0	4	2
127	MACS5053	3	5	2	5	3
128	DDK1057	2	4	0	4	2
VII. Special Trial- SPL-HYPT						
129	HD3317	3	4	2	4	3
130	WH1254	4	4	2	4	3
131	DBW301	4	4	0	4	3
132	WH1270	5	4	0	5	3
133	HD2967 (C)	4	4	0	4	3
134	PBW824	4	4	0	4	3
135	UP3043	3	4	0	4	2
136	DBW187	3	4	0	4	2
137	HD3086 (C)	4	4	0	4	3
138	DBW303	3	4	1	4	3
139	DBW304	4	4	1	4	3
140	UP3042	3	5	0	5	3
140A	Infector	5	4	3	5	4
141	DBW302	3	5	2	5	3
142	PBW825	3	4	0	4	2
143	HD3347	4	4	3	4	4
VIII. Special Trial (SPL-AST)						
144	WH1223	4	4	2	4	3
145	KRL19 (C)	3	5	0	5	3
146	Kharchia65 (C)	3	4	3	4	3
147	NW 7060	3	5	0	5	3
148	KRL210 (C)	4	5	3	5	4
149	WH 1228	4	5	0	5	3
150	NW 7062	3	5	0	5	3
IX. Special Trial (SPL-VLS)						
151	PBW757 (C)	5	5	0	5	3
152	WR544 (C)	5	5	3	5	4
153	HD3298	3	4	3	4	3
154	HD3271	3	5	3	5	4
155	DBW14 (C)	4	5	3	5	4
156	DBW71 (C)	3	5	3	5	4
157	HI1621	5	4	1	5	3
158	PBW 797	3	4	3	4	3
158A	Infector	5	4	3	5	4

COOPERATORS

NAME	**CENTRE**
AKHILESH SINGH	DHAULAKUAN
M.S. SAHARAN	DELHI
JASPAL KAUR	GURDASPUR
SUDHEER KUMAR, P.L. KASHYAP AND D.P. SINGH	KARNAL (COORDINATING UNIT)

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

Test Locations: Hisar, Ludhiana, Karnal and Durgapura

Flag smut is soil and externally seed bone disease caused by *Urocyctis agropyri.* The spores of the pathogen can survive for longer period in the soil. Disease development was low at all the centers. A total 158 entries were screened and entry-wise reaction of AVTs (2018-19) has been given in Tables 7.2. Data for 2nd year entries has also been given in Table 1.5. The entry DBW110 (C) found free at all the locations. The detail is given below:

Table 7.2. Performance of AVTs entres against flag smut (% incidence) under multilocational testing during 2018-19

S. No.	Entry	Flag smut incidence (%)					
		Ludhiana	Karnal	Hisar	Durgapura	HS	AV
I. Northern Hill Zone							
1	HPW349 (C)	0.0	0.0	6.8	0.0	6.8	1.7
2	VL907 (C)	2.1	1.0	7.5	0.0	7.5	2.7
3	HS507 (C)	0.0	0.0	8.3	0.0	8.3	2.1
4	HS652	2.9	0.0	9.3	5.3	9.3	4.4
5	HS562 (C)	0.0	0.6	11.1	0.0	11.1	2.9
6	VL892 (C)	4.4	0.0	10.5	6.1	10.5	5.3
7	HS490 (C)	0.0	1.0	9.6	0.0	9.6	2.6
8	HPW468	0.0	0.0	8.3	0.0	8.3	2.1
9	HS673	9.3	1.1	9.3	13.6	13.6	8.3
10	VL3020	1.9	1.1	6.8	0.0	6.8	2.4
11	UP3041	4.1	0.5	10.3	6.8	10.3	5.4
12	HPW467	0.0	0.0	9.6	0.0	9.6	2.4
13	HS674	0.0	0.0	8.6	0.0	8.6	2.2
14	VL3019	0.0	4.6	7.5	0.0	7.5	3.0
15	VL3021	0.0	1.9	8.1	0.0	8.1	2.5
II. North Western Plain Zone							
16	WH1105 (C)	0.0	0.0	9.3	0.0	9.3	2.3
17	HD3226(I) (C)	0.0	1.6	8.1	0.0	8.1	2.4
18	HD3086 (C)	0.0	1.2	7.8	0.0	7.8	2.2
19	PBW820^{M}	0.0	0.6	6.6	0.0	6.6	1.8
20	DBW 221*	5.5	0.9	8.3	0.0	8.3	3.7
20A	PBW 343 (Check)	23.3	18.5	18.3	30.8	30.8	22.7
21	DBW 222*	2.5	1.1	6.3	0.0	6.3	2.5
22	PBW550 (C)	4.0	0.5	6.1	4.8	6.1	3.8
23	PBW821^{M}	0.0	2.3	7.5	0.0	7.5	2.5
24	HD2967 (C)	0.0	2.8	7.1	0.0	7.1	2.5
25	NW 7049	0.0	4.3	5.6	0.0	5.6	2.5
26	DPW621-50 (C)	0.0	0.0	8.5	0.0	8.5	2.1
27	DBW88 (C)	0.0	1.2	8.3	0.0	8.3	2.4
28	PBW752(I) (C)	3.9	0.0	6.1	3.3	6.1	3.3
29	DBW173 (C)	0.0	1.4	5.7	0.0	5.7	1.8
30	WH1021 (C)	2.5	0.0	6.3	2.9	6.3	2.9
31	HD3059 (C)	0.0	0.6	6.6	0.0	6.6	1.8
32	WH1124 (C)	0.0	1.9	7.3	0.0	7.3	2.3
33	PBW 771*	4.0	0.0	9.1	6.5	9.1	4.9
34	HI1620(I) (C)	0.0	0.0	10.2	0.0	10.2	2.6

35	PBW 796	0.0	0.5	6.5	0.0	6.5	1.8
36	HI 1628*	0.0	0.5	9.8	0.0	9.8	2.6
37	WH1142 (C)	2.4	0.0	11.3	5.3	11.3	4.7
38	HD3043 (C)	0.0	2.8	5.6	0.0	5.6	2.1
39	PBW644 (C)	3.0	0.0	6.3	4.8	6.3	3.5
40	HD3237(I) (C)	0.0	1.0	7.5	0.0	7.5	2.1
40A	PBW 343 (Check)	16.7	28.8	18.6	41.0	41.0	26.3
41	BRW 3806*[#]	0.0	2.3	5.6	0.0	5.6	2.0
42	NIAW 3170*	0.0	0.0	6.4	0.0	6.4	1.6
43	WH1080 (C)	0.0	0.0	7.8	0.0	7.8	2.0
III. North Eastern Plain Zone							
44	HD3249*[#Q]	2.5	0.5	4.3	0.0	4.3	1.8
45	HD2733 (C)	0.0	0.0	5.7	0.0	5.7	1.4
46	PBW 781	2.8	1.7	7.8	6.1	7.8	4.6
47	DBW 257	0.0	1.0	6.1	0.0	6.1	1.8
48	DBW39 (C)	3.5	0.8	8.3	4.0	8.3	4.2
49	HD 3277	0.0	0.9	9.1	0.0	9.1	2.5
50	RAJ 4529	0.0	0.0	4.5	0.0	4.5	1.1
51	DBW187(I) (C)	0.0	0.0	5.9	0.0	5.9	1.5
52	WH 1239	0.0	0.5	3.9	0.0	3.9	1.1
53	K0307 (C)	1.5	0.0	4.1	0.0	4.1	1.4
54	HD2967 (C)	4.6	1.1	2.8	6.0	6.0	3.6
55	K1317 (C)	0.0	1.6	3.5	0.0	3.5	1.3
56	HI1612 (C)	5.3	0.0	9.5	9.5	9.5	6.1
57	HD 3293	6.8	2.2	2.6	8.1	8.1	4.9
58	HD3171 (C)	2.4	1.6	6.4	3.3	6.4	3.5
59	HD2888 (C)	1.4	0.0	5.3	7.3	7.3	3.5
60	DBW 252*[#]	6.3	7.7	4.6	11.1	11.1	7.4
60A	PBW 343 (Check)	14.3	24.1	17.3	28.1	28.1	20.9
61	K8027 (C)	6.4	6.3	7.1	7.4	7.4	6.8
62	DBW 273	0.0	2.6	8.9	0.0	8.9	2.9
IV. Central Zone							
63	HI8713(d) (C)	0.0	2.3	9.6	0.0	9.6	3.0
64	NIDW 1158 (d)	0.0	2.9	5.3	0.0	5.3	2.1
65	HI 8811 (d)	0.0	4.2	0.0	0.0	4.2	1.1
66	HD3343[M]	4.2	1.4	0.0	7.5	7.5	3.3
67	GW322 (C)	1.8	0.6	6.2	2.0	6.2	2.6
68	HI1544 (C)	7.1	0.6	7.9	29.9	29.9	11.4
69	HI8737(d) (C)	0.0	0.0	8.5	0.0	8.5	2.1
70	HI 8812 (d)	0.0	4.9	0.0	0.0	4.9	1.2
71	GW 1348 (d)	5.0	0.0	0.0	5.5	5.5	2.6
72	DDW 49 (d)	0.0	1.6	0.0	0.0	1.6	0.4
73	PBW 822[B]	0.0	0.5	0.0	0.0	0.5	0.1
74	HD 3345[B]	0.0	3.9	5.6	0.0	5.6	2.4
75	DDW 48 (d)	0.0	2.7	6.1	0.0	6.1	2.2
76	HI8627(d) (C)	0.0	1.1	0.0	0.0	1.1	0.3
77	DBW110 (C)	0.0	0.0	0.0	0.0	0.0	0.0
78	UAS 466(d)*	0.0	2.9	5.6	0.0	5.6	2.1
79	MP3288 (C)	3.6	0.6	0.0	4.6	4.6	2.2
80	DBW 277	0.0	0.5	4.3	0.0	4.3	1.2

80A	PBW 343 (Check)	11.1	19.7	16.6	25.0	25.0	18.1
81	DDW 47(d)*[Q]	0.0	0.5	8.3	0.0	8.3	2.2
82	HD2932 (C)	3.4	0.0	0.0	4.8	4.8	2.1
83	HD2864 (C)	0.0	1.3	7.1	0.0	7.1	2.1
84	MP3336 (C)	0.0	1.6	6.6	0.0	6.6	2.0
85	MP4010 (C)	0.0	1.6	5.3	0.0	5.3	1.7
86	CG1029	5.3	1.4	6.7	26.1	26.1	9.9
87	UAS3002	0.0	0.0	9.3	0.0	9.3	2.3
88	HI1633	0.0	0.0	8.6	0.0	8.6	2.2
89	HI1634	0.0	3.3	7.5	0.0	7.5	2.7
90	HI8808 (d)	0.0	2.6	6.3	0.0	6.3	2.2
91	HI8807 (d)	0.0	1.9	0.0	0.0	1.9	0.5
V. Peninsular Zone							
92	PBW 823[B]	0.0	1.0	0.0	0.0	1.0	0.2
93	UAS428 (d) (C)	0.0	2.6	7.1	0.0	7.1	2.4
94	DDW 49 (d)	0.0	1.5	0.0	0.0	1.5	0.4
95	UAS 3001	0.0	2.7	0.0	0.0	2.7	0.7
96	MACS3949 (d) (C)	0.0	4.3	5.3	0.0	5.3	2.4
97	MACS6222 (C)	2.4	0.5	0.0	4.8	4.8	1.9
98	GW 322 (C)	2.5	1.9	5.6	5.0	5.6	3.7
99	DDW 48 (d)	0.0	5.0	0.0	0.0	5.0	1.3
100	MACS6478 (C)	1.4	1.2	0.0	4.3	4.3	1.7
100A	PBW 343 (Check)	10.4	25.9	17.3	34.0	34.0	21.9
101	HD3343[M]	1.6	2.9	4.5	4.5	4.5	3.4
102	WHD 963 (d)	0.0	0.5	0.0	0.0	0.5	0.1
103	HI8807(d)	0.0	2.1	0.0	0.0	2.1	0.5
104	HI1633	1.9	0.0	3.5	0.0	3.5	1.3
105	UAS 3002	0.0	0.6	6.9	0.0	6.9	1.9
106	Raj4083 (C)	0.0	0.0	7.6	0.0	7.6	1.9
107	HD2932 (C)	13.6	0.6	8.3	13.6	13.6	9.0
108	GW509	2.3	0.0	9.1	2.3	9.1	3.4
109	HD3090 (C)	14.3	7.0	8.3	14.3	14.3	11.0
110	NIAW 3170*	0.0	0.0	8.7	0.0	8.7	2.2
111	GW 1346(d)*	0.0	3.4	0.0	0.0	3.4	0.9
112	MACS 4058(d)*	0.0	1.1	0.0	0.0	1.1	0.3
113	DBW93 (C)	8.3	3.5	8.6	13.9	13.9	8.6
114	HI 8805(d)*	0.0	0.5	0.0	0.0	0.5	0.1
115	AKDW2997-16(d) (C)	0.0	1.5	0.0	0.0	1.5	0.4
116	MACS 6695*	0.0	0.5	1.3	0.0	1.3	0.4
117	UAS446(d) (C)	0.0	3.1	0.0	0.0	3.1	0.8
118	HI1605 (C)	0.0	1.7	8.3	0.0	8.3	2.5
119	MACS 6696*	0.0	4.9	7.3	0.0	7.3	3.1
120	NIDW 1149(d)	0.0	4.1	0.0	0.0	4.1	1.0
120A	PBW 343 (Check)	12.8	23.8	18.6	30.5	30.5	21.4
121	HI 8802(d)*	0.0	3.5	2.5	0.0	3.5	1.5
VI. Special Trial (Dicoccum)							
122	DDK1029 (C)	0.0	2.8	0.0	0.0	2.8	0.7
123	MACS5052	0.0	0.8	4.6	0.0	4.6	1.4
124	MACS6222 (aest.) (C)	0.0	0.5	4.2	0.0	4.2	1.2
125	DDK1056	0.0	1.3	8.3	0.0	8.3	2.4

126	HW1098 (C)	0.0	0.0	3.7	0.0	3.7	0.9
127	MACS5053	0.0	2.2	3.6	0.0	3.6	1.4
128	DDK1057	0.0	2.7	4.2	0.0	4.2	1.7
VII. Special Trial- SPL-HYPT							
129	HD3317	2.7	1.2	7.5	3.6	7.5	3.8
130	WH1254	1.7	0.5	8.1	0.0	8.1	2.6
131	DBW301	3.6	3.2	7.5	4.6	7.5	4.7
132	WH1270	2.9	3.1	7.6	2.8	7.6	4.1
133	HD2967 (C)	0.0	4.7	5.2	0.0	5.2	2.5
134	PBW824	0.0	0.0	4.3	0.0	4.3	1.1
135	UP3043	2.0	4.8	8.1	0.0	8.1	3.7
136	DBW187	0.0	0.7	6.5	0.0	6.5	1.8
137	HD3086 (C)	0.0	2.0	5.2	0.0	5.2	1.8
138	DBW303	0.0	0.6	4.3	0.0	4.3	1.2
139	DBW304	0.0	2.8	6.5	0.0	6.5	2.3
140	UP3042	0.0	4.3	4.3	0.0	4.3	2.1
140A	PBW 343 (Check)	15.4	21.4	16.8	30.7	30.7	21.0
141	DBW302	0.0	4.8	8.6	0.0	8.6	3.4
142	PBW825	0.0	0.0	5.3	0.0	5.3	1.3
143	HD3347	6.9	6.5	6.5	11.6	11.6	7.9
VIII. Special Trial (SPL-AST)							
144	WH1223	0.0	1.7	8.3	0.0	8.3	2.5
145	KRL19 (C)	0.0	0.8	6.6	0.0	6.6	1.9
146	Kharchia65 (C)	2.6	2.8	5.6	11.4	11.4	5.6
147	NW 7060	0.0	1.9	6.1	0.0	6.1	2.0
148	KRL210 (C)	0.0	0.5	4.3	0.0	4.3	1.2
149	WH 1228	0.0	4.1	7.6	0.0	7.6	2.9
150	NW 7062	0.0	2.8	8.1	0.0	8.1	2.7
IX. Special Trial (SPL-VLS)							
151	PBW757 (C)	0.0	4.0	7.5	0.0	7.5	2.9
152	WR544 (C)	0.0	1.6	6.6	0.0	6.6	2.1
153	HD3298	0.0	1.4	3.5	0.0	3.5	1.2
154	HD3271	2.1	8.2	5.3	4.2	8.2	4.9
155	DBW14 (C)	0.0	0.0	2.5	0.0	2.5	0.6
156	DBW71 (C)	0.0	10.8	2.6	0.0	10.8	3.3
157	HI1621	0.0	6.7	4.3	0.0	6.7	2.8
158	PBW 797	0.0	3.3	5.4	0.0	5.4	2.2
158A	PBW 343(Check)	14.9	24.0	16.5	37.5	37.5	23.2

COOPERATORS

NAME	**CENTRE**
R.S. BENIWAL	HISAR
P.S. SHEKHAWAT AND NITIN CHAWLA	DURGAPURA
JASPAL KAUR	LUDHIANA
SUDHEER KUMAR P.L. KASHYAP AND D.P. SINGH	KARNAL (COORDINATING UNIT)

7.3 FOOT ROT (*Sclerotium rolfsii*)

AVT entries along with checks were evaluated at Dharwad center. AVTs (2018-2019) were evaluated against foot rot and entries wise reaction has been given in Tables 7.3. The entries showing upto 5 and 10.00 per cent incidence were categorized as highly resistant and resistant, respectively and are listed below:

AVTs Year 2018-19
Free
DBW301, DBW302, DDW 48 (d), HI 8805(d)*, HI 8812 (d), HI1612 (C), HS562 (C), HS673, K0307 (C), K1317 (C), KRL19 (C), NIAW 3170*, NW 7062, PBW 771*, PBW550 (C), PBW757 (C), WH 1239 and WH1223

Highly resistant (upto 5 % disease):
DBW303, GW 1348 (d), HD 3293, HD 3345[B], HD3090 (C), HD3347, HI 8802(d)*, HI8737(d) (C), HPW468, MACS6222 (C), MACS6478 (C), PBW 781, PBW 822[B], PBW 823[B], RAJ 4529 and WR544 (C)

Resistant (5-10 % disease):
DBW 222*, DBW 257, DBW187(I) (C), DDW 47(d)*[Q], GW509, HD2967 (C), HD3171 (C), HI8627(d) (C), HI8807(d), MACS 4058(d)*, MACS 6695*, NIDW 1158 (d), PBW825, UAS 3002 and VL3020

Table 7.3. Performance of AVTs material against foot rot (% incidence) at Dharwad during 2018-2019

S. No.	Entries	Foot rot (%)
		Dharwad
I. Northern Hill Zone		
1	HPW349 (C)	70.00
2	VL907 (C)	45.00
3	HS507 (C)	33.33
4	HS652	30.00
5	HS562 (C)	0.00
6	VL892 (C)	44.44
7	HS490 (C)	25.00
8	HPW468	5.00
9	HS673	0.00
10	VL3020	6.25
11	UP3041	NG
12	HPW467	NG
13	HS674	NG
14	VL3019	NG
15	VL3021	NG
II. North Western Plain Zone		
16	WH1105 (C)	NG
17	HD3226(I) (C)	NG
18	HD3086 (C)	NG
19	PBW820[M]	NG
20	DBW 221*	NG
21	DBW 222*	10.00
22	PBW550 (C)	0.00
23	PBW821[M]	56.25
24	HD2967 (C)	70.00
25	NW 7049	37.50
26	DPW621-50 (C)	44.44
27	DBW88 (C)	25.00
28	PBW752(I) (C)	60.00
29	DBW173 (C)	30.00
30	WH1021 (C)	30.00
31	HD3059 (C)	NG
32	WH1124 (C)	NG
33	PBW 771*	0.00
34	HI1620(I) (C)	45.00
35	PBW 796	90.00
36	HI 1628*	30.00
37	WH1142 (C)	45.00
38	HD3043 (C)	35.00
39	PBW644 (C)	65.00
40	HD3237(I) (C)	22.22
41	BRW 3806*[#]	65.00
42	NIAW 3170*	55.00

43	WH1080 (C)	65.00
III. North Eastern Plain Zone		
44	HD3249*#Q	65.00
45	HD2733 (C)	38.89
46	PBW 781	5.00
47	DBW 257	10.00
48	DBW39 (C)	50.00
49	HD 3277	25.00
50	RAJ 4529	5.00
51	DBW187(I) (C)	7.14
52	WH 1239	0.00
53	K0307 (C)	0.00
54	HD2967 (C)	10.00
55	K1317 (C)	0.00
56	HI1612 (C)	0.00
57	HD 3293	5.00
58	HD3171 (C)	5.56
59	HD2888 (C)	12.50
60	DBW 252*#	62.50
61	K8027 (C)	40.00
62	DBW 273	35.00
IV. Central Zone		
63	HI8713(d) (C)	25.00
64	NIDW 1158 (d)	10.00
65	HI 8811 (d)	27.78
66	HD3343M	50.00
67	GW322 (C)	45.00
68	HI1544 (C)	14.29
69	HI8737(d) (C)	5.00
70	HI 8812 (d)	0.00
71	GW 1348 (d)	5.00
72	DDW 49 (d)	50.00
73	PBW 822B	5.00
74	HD 3345B	5.00
75	DDW 48 (d)	0.00
76	HI8627(d) (C)	10.00
77	DBW110 (C)	15.00
78	UAS 466(d)*	37.50
79	MP3288 (C)	35.00
80	DBW 277	60.00
81	DDW 47(d)*Q	7.14
82	HD2932 (C)	45.00
83	HD2864 (C)	65.00
84	MP3336 (C)	65.00
85	MP4010 (C)	80.00
86	CG1029	90.00
87	UAS3002	70.00
88	HI1633	60.00
89	HI1634	55.00
90	HI8808 (d)	70.00
91	HI8807 (d)	55.00
V. Peninsular Zone		
92	PBW 823B	5.00
93	UAS428 (d) (C)	40.00
94	DDW 49 (d)	11.11
95	UAS 3001	55.00
96	MACS3949 (d) (C)	35.00
97	MACS6222 (C)	5.00
98	GW 322 (C)	40.00
99	DDW 48 (d)	50.00
100	MACS6478 (C)	5.00
101	HD3343M	25.00
102	WHD 963 (d)	20.00
103	HI8807(d)	10.00
104	HI1633	25.00
105	UAS 3002	10.00
106	Raj4083 (C)	25.00
107	HD2932 (C)	22.22
108	GW509	10.00
109	HD3090 (C)	5.00
110	NIAW 3170*	0.00
111	GW 1346(d)*	15.00
112	MACS 4058(d)*	10.00
113	DBW93 (C)	20.00
114	HI 8805(d)*	0.00
115	AKDW2997-16(d) (C)	50.00
116	MACS 6695*	10.00
117	UAS446(d) (C)	15.00
118	HI1605 (C)	44.44
119	MACS 6696*	90.00
120	NIDW 1149(d)	66.67
121	HI 8802(d)*	5.00
VI. Special Trial (Dicoccum)		
122	DDK1029 (C)	60.00
123	MACS5052	60.00
124	MACS6222 (aest.) (C)	57.14
125	DDK1056	30.00
126	HW1098 (C)	55.00

127	MACS5053	35.00
128	DDK1057	57.14
VII. Special Trial- SPL-HYPT		
129	HD3317	20.00
130	WH1254	20.00
131	DBW301	0.00
132	WH1270	45.00
133	HD2967 (C)	50.00
134	PBW824	78.57
135	UP3043	80.00
136	DBW187	25.00
137	HD3086 (C)	30.00
138	DBW303	5.00
139	DBW304	80.00
140	UP3042	25.00
141	DBW302	0.00
142	PBW825	10.00
143	HD3347	5.00

VIII. Special Trial (SPL-AST)		
144	WH1223	0.00
145	KRL19 (C)	0.00
146	Kharchia65 (C)	65.00
147	NW 7060	35.00
148	KRL210 (C)	60.00
149	WH 1228	80.00
150	NW 7062	0.00
IX. Special Trial (SPL-VLS)		
151	PBW757 (C)	0.00
152	WR544 (C)	5.00
153	HD3298	45.00
154	HD3271	45.00
155	DBW14 (C)	50.00
156	DBW71 (C)	25.00
157	HI1621	40.00
158	PBW 797	57.14

COOPERATOR

NAME

P.V. PATIL, GURUDATT M. HEGDE

SUDHEER KUMAR P.L. KASHYAP AND D.P. SINGH

CENTER

DHARWAD

KARNAL (COORDINATING UNIT)

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

Test Locations: Almora, Bajoura and Malan

A total 15 AVT entries were evaluated at three locations but disease development was not goot at Malan centre hence data is not considered. The data was taken by counting infected and healthy ear heads, for calculating per cent infected ear heads. There were differences in the disease incidence at both locations, the highest disease level as well as average was considered and has been given in Table 7.4.

AVTs 2018-19
Resistant (1-10 % disease):
HS562 (C), HS490 (C) and VL3021

Table 7.4. Performance of AVT material against hill bunt (% incidence) under multilocational testing during 2018-2019

S. No.	Entry	Hill Bunt Incidence (%)			
		Bajaura	**Almora**	**HS**	AV
I. Northern Hill Zone					
1	HPW349 (C)	40.2	0	40.2	20.1
2	VL907 (C)	45.4	3.94	45.4	24.7
3	HS507 (C)	60.0	2.14	60.0	31.1
4	HS652	61.3	10.76	61.3	36.0
5	HS562 (C)	0.0	0	0.0	0.0
6	VL892 (C)	50.0	9.52	50.0	29.8
7	HS490 (C)	0.0	3.81	3.8	1.9
8	HPW468	52.3	1.27	52.3	26.8
9	HS673	57.7	1.9	57.7	29.8
10	VL3020	23.3	0.68	23.3	12.0
11	UP3041	50.0	10.2	50.0	30.1
12	HPW467	23.2	1.56	23.2	12.4
13	HS674	46.9	5.19	46.9	26.0
14	VL3019	62.3	5.63	62.3	34.0
15	VL3021	4.3	5.69	5.7	5.0

COOPERATORS

NAME	**CENTRE**
K. K. MISHRA	ALMORA
SACHIN	MALAN
RAKESH DEVLASH	BAJAURA
SUDHEER KUMAR, P.L. KASHYAP AND D.P. SINGH	KARNAL

PROGRAMME 8. CROP HEALTH

8.1 Pre- Harvest Crop Health Monitoring

Crop health was rigorously monitored during the crop season 2018-19. Major focus was on the occurrence of yellow rust in NWPZ and surveillance for wheat blast. Status of other diseases as well as insect pests was also monitored during these surveys. The extensive surveys were also conducted by the wheat crop protection scientists of different cooperating centers including ICAR-IIWBR Karnal. Special teams of scientists were also constituted during the 57th All India Wheat and Barley Workers' Meet held at BAU, Ranchi in August, 2018. 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. 24 (Issues 1 to 5) which was issued during the crop season and also uploaded on ICAR-IIWBR website (www.iiwbr.org). The overall crop health status was excellent in the country. The yellow rust could not make any dent on wheat production and was very well controlled at initiation in adjoining districts in Punjab close to foot hills of H.P. So far, the exotic diseases and pathotypes like Ug99 race of stem rust and wheat blast were not reported from any part of the country.

Yellow rust occurrence in Northern States

- The first report of stripe rust was observed from village Fatehgarh Viran of block Chamkour Sahib of district Roopnagar on 14.1.2019. The field of approximately one acre of variety 'Barbet' was found infected with stripe rust.
- On 19.1.2019, yellow rust disease was reported from village Chandpur Bela near Kiratpur Sahib, Roopnagar, Punjab.
- Some yellow rust pustules were observed in SAARC and WDMN nursery at Gaumanasha on Agra local and PBW 343 on January, 26, 2019
- On February 12, 2019, yellow rust pustules of stripe rust were observed on 2-3 plants of wheat (HD-2967) in Diwan Garh (Arnia), Jammu.
- Wheat yellow rust was recorded on variety HD2967 on 14.2.2019 in Rampur Hadyan village of Bilaspur block in Yamuna Nagar, Haryana.
- On February 26, 2019 February, stripe rust was observed at Saidgarh (Bishna), Jammu.
- On February, 2019, yellow rust was noticed at Kuwarpur (Golapar), Uttarakhand.
- On 13.02.2019, yellow rust was reported by Almora.
- Wheat leaf rust was observed in Belgaum district on 19.2.2019.
- On March 19, 2019. Yellow rust incidence was reported in Sudhelgarh and Bidipur of RS Pura, J&K on HD 2967 cultivar.
- On March 19, 2019. Yellow rust incidence was reported in Jangi Check, Kathua and Karolvidho, Hiranagar J&K on HD 3086 cultivar.
- Yellow rust and brown rust of wheat was observed in TPN on February, 28, 2019 and March 10, 2019, respectively at Kanpur.
- On March 2, 2019, leaf rust was reported on Bailhongal, Karnataka.
- The first symptoms of yellow rust were observed on PBW 621 in Nangal Chowk area, Himachal Pradesh on March 8, 2019.
- On March 11, 2019, leaf rust incidence was noticed in Arabhavi of Belgaum district on Karnataka.
- Stem rust infection on Gulab under field conditions at Hol, Maharashtra on March 14, 2019.
- On March 14, 2019, leaf rust severity was reported on off type mixture in Gold 23 and trap plots at Songaon experimental farm on Lal Bahadur variety.

Besides the yellow rust, during the survey in January, 2019, flag smut of wheat was noticed on in traces in some farmers field in Sikar, Palsana, Ringus, Chomu areas of Rajasthan. Flag smut was observed in some of the samples received from the wheat fields of Ashok Nagar District, Madhya Pradesh in January month. During crop health survey on 24th and 25th of January, 2019, covered smut of barley was found in traces in at Sabour, Bihar. On 24th January, 2019, incidence of leaf blight was recorded in traces on some of the entries of Wheat Disease monitoring Nursery (viz., WL 711, HD 2329, WL 1562, HW 2021, WH 147, HP 1633 and HW 971) planted at Pimpalgaon Baswant, Maharsthra. During crop health survey from 21.01.2019 to 23.01.2019, leaf blight was observed on lower leaves in different wheat genotypes at Dharwad, Belgaum, Gadag and Bagalkot districts of Karnataka. On 20th February, 2019, powdery mildew of wheat was reported from Nainital, Uttrakhand. The detaled information was publidhed in *"Wheat Crop Health Newsletter",* Vol. 24 (Issuses 1 to 5) and same were uploaded on ICAR-IIWBR website (www.iiwbr.org).

Strategy Planning Meetings

1. Management of yellow rust and Karnal bunt: Meeting on evolving strategies for enhancing wheat production with special reference to management of wheat rust and Karnal bunt was held on 22.10.2018 under the Chairmanship of Secretary, DAC & FW in New Delhi. The overview was given by Director, IIWBR and Director Agriculture of different states. The participants were informed about the yellow rust resistant varieties for different states. Director, IIWBR Karnal offered help to all the wheat growing states and particularly to Haryana and U. P. in replacing old varieties of wheat and adoption of new technology in wheat production and protection**.**

2. Preparedness on occurrence of blast disease on wheat: Strategy planning meetings was also conducted on "Preparedness on occurrence of blast disease on wheat" on 31.8.2018 in Kolkata under Chairmanship of Hon. Commissioner of Agriculture, GOI. It was attended by Director, Agriculture, Govt. of West Bengal, ADG (PP&B), Director, IIWBR and other higher officials of Govt. of West Bengal, ICAR and SAUs. No wheat blast disease was reported in India. However as preventive measures it was decided to keep no wheat zone up to 5 km distance from border of Bangladesh in Indian states, prevent entry of wheat seed and grains from Bangladesh, wheat holiday in Nadia and Murshidabad districts as well as planting of trap plot nurseries along Indo-Bangladesh border.

3. Brain storming session on blast proofing in agriculture: A brain storming session on blast proofing in agriculture was jointly organized by IIWBR-Indian Phytopathological Society, Indian Society of Plant Pathologists and Society for the Advancement of Wheat and Barley Research at IIWBR Karnal on 8th August, 2018. It was attended by about 100 delegates all over India and Commissioner of Agriculture was the Chief Guest in plenary session whereas Director, IIWB Karnal was chairman.

Training of wheat health management

A training programme on "Disease Surveillance and Adoption of New Wheat and Barley Varieties for Better Productivity and Resistance" was conducted on 31.10.2018 at BCKV Kalyani (West Bengal). About 60 farmers and state government officials participated.

Advisory for stripe rust management: Advisory for stripe rust management was issued time to time i.e. in December, January and February for northern states. Awareness among farmers for stripe rust management was created through mobile, internet, toll free number, newspapers, discussions and delivering lectures in farmers training programmes.

Preparedness to wheat blast

Survey were conducted in North and South West Bengal near Indo-Bangladesh boarder by team of scientist from ICAR-IIWBR, Karnal, UBKV, Cooch Behar, West Bengal and BCKV, Kalyani, Nadia, West Bengal. It was observed that farmers are not fully observed wheat holiday in the district where wheat holiday was declared as well as some of the farmers were not observed No-wheat zone even within 5 Km area along Indo-Bangladesh border and growing local wheat varieties.

For identification of wheat blast resistant sources, a total of 353 Indian wheat varieties and advance breeding material were screened at Jessore, Bangladesh through CIMMYT and out of these 26 found free from blast infection and 31 showed resistance against wheat blast under artificially inoculated conditions. The varieties showed resistance are DBW 187, DBW 173, HD 2967, HD 3043 etc. which should be deployed in the disease prone areas. Anticipatory breeding programme has been initiated for faster breeding of blast resistant cultivars. During the current year 30 fresh crosses were made involving resistant donors and 18 crosses which were made last year were sent for generation advancement at Dalang Maidan in off season wheat nursery.

8.2 Post Harvest Surveys

The post harvest grain analysis for presence of Karnal bunt and black point in grains of farmers' fields collected from different regions was done by different cooperating centres of All India Coordinated Research Project on Wheat and Barley during April-June 2019. The Karnal bunt incidence was higher as compared to previous years during 2018-19 crop season. The detail report is given below:

Karnal Bunt (KB)

A total of 7321 grain samples collected from various mandies in different zones and were analyzed at cooperating centers (Table 8.1). The overall 32.02% samples were found infected. The samples from Haryana showed maximum infection (56.69%) followed by Jammu (54.85%) and Punjab (45.18%). Among different states from where samples were taken Madhya Pradesh, Gujarat, Maharashtra and Karnataka were found free from Karnal bunt infection.

Table 8.1. Karnal bunt situation in the country during 2018-19 crop season

State	Total samples	Infected samples	Infected samples (%)	Range of grain infection (%)
Punjab	2809	1269	45.18	0.1 – 12.14
Haryana	1318	747	56.69	0.05 – 14.0
Rajasthan	300	123	41.0	0.1 – 21.9
Uttarakhand	1189	58	4.88	0.1 – 5.0
Jammu	206	113	54.85	0.1 – 8.24
Uttar Pradesh	129	34	26.36	0.1 – 10.0
Madhya Pradesh	285	0	0	0
Maharashtra	341	0	0	0
Gujarat	692	0	0	0
Karnataka	52	0	0	0
Total	**7321**	**2344**	**32.02**	**0.05 – 21.9**

Jammu

A total of 206 samples collected from Jammu, Kathua, Sambha, Udhampur and Rajouri districts of J&K and analysed for presence of KB and data revealed that total 54.85 per cent samples were infected with KB and range of infection was 0.1-8.24 per cent. The KB infection was highest in Jammu district (61.66%) followed by Sambha (60.00%), Udhampur (58.62%), Kathua (49.09%) and Rajouri (43.75%) respectively (Table 8.2).

Table 8.2. Karnal bunt situation in Jammu during 2018-19 crop season.

Districts	Total samples	Infected samples (%)	Incidence Range	Number of samples showing different levels of KB incidence				
				0.0-0.5	0.5 - 1.0	1.1 - 5.0	5.1 - 10	>10
Jammu	60	61.67	0.1-8.24	11	14	10	2	0
Sambha	30	60.00	0.1-7.33	10	6	2	1	0
Kathua	55	49.09	0.1-4.66	10	11	6	0	0
Rajouri	32	43.75	0.1-3.50	7	5	1	0	0

Udhampur	29	58.62	0.1-4.66	12	4	1	0	0
Total	**206**	**54.85**	**0.1-8.24**	**50**	**40**	**20**	**3**	**0**

(M. K. Pandey, Amrish Vaid, Deepak Kumar and Shahid Ahamad)

Uttarakhand

In Uttarakhand 1189 wheat samples were collected from the seed growers of four districts of Uttarakhand namely, Udham Singh Nagar, Nainital, Dehradun and Haridwar (Table 8.3). Out of these, 58 samples had Karnal bunt infection. About 87.93 per cent of the total infected samples were in the category of below 0.25 per cent, which is the tolerance limit of Karnal bunt for certified seeds. The rest 12.07 % samples had more than 0.25 per cent infected grains. From Dehradun 35 samples were analysed out of which 12 samples were found to be infected. Therefore, the maximum incidence (34 %) was observed there followed by Haridwar (26.6%). In Nainital (Kotabagh) and Udham Singh Nagar districts the prevalence of Karnal bunt is low. Based on the overall KB occurrence, it emerged that in Uttarakhand this year KB incidence is low.

Table 8.3: Karnal bunt incidence in different districts of Uttarakhand during 2018-19

Districts	**Total samples**	**Infected samples**	**Infected samples (%)**	**Samples in different range of infection**			
				<0.25%	**0.26-1%**	**1.1- 5%**	**5.1-10%**
1.Udham Singh Nagar							
a) Pantnagar	702	19	2.70	19	0	0	0
b) Kashipur	02	00	0	0	0	0	0
c) Bajpur	50	01	2.0	0	01	0	0
d) Khatima	227	13	5.73	13	0	0	0
2. Dehradun	35	12	34.0	07	04	01	0
3. Haridwar	45	12	26.6	11	01	0	0
4. Nainital (Kotabagh)	128	01	0.78	01	0	0	0
Total	**1189**	**58**	**4.88**	**51**	**06**	**01**	**0**

(J. Kumar, Deepshikha, K. Srivastava)

Punjab

The surveys of 155 grain markets of the Punjab state during the months of April and May 2019 were conducted to collect the wheat grain samples for the analysis of various post harvest diseases of the wheat. A total of 2809 samples were collected and analyzed for the presence of Karnal bunt (Table 8.4). All the grain markets except Chamkour Sahib (Ropar), Mehraj Wala and Kattiyan Wali (Muktsar), Macchiwara, Khanna, dugri (Ludhiana), Sultanpur lodhi (Kapurthalla), Ranger Nangal (Gurdaspur), Smalsar, Talwandi Jhalle Khan, Chak Kande Shah, Saide K Mohan (Ferozepur), Ghubaiya, Laduke, Fazlika and Abohar (Faridkot), Mandi Gobindgarh (Fatehgarh Sahib), Kotakapura, Panjhgaryain, Sadique (Faridkot), and Jeevan Singh Wala (Bathinda) were found infected with KB. The Karnal bunt was found in 1269 samples accounting the 45.18 Percent samples. District Tarntaran showed the maximum KB infected samples followed by Hoshiarpur and Gurdaspur. The range of per cent KB infected samples was 10.85 (Muktsar) to 82.86 (Tarntaran). As far as severity in concerned, the highest KB infection was in the Hoshiarpur and Gudaspur districst followed by Tarntaran. An overall infection in rest of the districts ranged between 0.040 (Fazlika) to 1.47 (Hoshiarpur and Gudaspur) with average infection in the state 0.594 almost three times higher than the last year i.e 0.194 in 2017-18.

Table 8.4: Status of Karnal Bunt in Punjab during 2018-19

S. No.	**District**	**Total Samples**	**Infected Samples**	**Infected samples (%)**	**Average infection (%)**
1	Amritsar	99	54	54.55	1.40
2	Barnala	86	18	20.93	0.23

3	Bathinda	139	45	32.37	0.17
4	Faridkot	73	23	31.51	0.18
5	Fatehgarh Sahib	86	36	41.86	0.40
6	Fazilka	165	20	12.12	0.04
7	Ferozepur	164	37	22.56	0.10
8	Gurdaspur	105	79	75.24	1.47
9	Hoshiarpur	184	148	80.43	1.47
10	Jallandhar	233	148	63.52	0.70
11	Kapurthala	131	69	52.67	0.99
12	Ludhiana	355	118	33.24	0.28
13	Mansa	66	26	39.39	0.28
14	Moga	86	33	38.37	0.26
15	Mohali	34	19	55.88	1.24
16	Muktsar	129	14	10.85	0.18
17	Nawanshar	168	77	45.83	0.51
18	Pathankot	48	36	75.00	1.20
19	Patiala	77	43	55.84	0.50
20	Ropar	142	102	71.83	0.83
21	Sangrur	153	53	34.64	0.36
22	Tarantarn	86	71	82.56	1.41
	Total	**2809**	**1269**	**45.18**	**0.594**

(Jaspal Kaur, Ritu Bala)

Haryana

A total of 1318 samples collected from Haryana and analysed for presence of KB and revealed that 56.69% samples were infected with KB and range of infection was 0.05- 14.0% (Table 8.5). The KB infection was higher in this year coperivive to previous years because of raind at the time of booting.

Table 8.5. Status of Karnal bunt in Haryana during 2018-19 crop season.

District	Total samples	Infected samples (%)	Average infection (%)	Range of infection (%)	Cooperators
Ambal	16	62.5	0.31	0-1.2	IIWBR
Kurukshetra	36	47.22	0.49	0-5	
Nilokheri	18	78.94	1.96	0-9.1	
Karnal	11	90.9	1.06	0-3.3	
Gharaunda	34	82.35	2.32	0-10.5	
Panipat	30	30	0.09	0-0.5	
Gohana	51	39.21	0.61	0-6.4	
Sonipat	41	76.92	0.96	0-4.8	
Rohtak	69	26.08	0.69	0-8.9	
Kaithal	95	73.68	0.86	0-14	
Narwana	28	60.71	0.76	0-3.8	
Jind	47	27.65	0.2	0-3.3	
Bhiwani	20	35	0.81	0-12.9	
Rewari	20	50	0.5	0-5.1	
Mahendragarh	16	43.75	0.38	0-0.2	
Jhajhar	11	45.45	0.24	0-1.1	
Hisar	36	-	0.59	0.05-1.70	R. S. Beniwal

District	Total samples	Infected samples (%)	Average infection (%)	Range of infection (%)	Cooperators
Rohtak	60	-	0.14	0.05-0.40	
Bhiwani	57	-	0.29	0.05-0.60	
Charkhi Dadri	32	-	0.96	0.05-5.00	
Mahendergarh	72	-	0.82	0.05-4.5	
Rewari	53	-	0.28	0.05-1.5	
Jhajjar	47	-	0.11	0.05-0.20	
Gurgaon	42	-	0.07	0.05-0.25	
Nuh	41	-	0.14	0.05-0.70	
Panipat	53	-	0.35	0.05-1.50	
Palwal	47	-	0.34	0.05-1.80	
Faridabad	48	-	0.23	0.05-0.50	
Panchkula	37	-	0.37	0.05-0.75	
Karnal	100	88	0.89	0.1 – 4.5	M. S. Saharan
Sonipat	50	62	0.22	0.1 – 3.25	
Total	**1318**	**56.69**	**0.58**	**0.05 – 14.0**	

(Sudheer Kumar, P. L. kashyap, Ishwar Singh, R. S. Beniwal, M. S. Saharan)

Rajasthan

A total of 300 wheat grain samples were collected from ten grain mandies, Alwar (Alwar, Khertal & Bansur), Dausa (Dausa, Lalsot & Mandawari) and Jaipur (Bassi & Kotputli) districts of Rajasthan to know the status of Karnal bunt and black point diseases of wheat during Rabi, 2018-19 (Table 8.6). Among the total 300 samples collected, 41 per cent samples were found infected with Karnal bunt with per cent infection range was 1.1-21.9 being maximum percent incidence (21.9) was found in a sample collected from Alwar mandi.

Table 8.6. Status of Karnal bunt during Rabi, 2018-19

S. No.	Location	Total samples	Percent infected samples	Incidence range (%)	Number of samples showing different level of Karnal Bunt per cent incidence				
					0	0.1-1	1.1-5	5.1-10	>10
1	Alwar	50	58	0.1 - 21.9	21	24	4	0	1
2	Bansur	39	74.36	0.1 - 5.3	10	23	4	2	0
3	Kherthal	46	58.7	0.1 - 5.1	19	20	6	1	0
4	Dausa	27	40.74	0.1 - 10.5	16	9	1	0	1
5	Lalsot	53	22.64	0.1 - 0.7	41	12	0	0	0
6	Mandawari	50	4.0	0.1 - 0.2	48	2	0	0	0
7	Bassi	20	5.0	0.1	19	1	0	0	0
10	Kotputli	15	80.0	0.2 - 3.0	3	6	6	0	0
Total		**300**	**41.0**	**0.1 - 21.9**	**177**	**97**	**21**	**3**	**2**

(Pradeep S. Shekhawat)

U. P.

A total 129 grain samples were analysed and an average 26.36 samples were found infected. Infection ranged from 0 to 10% (Table 8.7)

Table 8.7. Status of Karnal bunt during Rabi, 2018-19

S. No.	District	Total samples	Infected samples	Infected samples (%)	Range of infection
1	Ata	16	4	25.00	0 - 5
2	Kasganj	17	7	41.18	0 - 5
3	Kanpur (rural)	46	10	21.74	0 - 5

4	Unnau	25	8	32.00	0 - 10
5	Fatehpur	25	5	20.00	0 - 2
	Total	**129**	**34**	**26.36**	**0 - 10**

(Javed Bahar Khan)

M. P.

A total of 285 wheat grain samples collected from different mandis during April and May, 2019, were analyzed for karnal bunt infection and none of the samples found infected with the disease (Table 8.8). Particulars of the samples given below:

Table 8.8. Status of Karnal bunt during Rabi, 2018-19

S. No.	District	Total samples	Infected samples
1	Indore	91	0
2	Dewas	156	0
3	Ujjain	34	0
4	Shajapur	4	0
5	Khargone	1	0
6	Rajgarh	1	0
	Total	**285**	**0**

(T. L. Prakasha, K. K. Mishra)

Gujarat

Eighteen different marketing yards and various farmers' fields located in different wheat growing areas of North Gujarat were surveyed for wheat seed health status. A total 692 seed samples that comparises 577 seed samples from marketing yards and 115 samples from farmers' fields were examined (Table 8.9). All the samples were free from karnal bunt infection.

Table 8.9: Status of Karnal bunt (KB) of wheat in North Gujarat during 2018-19

S. No.	Market yard/Farmers' fields	Total samples examined	Karnal bunt incidence
A	Market yards		
1	Himmatnagar	42	0
2	Idar	44	0
3	Vadali	36	0
4	Khedbrahma	32	0
5	Bhiloda	38	0
6	Mansa	22	0
7	Dehgam	35	0
8	Talod	40	0
9	Mehsana	33	0
10	Visnagar	35	0
11	Kukarwada	32	0
12	Gozaria	40	0
13	Vijapur	20	0
14	Palanpur	28	0
15	Deesa	42	0
16	Bayad	20	0
17	Dhansura	18	0
18	Kapadvang	20	0
	Total	**577**	0
B	Farmers' fields	115	0
	TOTAL	**692**	**0**

(S. I. Patel)

Maharashtra

A total of 264 wheat grain samples were collected from Nashik, Niphad, Dindori, Sinnar, Kopargaon, Sakari, Shahada, Akkalkuan and Nandurbar and like previous years, no KB infection was found (Table 8.10).

Table 8.10. Karnal bunt in during 2018-19 crop season (Niphad centre)

S. No.	Tahasil	Total samples	Infected	Infected samples (%)
1	Nashik	08	0	0
2	Niphad	57	0	0
3	Dindori	16	0	0
4	Sinnar	06	0	0
5	Kopargaon	58	0	0
6	Sakari	43	0	0
7	Shahada	11	0	0
8	Akkalkuan	12	0	0
9	Nandurbar	53	0	0
	Total	**264**	**0**	**0**
10	Pune	77	0	0
	Total	**341**	**0**	**0**

(B.M. Ilhe, B.C. Game, P.P. Khandagale, V.S. Pawar, C.B. Beldar)

Karnataka

A total of 52 wheat grain samples were collected from Ramgiri, Saunshi, Noolvi, Pashupatihal, Godageri, Chikkaganjal, Lakmeshwar, Shishuvinal, Harlapur, Shirur, Kamalapur, Hosayellapur, Hebballi Agasi, Dharwad, Govanakoppa and Nippani and analysed for the presence of KB. None of the sample showed KB infection and Karnataka state found free from KB infection over years.
(P.V. Patil)

It is concluded that KB incidence in Northwestern states was hingh this year due to rains at boot leaf stage. Satates like Rajasthan and some drier districts of Haryana adopted sprinkler irrigation which may also a resean to have higher KB infection in those areas. Like previous years, during 2018-19 crop season the states in central zone M. P. and Gujarat and in Peninsular zone Maharashtra and Karnataka remained free from KB and may be used for KB free wheat production.

Black Point (BP)

Gujarat

Eighteen different marketing yards and various farmers' fields located in different wheat growing areas of North Gujarat were surveyed for wheat seed health status. A total of 692 samples that comprises 577 seed samples from marketing yards and 115 samples from farmers' fields were examined (Table 8.11). The data indicated that per cent black point infection was ranged 15.0 (Gozaria) to 28.57 (Palanpur) in different marketing yards. The data further indicated that 22samples (19.13%) from farmers' field examined were found black point infected. In all, 20.66 per cent samples showed black point infection in the range of 0.0 to 9.2%.

Table 8.11: Status of Black point (BP) of wheat in North Gujarat during 2018-19

S. No.	Market yard/Farmers' fields	Total samples examined	Black point infection		
			Samples infected	Infection (%)	Range of infection
A	Market yards				
1	Himmatnagar	42	11	26.19	0.0-6.7

2	Idar	44	8	18.18	0.0-9.2
3	Vadali	36	7	19.44	0.0-5.8
4	Khedbrahma	32	6	18.75	0.0-4.8
5	Bhiloda	38	7	18.42	0.0-7.0
6	Mansa	22	6	27.27	0.0-7.5
7	Dehgam	35	7	20.00	0.0-6.7
8	Talod	40	7	17.50	0.0-3.3
9	Mehsana	33	6	18.18	0.0-3.5
10	Visnagar	35	7	20.00	0.0-4.4
11	Kukarwada	32	6	18.75	0.0-3.0
12	Gozaria	40	6	15.00	0.0-5.3
13	Vijapur	20	4	20.00	0.0-3.5
14	Palanpur	28	8	28.57	0.0-6.6
15	Deesa	42	11	26.19	0.0-4.8
16	Bayad	20	5	25.00	0.0-2.8
17	Dhansura	18	4	22.00	0.0-3.0
18	Kapadvang	20	5	25.00	0.0-3.0
	Total	**577**	**121**	**20.97**	**0.0-9.2**
B	Farmers' fields	115	22	19.13	0.0-6.8
	Total	**692**	**143**	**20.66**	**0.0-9.2**

(S. I. Patel)

Rajasthan

A total of 300 wheat grain samples were collected from ten grain mandies, Alwar (Alwar, Khertal & Bansur), Dausa (Dausa, Lalsot & Mandawari) and Jaipur (Bassi & Kotputli) districts of Rajasthan to know the status of black point diseases of wheat during Rabi, 2018-19. Of the total 300 wheat grain samples, 135 samples (45 per cent) were found infected with black point with infection range of 0.1 to 11.6 being maximum was found in a sample collected from Kherthal mandi of district Alwar (Table 8.12). However, the disease severity was very less as compare to previous years.

Table 8.12: Status of Black point during Rabi, 2018-19 in Rajasthan

S. No.	Location	Total samples	Infected samples	Infected samples (%)	Incidence range (%)
1	Alwar	50	18	36.0	0.2 - 1.9
2	Bansur	39	30	76.92	0.1 - 11.6
3	Kherthal	46	16	34.78	0.2 - 1.4
4	Dausa	27	14	51.85	0.2 - 1.2
5	Lalsot	53	22	41.51	0.1 - 4.0
6	Mandawari	50	18	36.0	0.1 - 3.2
7	Bassi	20	7	35.0	0.1 - 7.28
10	Kotputli	15	10	66.67	1.1 - 10.2
Total		**300**	**135**	**45.0**	**0.1 - 11.6**

(Pradeep S. Shekhawat)

Haryana

A total 1168 samples were collected from different districts of Haryana and annalysed for black point. Average infection was found 0.36% with the rage of infection of 0.05 to 4.3% (Table 8.13).

Table 8.13. Status Black point during 2018-19 in Haryana

S. No.	Districts	Total samples	Range of infection (%)	Average infection (%)	Cooperators
1	Ambal	16	0.2-1.3	0.25	IIWBR
2	Kurukshetra	36	0.3-1.9	0.21	

3	Nilokheri	18	0.3-2.1	0.34	
4	Karnal	11	0.2-2.7	0.59	
5	Gharaunda	34	0.1-1.3	0.45	
6	Panipat	30	0.1-2.4	0.51	
7	Gohana	51	0.1-1.2	0.25	
8	Sonipat	41	0.2-4.3	0.53	
9	Rohtak	69	0.1-1.9	0.34	
10	Kaithal	95	0.1-1.2	0.21	
11	Narwana	28	0.1-2.2	0.31	
12	Jind	47	0.2-2.0	0.31	
13	Bhiwani	20	0.3-1.8	0.21	
14	Rewari	20	0.3-1.4	0.18	
15	Mahendragarh	16	0.8-1.2	0.13	
16	Jhajhar	11	0.4-1.6	0.46	
17	Hisar	36	0.05-1.90	0.72	R. S. Beniwal
18	Rohtak	60	0.05-0.30	0.166	
19	Bhiwani	57	0.05-0.90	0.86	
20	Charkhi Dadri	32	0.05-0.85	0.43	
21	Mahendergarh	72	0.05-1.45	0.41	
22	Rewari	53	0.05-1.15	0.3	
23	Jhajjar	47	0.05-0.35	0.31	
24	Gurgaon	42	0.05-0.25	0.16	
25	Nuh	41	0.05-0.30	0.21	
26	Panipat	53	0.05-0.65	0.19	
27	Palwal	47	0.05-1.95	0.56	
28	Faridabad	48	0.05-0.70	0.39	
29	Panchkula	37	0.05-1.5	0.52	
	Total	**1168**	**0.05-4.3**	**0.36**	

(Sudheer Kumar, P. L. kashyap, Ishwar Singh, R. S. Beniwal)

Punjab

The surveys of 155 grain markets of the Punjab state during the months of April and May 2019 were conducted to collect the wheat grain samples for the analysis of various post harvest diseases of the wheat. A total of 2809 samples were collected and analyzed for the presence of black point infected grains and also for the percentage of shriveled grains (Table 8.14). About 41.44 % samples collected from the grain markets of the Punjab were found to be infected with Black point while 36.63 percent samples had shriveled grains. An average infection of black point and shriveled grains was 0.189 and 0.235 %, respectively. There has been increase in BP and SG from the last year. Almost all the districts (except few) showed prevalence and incidence of black point and shriveled grains during the current year 2018-19 and showed an increase BP severity over the last year. Similarly SG has also increased as compared to 2017-18.

Table 8.14: Spectrum of BP and SG in Punjab during 2018-19.

S. No	Districts	Black point		Shriveled grains	
		Infected samples (%)	Average infection (%)	Infected samples (%)	Average infection (%)
1	Amritsar	55.56	0.270	46.46	0.253
2	Barnala	53.49	0.230	47.67	0.260
3	Bathinda	33.81	0.156	17.99	0.137
4	Faridkot	65.75	0.384	47.95	0.360
5	Fatehgarh Sahib	40.70	0.256	39.53	0.313
6	Fazilka	84.24	0.348	56.97	0.424

7	Ferozepur	46.34	0.183	29.27	0.121
8	Gurdaspur	35.24	0.181	40.00	0.386
9	Hoshiarpur	43.48	0.323	42.39	0.318
10	Jallandhar	41.20	0.175	41.63	0.233
11	Kapurthala	31.30	0.092	17.56	0.185
12	Ludhiana	30.99	0.143	33.52	0.199
13	Mansa	34.85	0.142	12.12	0.230
14	Moga	50.00	0.215	40.70	0.031
15	Mohali	2.94	0.003	26.47	0.109
16	Muktsar	14.73	0.069	37.98	0.204
17	Nawanshar	48.21	0.092	56.55	0.349
18	Pathankot	54.17	0.271	43.75	0.546
19	Patiala	35.06	0.200	35.06	0.295
20	Ropar	34.51	0.182	33.80	0.158
21	Sangrur	22.88	0.090	16.99	0.080
22	Tarantarn	58.14	0.269	33.72	0.160
State		**41.44**	0.189	**36.63**	**0.235**

(Jaspal Kaur, Ritu Bala)

Maharashtra

A total 264 samples were collected and analysed for black point infestation during 2018-19 and data are presented in Table 8.15.

Table 8.15: Analysis of grain samples for black point during 2018-19 crop season (Niphad centre)

S. No.	Tahasil	Total samples	Infected samples	Infected samples (%)	Range of infection (%)
1	Nashik	08	06	75.0	0.0-0.9
2	Niphad	57	47	82.4	0.0-7.3
3	Dindori	16	09	56.2	0.0-2.7
4	Sinnar	06	05	83.3	0.0-2.7
5	Kopargaon	58	52	89.7	0.0-4.6
6	Sakari	43	23	53.5	0.0-5.0
7	Shahada	11	07	63.6	0.0-2.1
8	Akkalkuan	12	12	100	0.2-2.7
9	Nandurbar	53	28	52.8	0.0-3.8
	Total	**264**	**189**	**71.59**	**0.0-7.3**

(B.M. Ilhe, B.C. Game, P.P. Khandagale, V.S. Pawar, C.B. Beldar)

Karnataka

A total of 52 wheat grain samples were collected from Ramgiri, Saunshi, Noolvi, Pashupatihal, Godageri, Chikkaganjal, Lakmeshwar, Shishuvinal, Harlapur, Shirur, Kamalapur, Hosayellapur, Hebballi Agasi, Dharwad, Govanakoppa and Nippani and analysed for the presence of black point. All most all the samples showed black point infection in the rage of 0.1 to 0.5.

(P.V. Patil)

8.3 Pathotype distribution of wheat and barley rust pathogens during 2018-19

More than 600 samples of three rusts of wheat, yellow and black rusts of barley from thirteen Indian states, and Nepal were analyzed during 2018-19. Yellow rust of wheat appeared comparatively late in the season. It was first observed on Barbet wheat (January 14, 2019) planted at farmer field in Ropar district of Punjab. Brown rust sample was first received from Dharwad on 22nd December, 2018.

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

During this crop year, 201 samples of yellow rust of wheat and barley were analyzed from eight Indian states and Nepal. Six pathotypes (46S119, 110S119, 238S119, 110S84, P and T) of wheat stripe rust pathogen were identified. Stripe rust population was avirulent on *Yr5*, *Yr10*, *Yr15*, and *YrSp*. Most of the yellow rust samples of wheat were analyzed from Punjab (108) followed by Himachal Pradesh (49). The frequency of pathotype 46S119 (virulent on *Yr2*, *Yr3*, *Yr4*, *Yr6*, *Yr7*, *Yr8*, *Yr9*, *Yr17*, *Yr18*, *Yr19*, *Yr21*, *Yr22*, *Yr23*, *Yr25*, *YrA*) was maximum (47.3 %) in this cropping season (Table 8.16). Pathotype 110S119, first identified in 2013-14, has increased to 34.3 % of the samples. Other 4 pathotypes were observed in 13.3% samples only. Presence of barley yellow rust was negligible during this year. The barley yellow rust pathotypes 57 (0S0) and M (1S0) were observed in five and one samples, respectively.

Black rust of wheat (*Puccinia graminis* f. sp. *tritici*)

Eight pathotypes of black rust of wheat and barley were identified from the analyses of 134 samples, received/collected from five Indian states and Nepal. Population analyzed during the year has avirulence to *Sr*26, *27, 31, 32, 35, 39, 40, 43, Tt3 and Tmp*. Maximum number of samples were received from Karnataka followed by Tamil Nadu (Table 8.17). Pathotype 11 (79G31), virulent on *Sr2, Sr5, Sr6, Sr7b Sr9a, Sr9b, Sr9c, Sr9d, Sr9f, Sr9g, Sr10, Sr13, Sr14, Sr15, Sr16, Sr17, Sr18, Sr19, Sr20, Sr21, Sr28, Sr29, Sr30, Sr34, Sr36, Sr38, SrMcN* was recorded in 50% of the samples, which was followed by 15-1 (22.3 %) and 40A (15.6 %). Other pathotypes were observed in few samples only. Diversity of black rust pathotypes was maximum in Karnataka. Pathotypes 40A and 11 were detected in nine barley samples, received from Tamil Nadu and Karnataka.

Brown rust of wheat (*Puccinia triticina*)

Twenty-three pathotypes of *P. triticina* were identified in 292 samples analyzed from 11 states of India, and Nepal. Indian *P. triticina* population showed resistant infection type on *Lr24*, *Lr25*, *Lr29*, *Lr32*, *Lr39, Lr42, Lr45* and *Lr47*. Among 12,77,104 and 162 group of pathotype, 77 was the most predominant and was ascribed to 88.7% samples whereas remaining groups were attributed to 11.3% samples. The pathotype 77-9 (121R60-1) virulent on *Lr1, Lr3, Lr10, Lr11, Lr12, Lr13, Lr14a, Lr14b, Lr14ab, Lr15, Lr16, Lr17a, Lr17b, Lr18, Lr20, Lr21, Lr22a, Lr22b, Lr23, Lr26, Lr27+31, Lr30, Lr33, Lr34, Lr35, Lr36, Lr37, Lr38,* Lr40*, Lr44, Lr46, Lr48, Lr49*, *Lr67* was most frequent and identified in 149 rust samples (51.1 %). It was followed by pathotypes 77-13(121R60-1,7) in 20.2 % and 77-5 (121R63-1) in 15.1 % rust samples (Table 8.18). The diversity of *P. triticina* was comparatively higher in Haryana, Karnataka and Himachal Pradesh. The pathotype 77-9 was most frequent in all the states except Himachal Pradesh and Punjab.

8.4 51st Wheat Disease Monitoring Nursery (WDMN) 2018-19

Wheat disease monitoring nursery (earlier trap plot nursery) is an effective tool to monitor the occurrence of wheat diseases especially rusts across different wheat growing areas of India. In addition, it helps in knowing the seasonal progress of the diseases in all the zones. Wheat disease monitoring nurseries are planted in isoalation under natural conditions, preferably away from the artificially inoculated plots. Samples analyzed from WDMN give an overview of area wise distribution and load of different rust races. The nursery also helps in understanding the area wise distribution, progress of wheat diseases and the performance of different disease resistance genes. Like previous years, the 51st wheat disease monitoring nursery was planted at 41 locations, covering all the major wheat growing areas in the country, especially those situated near the bordering areas to the neighboring countries. The data have been received from 33 locations (Table 8.19).

Table 8.16: Pathotype distribution of yellow rust (*Puccinia striiformis*) in India and neighboring countries during 2018-19

S. No.	State / Country	No. of isolates analyzed	Pathotypes							
			P. striiformis f. sp. *tritici*						*P. striiformis* f. sp. *hordei*	
			46S119	110S119	238S119	110S84	46S103 (P)	47S103 (T)	0S0 (57)	1S0 (M)
1.	Jammu & Kashmir	13	07	01	01	-	-	01	03	-
2.	Himachal Pradesh	49	20	20	04	02	01	01	01	-
3.	Uttarakhand	05	-	01	02	-	-	01	-	01
4.	Punjab	108	54	41	11	-	02	-	-	-
5.	Haryana	07	02	01	04	-	-	-	-	-
6.	Uttar Pradesh	02	-	-	02	-	-	-	-	-
7.	Madhya Pradesh	07	03	04	-	-	-	-	-	-
8.	Rajasthan	07	06	01	-	-	-	-	-	-
9.	Nepal	03	03	-	-	-	-	-	-	-
Total		**201**	**95**	**69**	**24**	**02**	**03**	**03**	**04**	**01**

Table 8.17: Pathotype distribution of black rust (*Puccinia graminis* f. sp. *tritici*) in India and neighboring countries during 2018-19

S. No.	States/ Countries	Samples Received	Number of isolates analyzed	Pathotypes identified*							
				11	15-1	21	21A-2	40A	40-2	40-3	122
1	Gujarat	33	33	33	-	-	-	-	-	-	-
2	Karnataka	81	75	30	30	01	01	02	08	02	01
3	Madhya Pradesh	03	2	02	-	-	-	-	-	-	-
4	Maharashtra	02**	0		-	-	-	-	-	-	-
5	Tamil Nadu	37	23	01	-	-	-	19	-	03	-
6	Nepal	02	1	01	-	-	-	-	-	-	-
Total		**158**	**134**	**67**	**30**	**1**	**1**	**21**	**8**	**5**	**1**

*****Indian binomial names 11 (79G31), 15-1 (123G15), 21 (9G5) 21A-2 (75G5), 40A (62G29), 40-2 (58G13-3), 40-3 (127G29), 122 (7G11)

** Not established

Table 8.18: Pathotype distribution of brown rust (*Puccinia triticina*) in India and neighboring countries during 2018-19

S. No.	State/ Country	No. of isolates Analyzed	Pathotypes identified																					
			12-1(5R37)	12-4 (69R13)	12-5 (29R45)	12-7 (93R45)	12-8 (49R45)	77-1 (109R63)	77-2 (109R31-1)	77-5 (121R63-1)	77-6 (121R55-1)	77-8 (253R31)	77-9 (121R60-1)	77-9+Raj1555 (121R60-1,7)	104-1 (21R31-1)	104-2 (21R55)	104-3 (21R63)	104A (21R31)	104-4-Thew (93R57,-1)	104-4—IWP (93R49)	162 (93R7)	162-1 (93R47)	162-2 (93R39)	162-4 (29R39)	162-5(61R47)
1	Himachal Pradesh	26	1								1		6	15		1	1							1	
2	Jammu & Kashmir	3											2	1											
3	Punjab	23						1		1			9	12											
4	Haryana	45				1			2	7			21	11	1		1				1				
5	Uttar Pradesh	37					1			4			21	10			1								
6	Uttarakhand	20		1	1					2			11	4									1		
7	Madhya Pradesh	7								2			2				2				1				
8	West Bengal	5											3	1			1								
9	Gujarat	4											4												
10	Maharashtra	18		1						3			13	1											
11	Karnataka	30		2						6			18				1	1	1						1
12	Tamil Nadu	43								11			31			1									
Other Countries																									
1	Nepal	31						1		8		2	8	4	1	2	2			2		1			
Total		**292**	**1**	**4**	**1**	**1**	**1**	**2**	**2**	**44**	**1**	**2**	**149**	**59**	**2**	**4**	**9**	**1**	**1**	**2**	**2**	**1**	**1**	**1**	**1**

OP Gangwar, Pramod Prasad, SC Bhardwaj and Subodh Kumar
Regional Station, ICAR-IIWBR
Flowerdale, Shimla-171 002

Table 8.19. List of co-operators and locations where WDMN was planted during 2018-19

Northern Hills and High Altitude Zone		
Himachal Pradesh	R. Devlash Head, ICAR-IIWBR, RS, Shimla Sachin Upmanyu Dharam Pal	Bajaura IIWBRShimla Una, Malan (Kangra) IARI, Tutikandi Facility, Shimla
Jammu & Kashmir	F. A. Mohiddin and NA Bhat	Khudwani
Uttarakhand	K.K. Mishra	Hawalbagh (Almora)
North Western Plains Zone		
Jammu & Kashmir	M.K. Pandey AND Amrish Vaid M.K. Pandey M. K. Pandey and Dr. Deepak Kumar	Kathua Jammu Rajouri
Haryana	Rajender Singh Beniwal	Hisar
Himachal Pradesh	Akhilesh singh	Dhaulakuan
Rajasthan	P.S. Shekhawat and Nitin Chawla	RARI, Durgapura, Jaipur
Punjab	Jaspal Kaur	Abohar Gurdaspur Langroya Ludhiana
Uttarakhand	Deepshikha and Kanak Srivastava	Pantnagar
North Eastern Plains Zone		
Bihar	C. S. Azad K. K. Singh	Sabour Samastipur, Pusa
Jharkhand	H.C. Lal	Kanke , Ranchi
Uttar Pradesh	S.P. Singh J.B. Khan and C. Kanchan Shyam Saran Vaish	Faizabad Araul (Kanpur) B.H.U. Varanasi
West Bengal	Sunita Mahapatra	Kalyani (Jalangi), Murshidabad
Central Zone		
Gujarat	S.I. Patel and Premabati Devi I.B. Kapadiya	Ladol (Vijapur) Mangrol (Junagadh)
Madhya Pradesh	Prakasha T.L. K. K. Mishra	Indore Khojanpur (Powarkheda)
Peninsular and Southern Hills Zone		
Maharashtra	Sudhir Navathe, Yashvanth Kumar K.J., V. S. Baviskar, V. D. Surve B.C.Game	A.R.S. Baner, (Pune) ARS, Niphad
Karnataka	Gurudatt M. Hegde, P. V. Patil and Mr. S. V. Kulkarni	Ugar Khurd (Dharwad)
Tamil Nadu	C. Manjunatha	IARI, Regional Station, Wellington

There were a total of 20 entries in the WDMN however; one extra entry was added for northern hills and high altitude zone. Of the total entries first 15 constitute a common set for all the zones, rest of the five (six in northern hills and high altitude zone) entries were zone specific varieties. Keeping into account the changed varietal situation some changes were made in the constitution of WDMN for NWPZ and NEPZ. The detailed constituent of WDMN for 2018-19 crop season was as given below:

Common set of varieties for all zones

WL711, HD2329, Agra Local, HD2160, Lal Bahadur, WL1562, HW2021 (Lr24/Sr26), HD2204, C306, WH147, HW2008 (*Lr*24/*Sr*26), Kharchia Mutant, HP1633, DL 784-3 and RNB1001

Zone specific varieties

i) **North Western Plains Zone**
WH1105, HD3086, HD3226, DPW621-50 and PBW752

ii) **North Eastern Plains Zone**
K8804, HD2888, DBW187, HUW468 and NW1014

iii) **Central Zone**
HI8663, HI1544, LOK-1, GW366 and GW322

iv) **Peninsular and Southern Hills Zone**
MACS2496, Bijaga Yellow, HW971, HD2501 and HW2022 (*Sr*24/*Lr*24)

v) **Northern Hills and High Altitude Zone**
HPW349, VL892, HS420, Sonalika, HS507 and Barley Local

Seeds of all the entries along with the sowing plan and procedures were sent to co-operators early in the season to ensure timely planting of the nursery. Each entry of the nursery was planted in two consecutive rows with two rows of Agra local as spreader row covering the periphery of nursery area. 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 inoculated fields. The disease situation was monitored at regular intervals and the rust disease samples from these nurseries were analyzed at ICAR-IIWBR, Regional Station, Flowerdale, Shimla.

Disease incidence in WDMN

Information on wheat disease situation was received from Dhaulakuan, Malan (Kangra), Bajaura, Una, IARI Tutikandi, Shimla and IIWBR, Shimla in Himachal Pradesh; Jammu, Kathua, Khudwani and Rajouri in Jammu and Kashmir; Pantnagar and Hawalbagh (Almora) in Uttarakhand; Hisar in Haryana; Abohar, Ludhiana, Gurdaspur and Langroya in Punjab; Sabaur and Pusa in Bihar; Kanke (Ranchi) in Jharkhand; Faizabad, Araul (Kanpur) and Varanasi in Uttar Pradesh; Ladol (Vijapur) and Mangrol (Junagarh) in Gujarat; Indore and Khojanpur (Powarkheda) in Madhya Pradesh; A.R.S. Baner (Pune) and ARS Niphad in Maharashtra; Ugar Khurd (Dharwad) in Karnataka and Wellington in Tamil Nadu.

Rust diseases were not recorded on any of the entries of WDMN planted at Vijapur, Indore, Ranchi and Niphad. The yellow rust was noticed at all the locations of NHZ and NWPZ except at IIWBR, Shimla, where all the WDMN entries were yellow rust free. All the entries of WDMN in other zones were free from yellow rust. Yellow rust severity was more at few locations in NWPZ and NHZ, where severity of more than 60S was reported on many entries. Brown rust was reported from Almora and Shimla (NHZ); Kathua, Rajouri, Hisar, Jammu, Pantnagar, Langroya and Ludhiana (NWPZ). Brown rust appeared at all the locations of NEPZ, CZ, PZ and SHZ except Ranchi (NEPZ), Indore, Vijapur (CZ) and Niphad (PZ). Of the 33 locations of WDMNs black rust was observed only at Powarkheda in central zone, Dharwad in PZ and Wellington in SHZ. Leaf blight was reported from WDMN planted at Almora, Jammu, Kathua, Rajouri, Sabaur, Pusa, Ranchi, Faizabad, Kalyani, Kanpur, Varanasi and Niphad. Kathua, Dhaulakuan, Jammu and Almora were the only locations where powdery mildew was observed on WDMN entries.

Appearance of Wheat rusts in WDMN

High altitude, Northern Hills Zone and North Western Plain Zone

The information on first appearance of rust diseases on WDMN entries was received from few locations. Of the received data yellow rust was first observed at Kathua (24.01.19) followed by Jammu (27.01.19), Dhaulakuan (08.02.19), Ludhiana (10.02.19), Rajauri (16.02.19), Hisar (06.03.19), Almora (12.03.19) and Bajaura (28.03.19). Brown rust was first observed at Kathua (28.02.19) followed by Jammu (10.03.19), Ludhiana (15.03.19), Hisar (26.03.19) and Almora & Rajouri (15.04.19). Black rust did not appear on WDMN entries in these zones.

North Eastern Plain Zone, Central Zone, Peninsular Zone and Southern Hill Zone

Yellow rust was absent on WDMN entries in these zones. Brown rust was first observed at Powarkheda and Junagarh (20.02.19) followed by Pusa & Varanasi (26.02.19), Faizabad (07.03.19), Sabour (08.03.19), Kalyani (13.03.19) and Kanpur (20.03.19). Black rust appeared only at Powarkheda (28.02.19) in CZ and Wellington in SHZ. All other locations in these zones were black rust free.

Varietal Performance against wheat rusts

High Altitude and Northern Hills Zone (HA & NHZ)

In NHZ yellow rust (YR) was observed at all the locations except on off season at IIWBR, Shimla. Maximum yellow rust severity was recorded at Almora, where 11 entries had more than 40S severity of yellow rust. However, HPW349 and barley local were yellow rust free at Almora. Lal Bahadur at Almora and Kharchia Mutant at Bajaura had 80S yellow rust severity. Minimum yellow rust severity was observed at IARI, Tutikandi, where HW 2008 was the only entry showing 20S severity of yellow rust, other entries had low severity (<10S). Brown rust appeared only at Almora and IIWBR, Shimla. WDMN entries HD2329, HD2160, HW2021 (*Lr24*/*Sr26*), Kharchia Mutant, HP1633, DL 784-3, RNB1001 and Barley Local were brown rust free at Almora, while others had brown rust severity in the range of TS to 20S. Brown rust appeared only on WL711, HD2329, Lal Bahadur, HW2021 (*Lr24*/*Sr26*), HD2204, HW 2008, VL 892, HS420, Sonalika and HS507 at IIWBR, Shimla with the disease severity ranging between MR to 20S. Black rust did not appear on WDMN entries in this zone.

North Western Plain Zone (NWPZ)

All the entries were showing YR infection at Kathua, Dhaulakuan, Jammu, and Ludhiana. On an average maximum severity of YR was reported from Langroya, where fourteen entries had more than 50S YR severity. Maximum YR severity was recorded on WL711 (90S) at Pantnagar. Two entries i.e. Agra Local and Lal Bahadur had more than 40S YR severity at all the locations of NWPZ except Durgapura and Abohar. HD3086 and HD3226 were free from yellow rust infection at Durgapura, Hisar and Pantnagar, while RNB1001 was YR free at Durgapura and Hisar. Entries WL711 and Kharchia Mutant had YR severity of more than 40S at 8 locations, while HD2329 and Lal Bahadur showed more than 40S severity at 10 and 9 locations, respectively.

Brown rust appeared only at Kathua, Rajouri, Hisar, Jammu, Ludhiana, Langroya and Pantnagar in NWPZ. WDMN entries DL 784-3 and RNB1001 were brown rust free at all the locations of NWPZ. Similarly, HP1633 was free from brown rust infection at all the locations except Hisar, where 40S severity of brown rust was recorded on it. There appears to be something wrong as it has *Lr9* which confers resistant to leaf rust. Brown rust appeared on HW2021 (*Lr24*/*Sr26*) only at Jammu, Langroya and Ludhiana. Maximum brown rust severity was observed at Pantnagar, where 12 entries (WL711, HD2329, Agra Local, HD2160, Lal Bahadur, WL1562, HD2204, WH147, HD3086, HD3226, DPBW621-50 and PBW752) had more than 40S severity of brown rust. Entries PBW752 and WH147 had 100S brown rust severity at Pantnagar. Black rust was not observed on any of the entries of WDMN in NWPZ.

North Eastern Plain Zone (NEPZ)

All the entries of WDMN were free from yellow rust infection in this zone. Brown rust appeared at all the locations of NEPZ except Ranchi. At Varanasi brown rust was reported only on WL711 (20S) and Kharchia Mutant (10S), whereas at Kalyani brown rust appeared only on K 8804 (5R), DBW187 (10R), HUW468 (5R) and NW1014 (20R). All the WDMN entries were free from brown rust infection at Sabour except WL711 (5S), HD2329 (5S), Agra Local (40S), Lal Bahadur (30S), RNB1001 (TS) and NW1014 (5S). More than 40S severity was recorded on WL711, HD2329, Agra Local, Lal Bahadur and Kharchia Mutant at Faizabad. Black rust did not appear on any of the entries of WDMN in this zone.

Central Zone

Yellow rust did not appear in this zone. Brown rust was observed only at Powarkheda and Junagarh. At Powarkheda seven entries {HD2160 (5S), Lal Bahadur (TR), WL1562 (TR) C 306 (10S), HW147 (10S) DL 784-3 (TR) and LOK-1 (TS)} had brown rust infection. Similarly six entries viz. WL711 (5R), HD2329 (TR), Agra Local (TR), Lal Bahadur (10MR), C 306 (TR) and LOK-1 (TR) had brown rust infection at Junagarh. Black rust was observed only at Powarkheda, where only seven WDMN entries {Agra Local (10S), HD2160 (TR), Lal Bahadur (5S), C 306 (10S), WH147 (10S), DL 784-3 (TR) and LOK-1 (10S)} showed black rust inaction.

Peninsular Zone and Southern Hill Zone

Yellow rust did not appear at any of the locations of these zones. Brown rust appeared at Dharwad, Pune and Wellington. At Pune only Lal Bahadur (40S) was infected with brown rust, while other entries were brown rust free. All WDMN entries except Agra Local (40S), Lal Bahadur (40S), HP1633 (20S), RNB1001 (5MR) and MACS 2496 (10MS) were brown rust free at Ugar Khurd (Dharwad). At Wellington six WDMN entries *viz*. WL711 (100S), HD2329 (60S), Agra Local (80S), Lal Bahadur (100S), HW147 (80S) and Bijaga Yellow (60S) had more than 60S severity of black rust.

Other diseases

Blights

Information on foliar blights was received from 12 locations. Blight was absent in all the locations of Northern hills zone except Almora, where up to 12 disease score was reported on all the entries except RNB1001 and HPW349. WDMN entries WL711, WL1562, HW2021 (*Lr24*/*Sr26*), WH147, DL 784-3 and HS507 had disease score of 12 at Almora. In NWPZ blight was recorded at Kathua, Rajouri and Jammu. All the entries of WDMN in NEPZ were infected with leaf blight except at Kanpur, where HD2329, Agra Local, HD2160, Lal Bahadur, WL1562, HD2204, C 306, HW 2008, DL 784-3, RNB1001, K 8804, DBW187 and HUW468 were blight free. Maximum leaf blight severity (79) at Varanasi was observed on HD2402.

Powdery mildew

Powdery mildew was reported only from 5 locations *viz*. Almora in Uttarakhand (NHZ), Kathua, Rajouri and Jammu in Jammu & Kashmir and Dhaulakuan in Himachal Pradesh (NWPZ). All the entries of had powdery mildew infection at all these locations except Barley Local at Almora. Maximum severity of PM was observed at Dhaulakuan with seventeen entries showing PM severity of 6 or more. Thirteen entries (HD2329, HD2160, Lal Bahadur, WL1562, C306, WH147, Kharchia Mutant, HP1633, DL 784-3, HD3086, HD3226, DPBW621-50, PBW752) had powdery mildew score of 9 at Dhaulakuan.

Loose smut

There was no report of loose smut from any of the locations where WDMN was planted.

8.4 SAARC Wheat Disease Monitoring Nursery (2018-19)

There is about twenty million hectares area under wheat in SAARC countries having more or less similar conditions for cultivation of wheat. Under these circumstances, it becomes a common interest of the SAARC nations to combat wheat diseases jointly. Like the objectives of WDMN in India, an exercise for understanding the differences, spread and intensity of wheat diseases in SAARC nations is attempted through the SAARC-Wheat Disease Monitoring Nursery (SAARC-WDMN). During 2018-19, SAARC-WDMN was planted at 28 locations across the six SAARC countries (Table 8.20).

Table 8.20: Detail of SAARC-WDMN locations and contact persons.

S. No.	Country/ Locations	Contact person
1.	Nepal (3 sets)	CIMMYT, New Delhi, India*
2.	Bangladesh (5 sets)	-do-
3.	Pakistan (2 sets)	-do-
4.	Bhutan (1 set)	-do-

5.	Afghanistan (1set)	-do-
6.	India (16 sets)	Head, ICAR-IIWBR RS, Flowerdale, Shimla
Total	**28 locations**	

*Coordinator: Dr. A.K. Joshi

Information on wheat diseases in SAARC Wheat Disease Monitoring Nursery has been received from all the locations in India. Data from Afghanistan, Bangladesh, Bhutan, Nepal and Pakistan is awaited. In India SAARC–WDMN was planted at 16 locations as detailed in Table 8.21.

Table 8.21. Locations of SAARC wheat disease monitoring nursery in India

State	Co-operator	Locations
Himachal Pradesh	Akhilesh singh	Dhaulakuan
Jammu & Kashmir	MK Pandey	Udhaywalla (Jammu)
	MK Pandey	Kathua
	MK Pandey and Deepak Kumar	Rajauri
Delhi	VK Singh and Koshal Kishor Sameriya	New Delhi
Punjab	Jaspal Kaur	Abohar
		Gurdaspur
		Langroya
		Ludhiana
		Ropar
Bihar	KK Singh	Pusa, Bihar
Rajasthan	PS Shekhawat	Durgapura (Jaipur)
Tamil Nadu	C. Manjunatha	Wellington
Uttar Pradesh	SP Singh	Faizabad
Uttarakhand	Deepshikha and Kanak Srivastava	Pantnagar
	KK Mishra	Almora

The SAARC wheat disease monitoring nursery comprised 20 lines contributed by four SAARC countries (Table 8.22).

Table 8.22. 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 660	19.	Gourab
10.	Pak 81	20.	Susceptible Check

Wheat Disease Situation in SAARC countries

Disease situation in India

Rusts

SAARC nursery was planted at one location of NHZ (Almora, Uttarakhand), 12 locations of NWPZ, Faizabad, Pusa and Wellington. Yellow rust was observed at all the SAARC-WDMN locations in NHZ and NWPZ except at Durgapura (Jaipur), Pusa & Faizabad in NEPZ and Wellington in SHZ. First report of yellow rust on SAARC WDMN was from Kathua (21.01.19) followed by Jammu (27.01.19), Dhaulakuan (08.02.19), Ludhiana (10.02.19), Rajouri (16.02.19) and Delhi (25.02.19) (Annexure 8). At Durgapura yellow rust was observed only on PBW 343, Faisalabad 85, Gourab and susceptible check, other entries were free from yellow rust. Maximum YR severity (Up to 80S) was

observed at Jammu and Ludhiana in NWPZ, where more than 40S severity of yellow rust observed on 16 entries of WDMN-SAARC. Fifteen entries had more than 40S yellow rust severity at Langroya, Gurdaspur and Ropar, whereas at Dhaulakuan fourteen entries had more than 40S yellow rust severity. Annapurna-1 was most susceptible with more than 40S yellow rust severity at all the locations of NWPZ and NHZ except for Delhi, Durgapura and Abohar. Similarly, PBW343 showed more than 40S YR severity at all the locations of NWPZ and NHZ except Durgapura, Abohar and Pantnagar.

Brown rust was observed at all the locations of except Dhaulakuan, Ropar and Abohar. The date of first appearance of brown rust was received from few locations. Earliest appearance of brown rust was from Kathua (28.02.19) followed by Faizabad (07.03.19), Jammu (10.03.19), Ludhiana (15.03.19), Delhi (18.03.19) and Almora & Rajouri (15.04.19) (Table 4). At Delhi brown rust was reported only on WL1562 (5S) and susceptible check (40S), whereas susceptible check (5S) was the only entry showing brown rust infection at Durgapura. Maximum brown rust severity with seventeen entries showing more than 30S disease severity was recorded at Pantnagar. Entry HP1633 was brown rust free at all the locations except Almora, where brown rust was observed on it in traces. Gourab was brown rust free at all the locations except at Almora (10S), Faizabad (TS) and Pantnagar (40S).
Black rust was observed at Wellington only. At wellington two entries HD2204 (10M) and HP1633 (10MS) had black rust infection (Annexure 8).

Blights
Leaf Blight (LB) of wheat was observed only at six locations (Jammu, Kathua, Rajouri, Pusa, Faizabad and Almora). All the entries were showing blight infection at these locations. First report of blight was from Kathua (18.02.19) followed by Jammu (24.02.19) and Almora (20.03.19) (Table 8.23). Severity of leaf blight was maximum at Pusa, where minimum LB score was 45 for PBW343 and maximum score was 68 for eleven entries viz. WL1562, HD2204, HP1633, PAK 81, Punjab85, Faisalabad85, Inquilab91, Faisalabad83, Bakhtawar94, Gourab and Susceptible check. Blight severity was minimum at Almora with maximum disease score of 12 on Annapurna-1, WL1562, HD2189, RAJ3765, Punjab85 and Kohsar.

Powdery mildew
Powdery mildew was observed only at six locations (Almora, Dhaulakuan, Jammu. Kathua, Langroya and Rajouri). First report of powdery mildew was from Kathua (18.02.19) followed by Jammu (24.02.19) and Almora (20.03.19). All the entries were infected with powdery mildew at all five locations (Table 8.24). Maximum severity of powdery mildew was observed at Dhaulakuan, where 17 entries had PM severity of 6 or more. Three entries *viz.* HD2204, PBW660 and Faisalabad83 had powdery mildew score of 3 at Dhaulakuan. Powdery mildew score of 3 or less was reported on fourteen entries from Almora. At Langroya RAJ3765 with powdery mildew score of 8 was the only SAARC-WDMN entry showing powdery mildew infection.

Loose Smut
Like previous years there was no report of loose smut from any of the locations of SAARC-WDMN nursery during 2018-19.

Table 8.23: Leaf blight Incidence in SAARC-Wheat Disease Monitoring Nursery in India during 2018-19.

S. No.	Varieties	Leaf blight					
		Almora	Faizabad	Jammu	Kathua	Pusa	Rajouri
1	Annapurna-1	12	36	35	34	56	24
2	WL1562	12	68	56	24	68	23
3	HD 2204	01	58	57	26	68	12
4	PBW 343	11	46	35	23	45	23
5	HD 2687	01	58	47	26	56	23

6	HD 2189	12	47	46	12	57	24
7	HP 1633	01	36	56	23	68	36
8	Raj 3765	12	46	46	46	57	36
9	PBW 373	11	58	24	24	56	12
10	Pak 81	02	58	35	26	68	24
11	Punjab 85	12	36	24	26	68	24
12	Chakwal 86	11	46	24	34	57	24
13	Faisalabad 85	01	45	35	36	68	12
14	Inquilab 91	11	46	24	26	68	23
15	Faisalabad 83	01	46	35	36	68	12
16	Rawal 87	11	58	25	24	57	23
17	Kohsar	12	46	24	16	57	24
18	Bakhtawar 94	11	35	13	24	68	24
19	Gourab	01	36	35	12	68	12
20	Susceptible check	12	78	46	36	68	36
Date of first appearance		-	-	24.02.2019	18.02.2019	-	-

Table 8.24: Powdery Mildew incidence in SAARC Wheat Disease Monitoring Nursery in India during 2018-19

S. No.	Varieties	Powdery Mildew					
		Almora	Dhaulakuan	Jammu	Kathua	Langroya	Rajouri
1	Annapurna-1	3	6	3	6	0	5
2	WL1562	5	9	5	6	0	5
3	HD 2204	1	3	6	7	0	7
4	PBW 343	5	6	5	6	0	5
5	HD 2687	3	9	7	6	0	4
6	HD 2189	3	9	7	4	0	3
7	HP 1633	3	6	3	7	0	3
8	Raj 3765	7	9	3	8	8	5
9	PBW 373	3	3	3	4	0	2
10	Pak 81	3	9	5	7	0	5
11	Punjab 85	5	6	7	6	0	7
12	Chakwal 86	3	9	3	7	0	3
13	Faisalabad 85	3	6	2	5	0	5
14	Inquilab 91	5	6	9	7	0	7
15	Faisalabad 83	3	3	7	6	0	7
16	Rawal 87	5	6	7	6	0	5
17	Kohsar	3	9	7	7	0	7
18	Bakhtawar 94	3	9	7	4	0	5
19	Gourab	3	6	6	5	0	7
20	Susceptible check	3	9	5	7	0	5
Date of 1st appearance		20.3.2019	-	24.2.2019	18.2.2019	-	-

Pramod Prasad, OP Gangwar, S.C. Bhardwaj and Subodh Kumar
Regional Station, ICAR-IIWBR
Flowerdale, Shimla-171 002

PROGRAMME 9. INTEGRATED PEST MANGEMENT IN WHEAT

9.1 HOST RESISTANCE AGAINST DISEASES

I. Elite Plant Pathological Screening Nursery (EPPSN), 2018-19

Biotic stresses are the major production constraints in wheat. Growing of resistant cultivars has been the most effective and easy way to minimize losses due to biotic stresses in wheat in India. However, to develop resistant cultivars, breeders are in need of new sources of resistance to incorporate these in the future cultivars to tackle the threat of evolving new virulence 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.

Total entries: 58
Diseases: Stripe, Leaf and Stem rusts
Centres:
North: Karnal, Ludhiana, New Delhi, Pantnagar, Hisar, Durgapura, Almora, Jammu, Malan (9)
South: Wellington, Mahabaleshwar, Dharwad, Indore, Niphad (5)

The nursery was inoculated with most virulent and prevalent pathotypes of stripe, leaf and stem rusts as in case of PPSN. The stem rust data and leaf rust data of Mahabaleshwar is not received. The highest score and ACI were calculated. Entries with ACI up to 10.0 were categorized as resistant (Table 9.1).

Resistant sources identified

Resistant to all the rusts:
HPW 442, HPW459, HS660, MPO1343(d), GW1339(d), GW1346(d), GW492, HW4101, K1601, MACS4059(d), MACS5051, UP3016, HPW441, HPW450, HS665, PBW800 and VL3018

Resistant to stem and leaf rusts:
HI1628, PBW757, AKAW4924, DBW223, HI1625, HI8800 (d), NIAW3170, NIAW3170, PBW770, UAS466 (d), BRW3792, HD3271, HD3298, HS666, PBW752, PBW766 and WH1235

Resistant to leaf and strip rusts:
PBW801, PBW777, PBW797, DBW187, MPO1336 (d), HS661

Resistant to stem and stripe rusts:
PBW763, HI1624, HPW451, HS662, GW491, DDK1054 and GW495

Table 9.1. Entries tested in Elite Plant Pathological Screening Nursery, 2018-19

S. No.	Entry	Rusts							
		Stem		Leaf		Leaf		Stripe	
		South		South		North		North	
		HS	ACI	HS	ACI	HS	ACI	HS	ACI
A. Resistant to all three rusts									
Source: AVTs Year 2017-18									
1	DBW187	60S	36.0	TMR	0.1	10S	3.8	10S	3.0
2	DBW237	60S	32.0	40S	11.0	TS	0.4	20S	6.7
3	DDW47(d)	40S	26.2	40MS	10.0	50S	14.6	20MS	5.9
4	HI1620	20S	11.3	0.0	1.0	50S	14.8	20S	10.9
5	HI1628	10MS	2.2	0.0	0.1	TS	0.4	60S	25.9
6	HI8802(d)	60S	29.2	60S	21.0	30S	10.2	5S	1.6
7	HI8805(d)	40S	15.2	80S	22.0	40S	12.2	10S	3.8

8	HPW 442	20MS	7.0	20S	7.1	10S	3.0	20MS	4.1
9	HPW459	20S	6.1	10MS	2.1	30S	6.0	10S	2.3
10	HS660	20S	7.3	10S	2.6	10S	5.6	20MS	6.4
11	HS661	60S	25.3	5S	2.6	5S	2.0	20S	9.0
12	HS662	10MS	2.5	20S	12.3	30S	11.0	20S	5.1
13	MPO1336(d)	40S	17.6	10MS	2.6	5S	1.2	40S	8.9
14	MPO1343(d)	20MS	8.1	0.0	0.0	5S	1.0	5MS	0.6
15	PBW757	20S	6.4	5MR	0.6	30S	8.2	40S	12.5
16	PBW763	20S	9.2	5MR	0.8	30S	12.4	5S	0.8
17	PBW771	40S	20.2	5MR	0.5	50S	14.0	5S	1.3
18	PBW801	30S	11.5	10S	3.6	10S	4.8	10MS	2.0
19	UAS465(d)	40S	16.3	5MS	1.1	40S	11.0	10MS	2.0
B. Resistant to Stem and Leaf rusts									
Source: AVTs Year 2017-18									
20	AKAW4924	20S	9.1	5S	1.8	15S	3.4	60S	18.3
20A	Infector	100S	55.0	100S	77.5	90S	72.0	80S	62.9
21	DBW223	10S	4.6	10MS	2.2	20S	6.0	40S	10.7
22	DDK1054	10S	5.1	40S	11.5	20S	4.4	20S	8.6
23	GW1339(d)	10S	4.6	10MR	1.5	30S	8.0	30MS	7.7
24	GW1346(d)	10MS	3.1	TMR	0.1	15S	5.0	20S	8.1
25	GW491	10MS	2.5	5S	1.4	50S	10.4	10S	5.9
26	GW492	10MS	4.1	5MR	0.6	40S	9.0	20MS	5.2
27	GW493	30MS	9.6	5S	2.3	50S	15.0	40S	12.3
28	GW495	20S	9.1	60S	18.3	60S	13.0	40S	9.0
29	HD3249	40S	11.2	40S	12.0	60S	16.4	10MS	3.3
30	HI1624	20S	6.3	60S	16.0	15S	6.0	10S	3.7
31	HI1625	10MS	3.1	20MR	2.5	15S	6.0	60S	19.9
32	HI1628	60MS	11.2	5MS	1.0	10S	2.0	60S	33.6
33	HI8800(d)	5MS	3.6	TMR	0.1	30S	6.4	80S	32.1
34	HW4101	5MS	2.1	20MS	4.6	15S	3.2	5S	1.9
35	K1601	10MS	4.0	10MR	2.5	10S	2.0	10S	2.9
36	MACS4059(d)	10MS	3.1	5S	1.8	15S	3.2	40S	7.2
37	MACS5051	5MS	2.0	TMR	0.1	30S	6.2	20S	5.5
38	NIAW3170	10MS	4.0	10S	3.0	30S	6.4	60S	21.1
39	NIAW3170	40MR	5.0	5MR	0.5	30S	6.8	80S	56.0
40	PBW770	20MR	3.1	TR	0.1	15S	3.0	60S	41.9
40A	Infector	100S	50.0	100S	85.0	90S	52.5	80S	62.9
41	UAS466(d)	10MS	3.6	TR	0.1	10S	2.0	60S	26.1
42	UP3016	5MS	2.3	10MS	2.2	10MS	1.8	40S	7.2
C. Resistant to Leaf and Stripe rusts									
Source: AVTs Year 2017-18									
43	BRW3792	TMS	0.2	0.0	0.0	5S	1.0	60S	34.6
44	HD3271	5MS	1.1	0.0	0.0	TS	0.2	40S	16.3
45	HD3298	20MR	4.4	5S	1.3	5S	1.2	80S	36.0
46	HPW441	5MS	1.3	10MS	2.5	10S	3.0	40S	9.9
47	HPW450	5MR	0.7	20S	7.6	15S	3.4	40S	9.0
48	HPW451	10MS	2.2	10S	5.0	50S	10.2	20S	3.9
49	HS665	10MS	3.1	5MS	2.1	5S	1.0	40MS	8.8
50	HS666	10S	3.5	0.0	0.0	5S	1.0	60S	25.6
51	PBW752	TMS	0.2	TR	0.1	10S	3.0	40S	17.8
52	PBW766	TMS	0.2	TMR	0.2	0	0.0	40S	15.0
53	PBW777	40S	16.0	5MS	1.1	TS	0.2	10MS	2.5
54	PBW797	40S	22.5	TR	0.1	40S	8.0	5S	2.6

55	PBW800	20MS	6.0	10S	2.5	5S	1.6	5S	1.0
56	VL3018	20MS	6.1	TR	0.1	5S	2.0	20S	6.7
57	WH1218	40S	16.0	10MS	2.1	5S	1.0	40S	13.4
58	WH1235	10S	3.5	0.0	0.0	5S	1.0	80S	23.6
58A	Infector	100S	65.0	100S	85.0	90S	70.0	80S	64.3

COOPERATORS:

NAME	CENTRE	RUSTS
JASPAL KAUR, RITU BALA	LUDHIANA	STRIPE
R.S. BENIWAL	HISAR	LEAF
DEEPSHIKHA, K.SRIVASTAVA	PANTNAGAR	STRIPE AND LEAF
P.S. SHEKHAWAT	DURGAPURA	STRIPE AND LEAF
P.V. PATIL, GURUDATT M. HEGDE	DHARWAD	STEM AND LEAF
T.L. PRAKASHA	INDORE	STEM AND LEAF
T.K. NARUTE, R. R. PERANE	MAHABALESHWAR	STEM AND LEAF
V.K. SINGH	NEW DELHI	LEAF
K K MISHRA	ALMORA	STRIPE
M.K. PANDEY	JAMMU	STRIPE
B.C. GAME, P.E. MORE	NIPHAD	STEM AND LEAF
SUDHEER KUMAR AND D P SINGH	KARNAL (CO-ORDINATING UNIT)	STRIPE AND LEAF

II. Multiple Disease Screening Nursery, 2018-19

Thirty eight resistant sources identified in EPPSN against rusts are cross checked for resistance to other diseases at hot spot multi-locations under artificially created conditions to reconfirm their resistance. Centers for stem rust: Mahabaleshwar, Indore, Dharwar, Niphad and Wellington; for stripe rust: Ludhiana, Pantnagar, Hisar, Dhaulakaun, Mallan, and Karnal; for leaf rust (N): Delhi, Ludhiana, Hisar and Karnal; for leaf rust (S): Mahabaleshwar, Indore, Dharwar, Niphad and Wellington; for Karnal bunt: Delhi, Dhaulakaun, Pantnagar, and Ludhiana; for leaf blight: Faizabad, Varanasi, Coochbehar, Sabour, Hisar, Murshidabad and Kalyani; for Head scab: Delhi, Dhaulakuan, Gurdaspur; for flag smut: Hisar, Ludhiana and Durgapura; for loose smut: Hisar, Ludhiana and Durgapura; for powdery mildew: Jammu, Pantnagar, Jammu and Mallan; and for cereal cyst nematode: Durgapura, hisar and Ludhiana. The KB data for Dhaulakaun, loose data for Almora, Leaf blight data for Murshidabad and Hisar not received. Based on the ACI up to 10.0, Karnal bunt up to 5.0%, Flag smut up to 5%, powdery mildew up to 3, head scab upto 2, and leaf blight up to Avg. score upto 35 and highest score upto 57 entries were categorized resistant (Table 9.2). Following entries were found to possess multiple disease resistance:

A. Resistant to stem, leaf and stripe rusts +

Resistant to all three rusts + PM + FS + KB: PBW 777, TL 3011(T), TL 3012(T), TL 3013(T), TL 3014(T), TL 3015(T)

Resistant to all three rusts + FS + KB: HS 611, PBW 778, B662, HG 110

Resistant to all three rusts + FS: HI 8791(d)

Resistant to all three rusts + PM + FS: VL 3014

Resistant to all three rusts + LB + FS + FHS: HS 645

Resistant to all three rusts + LB +PM + FS + KB: UAS 462(d)

B. Resistant to Stem and Leaf rust +

Resistant to Stem and Leaf rust + FS + KB: HI 1620, DDK 1053(dic.), HS 644, MACS 5047, MACS 5049, WH 1232, IWP 5019, Line 1172

Resistant to Stem and Leaf rust + LB + PM + FS + KB: DDK 1052(dic.)

Resistant to Stem and Leaf rust + PM + FS + KB: HS 646

Resistant to Stem and Leaf rust + KB: VL 3013

C. Resistant to leaf and stripe rust +
Resistant to leaf and stripe rust + PM + FS + KB: HPW 439, PBW 780, DBW 246
Resistant to leaf and stripe rust + LB + FS + KB: HD 3271
Resistant to leaf and stripe rust + FS + KB: HI 1619, KRL 370, DBW 251
Resistant to leaf and stripe rust + KB: HI 1612
Resistant to leaf and stripe rust + FS: HS 468, WH 1233

D. Resistant to LB +
Resistant to LB + PM + FS + KB + FHS: VL 1013

COOPERATORS

CENTERS	**COOPERATORS**
LUDHIANA	JASPAL KAUR, RITU BALA
ALMORA	K. K. MISHRA
HISAR	R.S. BENIWAL
DHAULAKUAN	AKHILESH SINGH
PANTNAGAR	DEEPSHIKHA, K. SRIVASTAVA
INDORE	T.L. PRAKASHA
MAHABALESHWAR	T.K. NARUTE, R. R. PERANE
COOCHBEHAR	S. HEMBRAM
WELLINGTON	P. NALLATHAMBI, C. UMA MAHESHWARI
FAIZABAD	S.P. SINGH
DURGAPURA	P.S. SHEKHAWAT
JAMMU	M. K. PANDEY
DHARWAD	P.V. PATIL GURUDATT M. HEGDE
NEW DELHI	V.K. SINGH AND M.S. SAHARAN
VARANASI	S.S. VAISH
KARNAL	SUDHEER KUMAR, P.L. KASHYAP D. P. SINGH (COORDINATING UNIT)
FOR CCN	
DURGAPURA	S.P. BISHNOI
HISAR	PRIYANKA DUGGAL
LUDHIANA	RAMANNA KOULAGI

Table 9.2 Reactions of different entries of Multiple Diseases Screening Nursery 2018-19 against diseases and CCN

S. No.	Entry	Stem rust South		Leaf rust South		Leaf rust North		Stripe rust North		LB (dd)		PM 0-9		FS (%)	KB (%)	FHB	CCN
Sources : EPPSN 2017-18		**HS**	**ACI**	**HS**	**ACI**	**HS**	**ACI**	**HS**	**ACI**	**HS**	**AV**	**HS**	**AV**	**HS**	**HS**	**HS**	**HS**
A. Resistant to all three rusts																	
Source: AVT Ist Year 2016-17																	
1	DBW246	40S	12.0	5MS	1.5	5MS	1.6	0	0.0	67	35	5	2	2.5	8.6	4	S
2	DBW251	30S	10.3	TR	0.1	0.0	0.0	20MS	6.6	78	46	6	2	2.6	0.0	3	S
3	HI8791(d)	30MS	6.6	20S	5.2	TR	0.1	20MS	5.2	78	46	7	4	0.0	9.5	3	S
4	HS611	10MS	2.0	20S	5.1	5S	3.0	10MS	1.3	78	56	7	2	1.6	2.9	3	S
5	HS645	5S	3.3	10S	2.5	10MS	2.7	10MS	1.7	56	35	6	4	2.5	9.7	2	S
6	PBW777	10S	3.5	20MS	5.1	10MS	4.3	5MS	0.6	56	46	4	3	5.2	2.3	4	S
7	PBW778	20S	6.3	5MS	1.0	20S	8.3	40S	8.3	67	46	6	3	5.6	5.0	4	S
8	TL3011 (T)	5MS	1.0	0	0.0	0	0.0	TS	0.1	78	46	2	0	0.0	3.3	5	S
9	TL3012 (T)	10S	2.5	10MR	1.1	TMS	0.3	5MS	0.6	78	56	3	1	0.0	0.0	5	HS
10	TL3013 (T)	5MS	1.0	10MR	1.1	TR	0.1	0	0.0	78	56	1	0	0.0	5.7	4	S
11	TL3014 (T)	5MS	1.0	10MR	1.0	0	0.0	0	0.0	78	46	3	1	0.0	0.0	5	S
12	TL3015 (T)	5MS	1.0	10MR	1.5	5MS	1.3	TMS	0.1	78	46	2	1	0.0	0.0	5	S
13	UAS462(d)	20MS	5.1	10S	6.0	20S	6.7	5S	0.8	56	35	5	3	0.0	5.6	5	S
14	VL1013	20S	14.2	10MR	1.1	40S	16.3	TS	0.3	56	35	5	2	5.6	4.5	1	S
15	VL3014	10MS	4.1	5MR	0.5	0	0.0	20S	4.6	67	46	4	1	6.3	11.1	4	S
16	WH1233	40S	13.5	5MR	0.5	10MS	2.7	10S	2.3	89	57	6	3	1.6	6.8	4	HS
17	B622	10MS	2.5	5S	3.5	TR	0.1	10S	1.6	89	57	9	5	0.0	0.0	5	HS
18	HG110	10MS	5.0	5MR	1.0	20MS	5.4	10S	2.7	78	67	9	5	0.0	0.0	5	S
B. Resistant to Stem and Leaf rusts																	
Source: AVT Ist Year 2016-17																	
19	HI1620	20S	7.1	5MR	1.0	10S	3.3	20S	5.2	57	46	6	2	4.5	0.0	4	S
20	DDK1052(dic)	10MS	3.0	TR	0.1	0.0	0.0	40S	22.3	46	25	3	1	3.6	0.0	4	S
20A	INFECTOR	100S	42.5	100S	75.0	90S	63.3	80S	64.3	79	57	6	4	16.5	22.6	5	S
20B	A9-30-1 for L.B.(C)	20S	10.3	100S	45.0	90S	55.0	60S	35.0	99	67	5	4	15.3	14.0	4	S
20C	UP2338 for K.B.(C)	10S	6.7	100S	42.7	80S	70.0	60S	43.3	78	56	6	5	18.6	16.2	5	S
20D	PBW343 for P.M.(C)	30S	16.7	80S	60.0	60S	50.0	80S	53.3	78	46	9	6	23.0	15.3	4	S
20E	Sonalika for L.S.(C)	40S	16.9	100S	73.3	80S	70.0	60S	43.3	78	67	6	4	25.0	11.2	5	S
21	DDK1053(dic)	10MS	3.1	20S	5.5	20S	6.7	40S	25.6	78	46	7	4	4.6	0.0	5	S
22	HS644	5R	0.5	5MR	0.6	10MS	4.3	40S	15.4	68	46	7	4	1.3	4.0	4	S
23	HS646	20S	5.1	20.0	7.6	10MS	2.7	40S	15.0	78	46	5	2	5.7	3.6	5	S
24	MACS5047	5MS	1.5	10S	2.6	5MS	1.3	40S	18.4	78	46	9	4	6.3	4.9	5	S

25	MACS5049	5R	0.7	5MR	0.5	0.0	0.0	40S	17.7	78	56	7	2	2.5	0.0	5	HS
26	MACS6677	20MS	7.0	80S	21.1	5S	3.3	40S	17.1	56	36	7	3	3.3	0.0	-	S
27	VL3013	20MR	3.1	10MR	1.6	0.0	0.0	10S	3.4	78	46	5	4	3.5	0.0	5	S
28	WH1232	10MS	2.6	10S	4.0	10MS	4.3	20S	12.1	67	57	5	4	3.2	5.0	4	S
29	IWP 5019	20MS	5.0	TR	0.1	20MS	7.0	40S	15.6	99	78	6	2	5.3	3.0	-	S
30	LINE 1172	10MS	5.3	5MS	1.5	10MS	4.3	20S	8.9	99	67	7	4	0.0	0.0	5	S
C. Resistant to Leaf and Stripe rusts																	
Source: AVT IInd Year 2016-17																	
31	HI1612	60S	33.1	5MS	1.5	0.0	0.0	20S	7.3	56	36	7	4	0.0	0.0	3	HS
Source: AVT Ist Year 2016-17																	
32	HD3271	40S	16.3	5MS	1.0	5MS	1.3	20S	5.0	45	36	7	4	2.6	5.0	5	S
33	HI1619	40S	20.1	5MS	1.0	5S	1.7	40S	7.5	78	47	7	3	3.5	0.0	4	HS
34	HPW439	40S	18.3	5MR	0.6	5S	3.0	10S	5.0	67	46	5	2	4.5	3.3	4	HS
35	HS648	40S	21.0	0	0.0	TR	0.1	20S	3.6	67	47	5	4	5.3	10.0	3	S
36	KRL370	40S	18.5	10MS	2.0	5S	1.7	40S	8.9	67	46	9	3	6.6	2.9	3	S
37	PBW780	30S	11.6	0	0.0	20S	8.0	10S	2.9	67	46	5	2	2.5	5.8	3	S
38	WH1316	40S	17.7	60S	16.1	20S	9.3	40S	8.3	78	46	5	3	2.3	2.0	4	S
38A	INFECTOR	100S	45.0	100S	90.0	90S	76.7	80S	57.1	78	67	9	7	16.7	19.7	4	S
38B	A9-30-1 for L.B.(C)	40S	20.3	100S	66.7	90S	55.0	80S	50.0	99	77	9	6	15.3	14.2	4	S
38C	UP2338 for K.B.(C)	10S	5.1	100S	42.7	80S	70.0	60S	50.0	78	57	9	6	18.6	12.3	5	S
38D	PBW343 for P.M.(C)	40MS	22.0	100S	60.0	60S	50.0	80S	58.3	78	56	9	6	23.3	14.6	4	S
38E	Sonalika for L.S.(C)	40S	26.9	100S	63.3	80S	70.0	80S	55.0	78	57	9	6	25.0	18.6	5	S

III. Screening of MDSN 2017-18 entries against loose smut during 2018-19

Fifty three entries of MDSN 2016-17 were inoculated with loose smut during 2017-18 crop season and expression of loose smut was observed during 2018-19 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, 2017-18, against loose smut during 2018-19 crop season

S. No.	Entry	Loose smut (%)				
		Durgapura	Hisar	Ludhiana	HS	AV
Sources : EPPSN 2016-17						
A. Resistant to all three rusts						
Source: AVT II Year 2015-16						
1	HI 8759 (d)	0.0	12.5	0.0	12.5	4.2
Source: AVT Ist Year 2015-16						
2	HI 8774 (d)	0.0	26.6	0.0	26.6	8.9
3	HPPAU 05	6.5	13.3	7.0	13.3	8.9
4	HPW 423	19.1	36.1	1.9	36.1	19.0
5	HPW 433	0.0	28.6	0.0	28.6	9.5
6	HS 622	14.9	18.3	10.0	18.3	14.4
7	HS 623	15.8	14.3	32.5	32.5	20.9
8	HS 626	5.4	71.1	30.4	71.1	35.6
9	HS 628	32.7	24.3	31.7	32.7	29.6
10	PBW 725	19.0	35.0	0.0	35.0	18.0
11	PBW 756	15.7	NG	3.4	15.7	9.6
12	PBW 760	15.1	5.0	9.2	15.1	9.8
13	RKD 283 (d)	1.2	4.6	5.5	5.5	3.8
14	TL 3006 (T)	0.0	5.0	0.0	5.0	1.7
15	TL 3007 (T)	0.0	5.0	0.0	5.0	1.7
16	TL 3008 (T)	0.0	8.3	0.0	8.3	2.8
17	TL 3009 (T)	0.0	6.7	0.0	6.7	2.2
18	VL 3002	0.0	21.1	0.0	21.1	7.0
19	VL 3012	3.1	12.5	25.5	25.5	13.7
20	WH 1181	13.2	16.7	26.0	26.0	18.6
20A	Sonalika for L.S.(C)	52.1	35.0	30.6	52.1	39.2
21	WH 1216	15.8	14.2	0.0	15.8	10.0
22	WH 1310	20.8	15.0	36.1	36.1	24.0
23	HS 627	17.0	14.3	22.2	22.2	17.8
24	WH 1184	0.0	10.0	21.6	21.6	10.5
B. Resistant to Stem and Leaf rusts						
Source: AVT II Year 2015-16						
25	HD 3171	0.0	12.5	10.4	12.5	7.6
26	WB 2	18.8	12.5	12.3	18.8	14.5
Source: AVT Ist Year 2015-16						
27	AKAW 4842	15.6	37.5	24.5	37.5	25.9
28	DBW 179	7.0	24.0	17.6	24.0	16.2
29	DBW 216	47.4	26.6	24.6	47.4	32.9
30	DBW 217	30.2	13.3	26.3	30.2	23.3
31	DBW 219	3.4	18.7	9.1	18.7	10.4
32	DDK 1051 (dic.)	0.0	5.0	0.0	5.0	1.7
33	MACS 5044 (dic.)	3.1	5.0	0.0	5.0	2.7
34	MACS 5046 (dic.)	0.0	8.3	0.0	8.3	2.8

35	NW 6094	65.0	5.0	46.7	65.0	38.9
36	PBW 621	12.5	5.0	15.7	15.7	11.1
37	RKD 292 (d)	0.0	NG	4.3	4.3	2.2
38	VL 4001	6.9	5.0	7.2	7.2	6.4
39	WH 1215	21.7	6.7	0.0	21.7	9.5
40	UP 2955	0.0	12.5	0.0	12.5	4.2
40A	Sonalika for L.S.(C)	57.6	25.0	35.4	57.6	39.3
41	VL 3011	53.2	53.3	33.3	53.3	46.6
C. Resistant to Leaf and Stripe rusts						
Source: AVT Ist Year 2015-16						
42	DBW 220	0.0	12.5	33.3	33.3	15.3
43	PBW 757	0.0	24.0	8.5	24.0	10.8
44	HPPAU 10	0.9	63.3	22.1	63.3	28.8
45	HPW 424	16.9	37.1	26.3	37.1	26.8
46	NW 6046	6.6	12.5	16.9	16.9	12.0
47	PDW 344 (d)	12.1	NG	19.5	19.5	15.8
48	UAS 459 (d)	8.8	5.0	0.0	8.8	4.6
49	UP 2954	7.5	6.6	26.9	26.9	13.7
D. Resistant to Stem and Leaf rusts & WB						
50	DBW 88	30.8	18.3	22.6	30.8	23.9
51	HD2967	7.9	26.0	37.7	37.7	23.9
E. Resistant to Leaf rusts & WB						
52	HD 3171	8.5	11.1	16.7	16.7	12.1
53	HD 3043	9.2	26.0	37.5	37.5	24.2

COOPERATORS:

NAME	**CENTRE**
JASPAL KAUR, RITU BALA	LUDHIANA
R.S. BENIWAL	HISAR
P.S. SHEKHAWAT AND NITIN CHAWLA	DURGAPURA
SUDHEER KUMAR, P.L. KASHYAP AND D.P. SINGH	KARNAL (COORDINATING UNIT)

IV. National Genetic Stock Nursery (NGSN), 2018-19

The confirmed sources of multiple disease and insect pest resistance were contributed in the NGSN and were planted at 27 breeding centers across different agro climatic zones of country for their utilization in breeding for resistance to biotic stresses. All 16 entries were utilized in the range of 7.4 – 48.1% by the breeding centres (Fig. 9.1). The most utilized entries at many centres were HS 626, DBW 179, WH 1310 and HS 627 (Table 9.4). The Faizabad centre, utilized maximum 13 entries in their breeding programme followed by Niphad (Fig. 9.2).

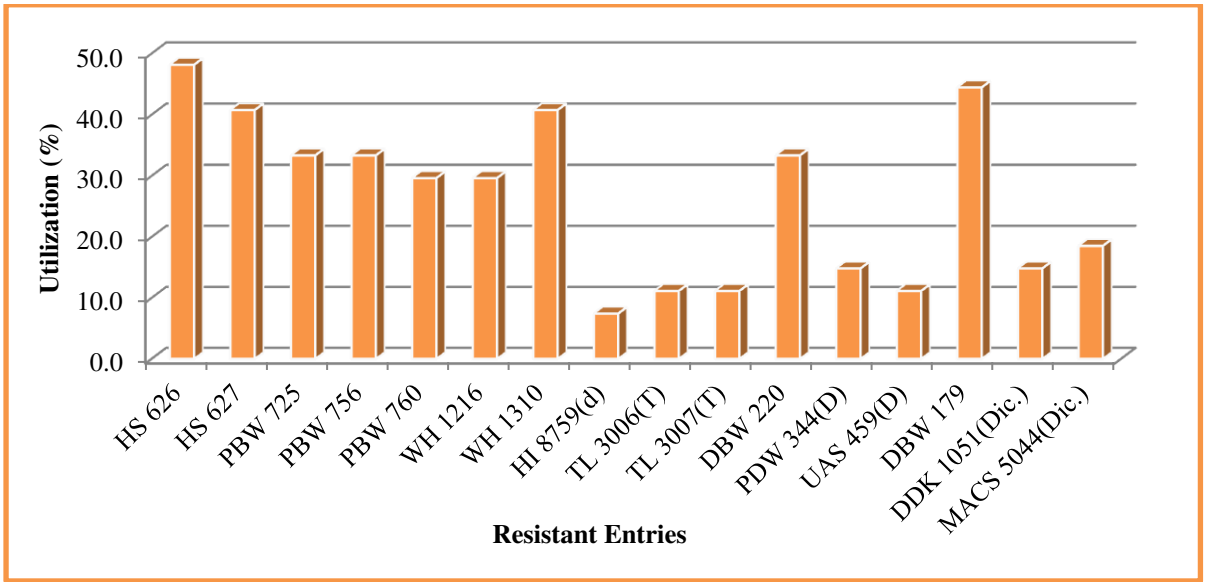

Fig. 9.1. Percent utilization of promising resistant genotypes at different breeding centres in NGSN, 2018-19

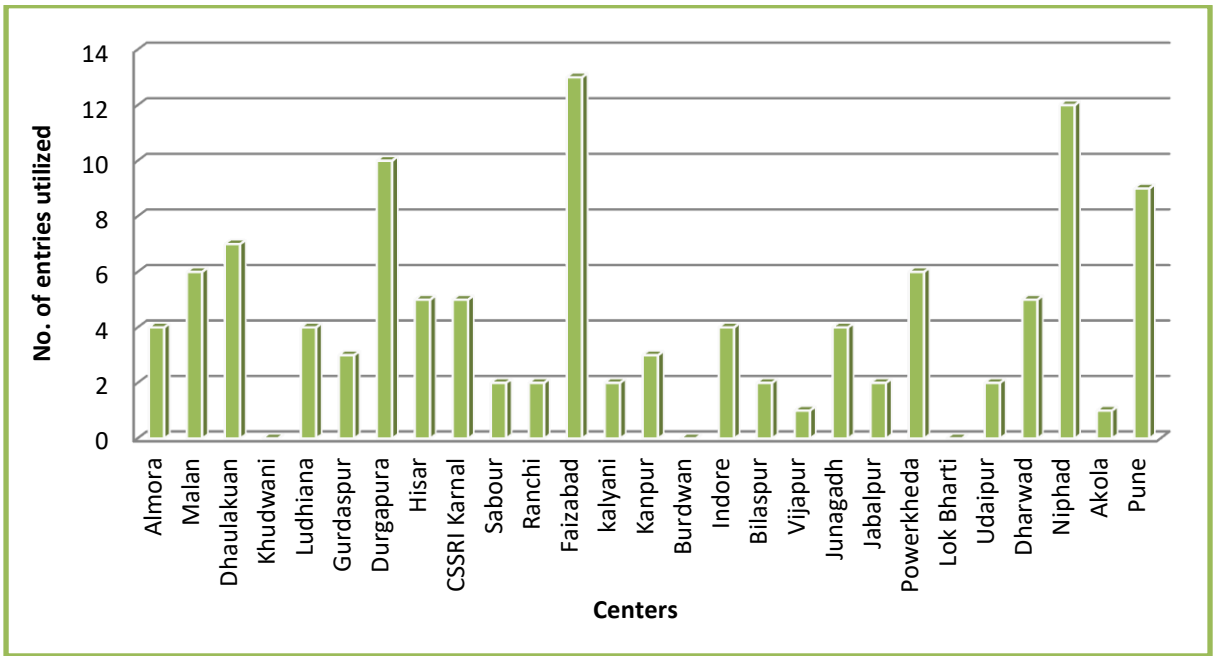

Fig. 9.2. Centre wise utilization of promising resistant genotypes from NGSN, 2018-19

Table 9.4. National genetic stock nursery (NGSN), 2018-19

S. No.	Entry	Almora	Malan	Dhaulakuan	Khudwani	Ludhiana	Gurdaspur	Durgapura	Hisar	CSSRI Karnal	Sabour	Ranchi	Faizabad	kalyani	Kanpur	Burdwan	Indore	Bilaspur	Vijapur	Junagadh	Jabalpur	Powerkheda	Lok Bharti	Udaipur	Dharwad	Niphad	Akola	Pune	Total
1	HS 626	1		1		1			1	1			1		1		1			1	1	1		1				1	**13**
2	HS 627		1	1		1		1	1	1	1		1									1			1	1			**11**
3	PBW 725	1	1	1				1	1				1									1				1		1	**9**
4	PBW 756		1	1			1	1	1	1										1		1						1	**9**
5	PBW 760		1	1			1	1					1				1			1								1	**8**
6	WH 1216		1	1				1	1						1		1			1						1			**8**
7	WH 1310	1		1		1		1		1		1	2						1						1		1		**11**
8	HI 8759(d)																					1				1			**2**
9	TL 3006(T)												1	1												1			**3**
10	TL 3007(T)												1											1		1			**3**
11	DBW 220							1				1	1	1			1	1							1	1		1	**9**
12	PDW 344(D)												1		1											1		1	**4**
13	UAS 459(D)												1								1					1			**3**
14	DBW 179	1	1			1	1	1		1	1		1					1				1				1		1	**12**
15	DDK 1051(Dic.)							1																	1	1		1	**4**
16	MACS 5044(Dic.)							1					1												1	1		1	**5**
	Total	**4**	**6**	**7**	**0**	**4**	**3**	**10**	**5**	**5**	**2**	**2**	**13**	**2**	**3**	**0**	**4**	**2**	**1**	**4**	**2**	**6**	**0**	**2**	**5**	**12**	**1**	**9**	**114**

Cooperators: D P SINGH, SUDHEER KUMAR, P.L. KASHYAP AND S. K. SINGH

9.2 Management of Diseases: Chemical Control

Evaluation of chemical fungicides namely, Trifloxystrobin+ Tebuconazole at different concentrations along with standard recommended fungicide, Propiconazole @0.1% were performed at Jammu and Karnal locations for the management of yellow rust of wheat. Foliar application of Trifloxystrobin+ Tebuconazole @ 0.1% at rust infection initiation followed by two sprays at 15 days interval was found effective in controlling the yellow rust infection on both PBW343 and HD 2967 cultivars (Table 9.5). Highest yield was recorded in the Trifloxystrobin+ Tebuconazole @ 0.1% combination followed by Trifloxystrobin+ Tebuconazole @ 0.06%, when these fungicides were applied at disease initiation followed by two sprays at 15 days interval on wheat foliage (Fig. 9.3). The experiments for the chemical management of yellow rust using fungicide combinations involving Trifloxystrobin+ Tebuconazole and Propiconazole at different concentrations were also conducted at Ludhiana during 2018-19. Two spray of Propiconazole @0.1% was found equally effective to two sprays of Trifloxystrobin+ Tebuconazole against yellow rust.

Table 9.5 : Chemical control of yellow rust of wheat during 2018-19 at two different locations

Treatments	Description of treatments	No of sprays	HD 2967		PBW343	
			Jammu	Karnal	Jammu	Karnal
T1	Unsprayed control	-	*55.0	55.0	72.5	60.0
T2	Trifloxystrobin+ Tebuconazole @ 0.06%	1	36.5	7.5	55.0	23.0
T3	Trifloxystrobin+ Tebuconazole @ 0.06%	2	20.0	10.0	27.0	18.0
T4	Trifloxystrobin+ Tebuconazole @ 0.06%	2	9.3	8.0	7.0	19.0
T5	Propiconazole @0.1%	1	20.0	8.5	50.0	24.0
T6	Trifloxystrobin+ Tebuconazole @ 0.1%	2	11.5	6.0	9.0	17.0
T7	Trifloxystrobin+ Tebuconazole @ 0.1%	3	3.3	9.5	2.0	20.0
*ACI						

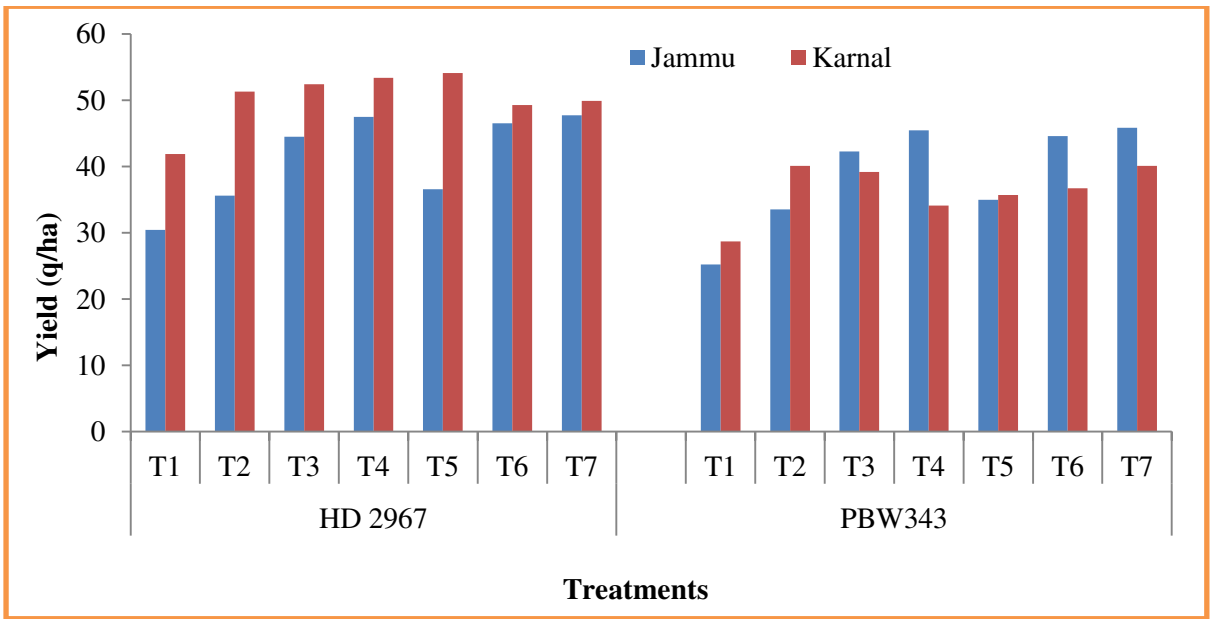

Fig 9.3: Effect of chemical fungicides employed for the management of yellow rust on wheat yield at two different locations during 2018-19.

PROGRAMME 10. Wheat Entomology

Wheat entomology programme covers three aspects viz. host plant resistance, integrated pest management (IPM) and stored grain pest management. During 2018-19 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 integrated pest management aspect coveredsurvey and surveillance of insect-pests and their natural enemies, trapping efficiency of different type of insect-traps for monitoring insect-pests and effect of varied nitrogen fertilization on aphid and termite infestation in wheat. Besides, studies were also conducted on influence of sowing time on the incidence and population build-up of major insect pest of wheat and eco friendly management of foliar aphid and termites through bio-pestcides and chemical insecticides. The salient findlings of the experiments conducted during 2018-19 at various AICRP centres are given below.

10.1(A) HOST PLANT RESISTANCE

The results are described here in the following paragraphs.

A1: Entomological Screening Nurseries (ESN)

AVT-Entries

(a) Shoot fly

Amongst 158 AVT entries tested at five locations during 2018-19,113 entries showed average of shoot fly infestation below 10% of. The lowest infestation of shootfly i.e 5.04 % was recorded in entry HI 1628. Entry HPW467 had lowest infestation of 4.64% at Dharwad whereas at Ludhiana, entry DBW 252* had lowest infestation of 4.12%. Two entries viz.,HI 1628*and HI 8805(d)* recorded lowest infestation of 3.57% at Kanpur (Table A1-10.1a).

(b) Brown wheat mite

At Ludhiana, two entries viz., recorded PBW821M and MACS6478 (C) recorded the minimum mite population of 7/10 cm^2 area while at Durgapura location entry HI8627 (d) (C) recorded the minimum mite population of 9.33/10 cm^2(Table A1-10.1a).

(c) Foliar wheat aphid and root aphid

Foliar aphid: The foliar wheat aphid screenings nursery consisting of 158 AVT genotypes was screened at five locations *viz.*Niphad, Ludhiana, Karnal, Shillongani, and Kharibari. Aphid count/shoots were recorded at weekly interval from all these genotypes and grades were given according to 5 point system described below.

Grading and rating of foliar aphid and root aphid on the basis of population in wheat

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

On the basis of average aphid score of four locations, amongst 158 AVT entries, four entries viz., DBW93 (C), UP3043, KRL19 (C) and PBW757 (C) scored lowest (3.8).Three entries viz. GW 1348 (d),DBW93 (C) and UP3043 at Ludhiana and six entries at Karnal DBW93 (C),UP3043, HD3086 (C),WH1223, KRL19 (C) and PBW757(C) showed moderately resistance to foliar aphid. However, at Kharibari, one entry UP3042 was found to be resistant (grade 2) and three entries viz., DBW304, DBW302 and PBW825 were found to be moderately resistant. At Niphad, all the entries were found to be either in susceptible (grade 4) or highly susceptible (grade 5) category.Shillongani data was included because of low aphid numbers on checks(Table A1-10.1b).

Root aphid: Out of total 158 entries, eight entries *viz.* PBW752 (I) (C), WH1124 (C), BRW 3806*, NIDW 1158 (d), GW322 (C), UAS 466(d)*, AKDW2997-16(d) (C) and HI1621 showed the moderately resistance reaction at Ludhiana(Table A1-10.1b).

NIVT-Entries

(a) Foliar aphid:

Amongst NIVT entries, all the entries were found to be either in susceptible (grade 4) or highly susceptible (grade 5) category (Table A1-10.1c).

(A2) Multiple pest screening nurseries (MPSN)

(a)Shoot fly: The average minimum score (6.01%) for shoot fly was observed in entry HI1612 and the maximum score of 15.26% was recorded for GW 173 (C) (Table A2-10.1a).
(b)Brown wheat mite: The lowest population of 10 brown wheat mites/ 10 cm2 area was recorded for DBW251 at Ludhiana while entry HI8791 (d) had lowest population of 10.66 mites/ 10 cm^2 (Table A2-10.1a).
(c) Foliar aphid: Based on average score of four locations, two entries DBW251 and PBW780 showed moderately resistance to foliar aphid (Table A2-10.1b).
(d)Root aphid: At Ludhiana, one entry B622 was found to be moderately resistant (grade 3) to root aphid (Table A2-10.1b).

Table A1-10.1a: Screening of AVT lines against Shootfly and Brown Wheat mite (Year-2018-19)

Entry no.	Code	Entry	Shoot fly Incidence (%)							Brown Wheat mite (No. of mites/10 cm^2 area)	
			Dharwad	Ludhiana	Niphad	Kharibari	Kanpur	Av. incidence (%)	Highest incidence (%)	Ludhiana	Durgapura
I. Northern Hill Zone											
1	NHTSZ-01	HPW349 (C)	9.62	9.52	0.00	2.00	20.00	8.23	20.00	20.00	12.33
2	NHTSZ-02	VL907 (C)	11.38	16.67	0.00	2.00	16.00	9.21	16.67	25.00	17.00
3	NHTSZ-03	HS507 (C)	12.78	13.38	0.00	2.00	16.66	8.96	16.66	12.00	11.33
4	NHTSZ-04	HS652	10.39	18.63	3.33	2.00	13.33	9.54	18.63	15.00	10.66
5	NHTSZ-05	HS562 (C)	13.07	14.75	0.00	1.00	16.66	9.10	16.66	10.00	12.00
6	NHLSZ-01	VL892 (C)	15.65	15.85	8.33	1.00	16.00	11.37	16.00	18.00	10.66
7	NHLSZ-02	HS490 (C)	13.43	15.45	0.00	1.00	16.00	9.18	16.00	10.00	14.00
8	NHLSZ-03	HPW468	8.61	11.43	3.33	1.00	12.00	7.27	12.00	14.00	16.66
9	NHLSZ-04	HS673	22.67	16.30	3.33	2.00	8.00	10.46	22.67	8.00	11.66
10	NHLSZ-05	VL3020	15.43	13.33	0.00	3.00	13.33	9.02	15.43	25.00	10.00
11	NHLSZ-06	UP3041	16.67	16.00	1.66	2.00	10.00	9.27	16.67	14.00	14.33
12	NHLSZ-07	HPW467	4.64	11.82	3.33	2.00	16.00	7.56	16.00	15.00	18.00
13	NHLSZ-08	HS674	7.45	9.23	6.66	3.00	8.00	6.87	9.23	18.00	15.00
14	NHLSZ-09	VL3019	8.09	13.54	3.33	2.00	13.33	8.06	13.54	10.00	17.66
15	NHLSZ-10	VL3021	11.54	12.56	5.00	2.00	13.33	8.89	13.33	10.00	13.33
II. North Western Plain Zone											
16	NW-TS-101	WH1105 (C)	16.52	12.73	0.00	2.00	16.66	9.58	16.66	15.00	10.33
17	NW-TS-102	HD3226(I) (C)	5.85	13.02	0.00	1.00	13.33	6.64	13.33	13.00	9.66
18	NW-TS-103	HD3086 (C)	11.71	9.70	0.00	2.00	16.66	8.01	16.66	22.00	10.66

19	NW-TS-104	PBW820[M]	10.67	12.50	6.66	1.00	13.33	8.83	13.33	18.00	10.00
20	NW-TS-105	DBW 221*	11.37	8.21	3.33	2.00	12.00	7.38	12.00	16.00	11.00
20 A	INFECTOR	Infector	14.00	19.26	3.33	3.00	20.00	11.92	20.00	30.00	22.46
21	NW-TS-106	DBW 222*	11.19	10.43	0.00	2.00	20.00	8.72	20.00	9.00	12.00
22	NW-TS-107	PBW550 (C)	11.65	10.24	0.00	3.00	15.00	7.98	15.00	20.00	10.66
23	NW-TS-108	PBW821[M]	13.64	14.86	0.00	2.00	16.66	9.43	16.66	7.00	11.00
24	NW-TS-109	HD2967 (C)	8.57	10.81	3.33	3.00	20.00	9.14	20.00	10.00	16.00
25	NW-TS-110	NW 7049	9.87	16.67	0.00	2.00	20.00	9.71	20.00	8.00	12.33
26	NW-TS-111	DPW621-50 (C)	9.75	14.61	3.33	3.00	13.33	8.80	14.61	15.00	14.66
27	NW-TS-112	DBW88 (C)	9.09	14.55	0.00	2.00	15.00	8.13	15.00	17.00	15.00
28	NW-LS-201	PBW752(I) (C)	8.60	14.14	0.00	3.00	15.00	8.15	15.00	20.00	17.00
29	NW-LS-202	DBW173 (C)	11.43	10.91	0.00	2.00	10.71	7.01	11.43	12.00	15.33
30	NW-LS-203	WH1021 (C)	9.25	15.79	6.66	3.00	7.69	8.48	15.79	15.00	13.66
31	NW-LS-204	HD3059 (C)	7.50	8.89	0.00	2.00	7.69	5.22	8.89	14.00	14.33
32	NW-LS-205	WH1124 (C)	11.28	14.15	3.33	3.00	12.50	8.85	14.15	12.00	9.33
33	NW-LS-206	PBW 771*	15.95	9.52	0.00	2.00	6.25	6.74	15.95	16.00	12.66
34	NW-RI-301	HI1620(I) (C)	7.72	17.65	0.00	2.00	3.12	6.10	17.65	15.00	11.33
35	NW-RI-302	PBW 796	16.67	13.16	0.00	2.00	8.57	8.08	16.67	10.00	10.66
36	NW-RI-303	HI 1628*	7.45	12.20	0.00	2.00	3.57	5.04	12.20	12.00	13.33
37	NW-RI-304	WH1142 (C)	11.08	9.85	0.00	2.00	7.14	6.01	11.08	20.00	11.66
38	NW-RI-305	HD3043 (C)	12.55	12.90	3.33	2.00	11.11	8.38	12.90	24.00	16.00
39	NW-RI-306	PBW644 (C)	16.00	14.29	0.00	1.00	7.69	7.80	16.00	13.00	15.33
40	NW-RI-307	HD3237(I) (C)	13.10	15.00	3.33	2.00	15.38	9.76	15.38	18.00	13.66
40 A	INFECTOR	Infector	30.21	32.69	3.33	3.00	13.79	16.60	32.69	28.00	22.33
41	NW-RI-308	BRW 3806*[#]	33.68	21.18	5.00	3.00	15.38	15.65	33.68	12.00	12.33
42	NW-RI-309	NIAW 3170*	13.11	10.91	3.33	3.00	18.18	9.71	18.18	16.00	13.66
43	NW-RI-310	WH1080 (C)	11.95	12.38	3.33	3.00	15.38	9.21	15.38	18.00	10.33
III. North Eastern Plain Zone											
44	NE-IR-101	HD3249*[#Q]	15.36	16.25	0.00	2.00	16.00	9.92	16.25	10.00	10.33
45	NE-IR-102	HD2733 (C)	12.47	12.31	0.00	3.00	7.69	7.09	12.47	15.00	13.00
46	NE-IR-103	PBW 781	13.60	14.78	5.00	2.00	7.14	8.50	14.78	25.00	12.66
47	NE-IR-104	DBW 257	15.50	16.30	5.00	3.00	8.00	9.56	16.30	20.00	13.33
48	NE-IR-105	DBW39 (C)	28.78	19.78	0.00	2.00	4.00	10.91	28.78	13.00	12.66
49	NE-IR-106	HD 3277	21.07	11.33	3.33	3.00	9.37	9.62	21.07	8.00	11.33
50	NE-IR-107	RAJ 4529	21.38	18.25	0.00	2.00	3.84	9.09	21.38	15.00	15.33
51	NE-IR-108	DBW187(I) (C)	12.00	14.55	0.00	3.00	15.62	9.03	15.62	20.00	15.00
52	NE-IR-109	WH 1239	14.62	14.17	3.33	2.00	14.28	9.68	14.62	25.00	14.00
53	NE-IR-110	K0307 (C)	10.53	12.82	5.00	1.00	12.00	8.27	12.82	28.00	10.00
54	NE-IR-111	HD2967 (C)	13.86	15.24	5.00	1.00	11.53	9.33	15.24	13.00	11.33
55	NE-RI-301	K1317 (C)	13.25	13.00	0.00	1.00	6.25	6.70	13.25	20.00	10.33
56	NE-RI-302	HI1612 (C)	7.01	14.12	0.00	1.00	9.37	6.30	14.12	10.00	10.33
57	NE-RI-303	HD 3293	10.97	17.48	0.00	2.00	17.85	9.66	17.85	14.00	11.66
58	NE-RI-304	HD3171 (C)	22.35	12.50	0.00	3.00	8.00	9.17	22.35	23.00	12.00
59	NE-RI-305	HD2888 (C)	10.83	8.89	3.33	2.00	16.00	8.21	16.00	12.00	13.66
60	NE-RI-306	DBW 252*[#]	12.97	4.12	0.00	3.00	15.00	7.02	15.00	25.00	12.33
60 A	INFECTOR	Infector	32.00	20.97	3.33	3.00	12.71	14.40	32.00	26.00	21.33
61	NE-RI-307	K8027 (C)	13.33	4.35	3.33	3.00	17.85	8.37	17.85	20.00	12.66
62	NE-RI-308	DBW 273	8.21	3.33	0.00	3.00	15.62	6.03	15.62	16.00	11.33
IV. Central Zone											
63	CZ-TS-101	HI8713(d) (C)	25.26	19.05	0.00	0.00	11.53	11.17	25.26	20.00	16.33
64	CZ-TS-102	NIDW 1158 (d)	23.72	9.24	0.00	0.00	10.71	8.73	23.72	14.00	12.66
65	CZ-TS-103	HI 8811 (d)	12.92	11.27	3.33	0.00	11.53	7.81	12.92	20.00	13.33
66	CZ-TS-104	HD3343[M]	20.98	8.62	1.66	0.00	10.71	8.39	20.98	12.00	11.33
67	CZ-TS-105	GW322 (C)	8.00	14.84	0.00	0.00	4.54	5.48	14.84	10.00	14.00
68	CZ-TS-106	HI1544 (C)	18.82	14.60	0.00	0.00	14.28	9.54	18.82	13.00	10.00
69	CZ-TS-107	HI8737(d) (C)	20.50	MIS	3.33	1.00	16.66	10.37	20.50	22.00	12.33
70	CZ-TS-108	HI 8812 (d)	15.60	MIS	3.33	2.00	7.69	7.16	15.60	19.00	14.33
71	CZ-TS-109	GW 1348 (d)	35.00	MIS	0.00	1.00	7.14	10.79	35.00	12.00	15.00
72	CZ-TS-110	DDW 49 (d)	21.82	12.32	0.00	2.00	14.28	10.08	21.82	17.00	11.33
73	CZ-TS-111	PBW 822[B]	13.83	6.84	6.66	1.00	10.71	7.81	13.83	20.00	11.33
74	CZ-TS-112	HD 3345[B]	19.15	12.66	5.00	2.00	7.69	9.30	19.15	22.00	14.33
75	CZ-TS-113	DDW 48 (d)	12.63	6.96	0.00	1.00	9.09	5.94	12.63	13.00	10.66
76	CZ-RI-301	HI8627(d) (C)	25.83	6.40	0.00	2.00	14.28	9.70	25.83	25.00	9.33
77	CZ-RI-302	DBW110 (C)	19.35	11.49	0.00	1.00	10.71	8.51	19.35	24.00	15.00
78	CZ-RI-303	UAS 466(d)*	12.00	8.00	0.00	2.00	7.69	5.94	12.00	25.00	17.00
79	CZ-RI-304	MP3288 (C)	28.82	4.27	0.00	1.00	5.55	7.93	28.82	15.00	12.66
80	CZ-RI-305	DBW 277	8.97	11.40	0.00	2.00	16.66	7.81	16.66	20.00	11.33
80	INFECTOR	Infector	15.38	25.50	3.33	3.00	13.63	12.17	25.50	28.00	22.66

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81	CZ-RI-306	DDW 47(d)*[Q]	27.22	11.81	0.00	4.00	14.28	11.46	27.22	10.00	12.66
82	CZ-LS-201	HD2932 (C)	24.35	11.32	3.33	3.00	8.69	10.14	24.35	20.00	13.33
83	CZ-LS-202	HD2864 (C)	15.83	15.08	0.00	4.00	7.69	8.52	15.83	18.00	10.66
84	CZ-LS-203	MP3336 (C)	15.91	12.57	0.00	1.00	13.63	8.62	15.91	22.00	14.33
85	CZ-LS-204	MP4010 (C)	20.48	9.66	0.00	2.00	9.09	8.25	20.48	20.00	11.66
86	CZ-LS-205	CG1029	29.29	14.74	0.00	1.00	13.63	11.73	29.29	13.00	10.33
87	CZ-LS-206	UAS3002	10.00	10.34	6.66	2.00	8.00	7.40	10.34	16.00	12.66
88	CZ-LS-207	HI1633	15.79	10.00	8.33	1.00	6.25	8.27	15.79	18.00	13.33
89	CZ-LS-208	HI1634	10.55	11.81	3.33	2.00	16.66	8.87	16.66	26.00	11.66
90	CZ-LS-209	HI8808 (d)	26.86	16.30	0.00	1.00	17.39	12.31	26.86	22.00	12.33
91	CZ-LS-210	HI8807 (d)	18.67	15.50	0.00	2.00	13.63	9.96	18.67	10.00	14.00
V. Peninsular Zone											
92	PZ-TS-101	PBW 823[B]	20.00	15.18	6.66	1.00	13.33	11.23	20.00	10.00	12.66
93	PZ-TS-102	UAS428 (d) (C)	33.33	13.64	0.00	2.00	10.71	11.94	33.33	16.00	13.00
94	PZ-TS-103	DDW 49 (d)	18.31	18.18	0.00	1.00	14.28	10.35	18.31	14.00	10.33
95	PZ-TS-104	UAS 3001	18.57	13.78	0.00	1.00	16.66	10.00	18.57	17.00	9.66
96	PZ-TS-105	MACS3949 (d) (C)	20.80	12.57	0.00	1.00	12.00	9.27	20.80	15.00	10.33
97	PZ-TS-106	MACS6222 (C)	38.00	6.14	5.00	1.00	7.69	11.57	38.00	8.00	15.00
98	PZ-TS-107	GW 322 (C)	17.14	5.99	6.66	2.00	x	7.95	17.14	11.00	10.00
99	PZ-TS-108	DDW 48 (d)	26.40	9.52	0.00	2.00	16.66	10.92	26.40	16.00	11.33
100	PZ-TS-109	MACS6478 (C)	7.50	14.19	0.00	2.00	8.00	6.34	14.19	7.00	13.66
100 A	INFECTOR	Infector	15.56	23.88	3.33	3.00	15.38	12.23	23.88	30.00	22.66
101	PZ-TS-110	HD3343[M]	10.59	13.08	0.00	3.00	7.69	6.87	13.08	13.00	13.66
102	PZ-TS-111	WHD 963 (d)	29.57	9.57	0.00	3.00	16.66	11.76	29.57	13.00	14.33
103	PZ-LS-201	HI8807(d)	24.39	9.15	0.00	3.00	11.58	9.62	24.39	20.00	11.66
104	PZ-LS-202	HI1633	27.22	15.94	0.00	3.00	15.00	12.23	27.22	15.00	9.33
105	PZ-LS-203	UAS 3002	18.00	12.57	6.66	3.00	14.28	10.90	18.00	10.00	15.66
106	PZ-LS-204	Raj4083 (C)	27.03	5.19	8.33	2.00	12.50	11.01	27.03	27.00	10.33
107	PZ-LS-205	HD2932 (C)	10.00	8.22	6.66	3.00	8.00	7.18	10.00	16.00	17.33
108	PZ-LS-206	GW509	11.47	14.84	5.00	2.00	7.69	8.20	14.84	13.00	12.33
109	PZ-LS-207	HD3090 (C)	10.00	7.75	0.00	3.00	8.69	5.89	10.00	10.00	16.66
110	PZ-RI-301	NIAW 3170*	24.71	10.40	0.00	2.00	12.00	9.82	24.71	15.00	13.66
111	PZ-RI-302	GW 1346(d)*	12.07	12.89	0.00	3.00	17.85	9.16	17.85	25.00	12.33
112	PZ-RI-303	MACS 4058(d)*	16.07	14.53	0.00	2.00	15.78	9.68	16.07	9.00	14.66
113	PZ-RI-304	DBW93 (C)	17.50	15.33	6.66	3.00	10.52	10.60	17.50	20.00	11.33
114	PZ-RI-305	HI 8805(d)*	15.00	14.00	0.00	2.00	3.57	6.91	15.00	14.00	15.33
115	PZ-RI-306	AKDW2997-16(d) (C)	19.17	14.00	0.00	3.00	4.00	8.03	19.17	18.00	17.66
116	PZ-RI-307	MACS 6695*	18.10	8.11	0.00	2.00	10.71	7.78	18.10	11.00	12.00
117	PZ-RI-308	UAS446(d) (C)	22.33	8.06	5.00	3.00	10.52	9.78	22.33	24.00	11.00
118	PZ-RI-309	HI1605 (C)	26.67	8.93	5.00	2.00	15.38	11.60	26.67	17.00	13.00
119	PZ-RI-310	MACS 6696*	15.17	10.77	6.66	3.00	10.00	9.12	15.17	18.00	10.33
120	PZ-RI-311	NIDW 1149(d)	24.71	12.20	0.00	2.00	11.11	10.00	24.71	12.00	12.66
120 A	INFECTOR	Infector	26.32	23.53	3.33	3.00	13.33	13.90	26.32	30.00	22.66
121	PZ-RI-312	HI 8802(d)*	19.20	6.25	0.00	3.00	12.00	8.09	19.20	10.00	12.33
VI. Special Trial (Dicoccum)											
122	DIC-IR-101	DDK1029 (C)	40.00	12.75	0.00	2.00	13.63	13.68	40.00	15.00	11.66
123	DIC-IR-102	MACS5052	27.78	9.26	6.66	3.00	12.00	11.74	27.78	23.00	16.33
124	DIC-IR-103	MACS6222 (aest.) (C)	20.00	8.50	0.00	2.00	11.11	8.32	20.00	25.00	14.33
125	DIC-IR-104	DDK1056	22.67	7.09	3.33	3.00	11.53	9.52	22.67	20.00	12.33
126	DIC-IR-105	HW1098 (C)	22.86	13.07	6.66	2.00	11.53	11.22	22.86	25.00	10.33
127	DIC-IR-106	MACS5053	15.79	9.20	5.00	3.00	11.11	8.82	15.79	20.00	13.66
128	DIC-IR-107	DDK1057	36.00	13.79	0.00	2.00	12.00	12.76	36.00	24.00	10.00
VII. Special Trial- SPL-HYPT											
129	SPL-HYPT-1	HD3317	48.00	6.94	3.33	2.00	15.78	15.21	48.00	17.00	12.00
130	SPL-HYPT-2	WH1254	17.19	15.38	3.33	3.00	9.37	9.65	17.19	20.00	14.66
131	SPL-HYPT-3	DBW301	14.17	19.26	0.00	2.00	13.33	9.75	19.26	28.00	11.33
132	SPL-HYPT-4	WH1270	20.31	6.49	6.66	3.00	14.28	10.15	20.31	25.00	12.66
133	SPL-HYPT-5	HD2967 (C)	28.42	8.24	3.33	2.00	12.00	10.80	28.42	18.00	15.00
134	SPL-HYPT-6	PBW824	12.67	10.87	5.00	3.00	14.28	9.16	14.28	26.00	10.66
135	SPL-HYPT-7	UP3043	11.82	12.42	0.00	2.00	15.00	8.25	15.00	8.00	16.33
136	SPL-HYPT-8	DBW187	20.00	11.73	6.66	3.00	11.53	10.58	20.00	24.00	15.33
137	SPL-HYPT-9	HD3086 (C)	14.29	14.29	5.00	2.00	14.28	9.97	14.29	26.00	11.66
138	SPL-HYPT-10	DBW303	22.81	16.84	0.00	3.00	15.38	11.61	22.81	14.00	11.00
139	SPL-HYPT-11	DBW304	27.50	13.60	3.33	2.00	14.28	12.14	27.50	12.00	10.00
140	SPL-HYPT-12	UP3042	20.00	15.13	0.00	3.00	15.62	10.75	20.00	15.00	12.33
140	INFECTOR	Infector	26.34	23.81	3.33	3.00	14.00	14.10	26.34	28.00	22.66

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141	SPL-HYPT-13	DBW302	29.71	6.86	3.33	2.00	11.53	10.69	29.71	18.00	11.33
142	SPL-HYPT-14	PBW825	16.57	15.38	6.66	2.00	7.14	9.55	16.57	13.00	10.66
143	SPL-HYPT-15	HD3347	26.84	20.00	0.00	3.00	12.00	12.37	26.84	16.00	13.33
VIII. Special Trial (SPL-AST)											
144	SPL-AST-101	WH1223	10.00	17.11	3.33	3.00	11.53	8.99	17.11	27.00	13.00
145	SPL-AST-102	KRL19 (C)	18.18	18.31	5.00	3.00	9.09	10.72	18.31	17.00	12.00
146	SPL-AST-103	Kharchia65 (C)	14.33	7.46	5.00	3.00	10.00	7.96	14.33	10.00	13.66
147	SPL-AST-104	NW 7060	32.50	6.38	0.00	3.00	8.00	9.98	32.50	14.00	10.33
148	SPL-AST-105	KRL210 (C)	18.52	5.97	5.00	3.00	11.53	8.80	18.52	12.00	14.66
149	SPL-AST-106	WH 1228	38.89	10.14	3.33	3.00	11.53	13.38	38.89	20.00	17.33
150	SPL-AST-107	NW 7062	27.10	10.88	0.00	2.00	16.00	11.20	27.10	10.00	11.66
IX. Special Trial (SPL-VLS)											
151	SPL-VLS-101	PBW757 (C)	36.55	14.29	0.00	2.00	9.37	12.44	36.55	15.00	13.33
152	SPL-VLS-102	WR544 (C)	15.74	18.92	5.00	2.00	15.00	11.33	18.92	14.00	11.66
153	SPL-VLS-103	HD3298	14.93	14.17	0.00	2.00	12.00	8.62	14.93	24.00	14.33
154	SPL-VLS-104	HD3271	9.44	11.65	3.33	2.00	11.53	7.59	11.65	18.00	10.00
155	SPL-VLS-105	DBW14 (C)	7.46	17.43	0.00	3.00	13.33	8.24	17.43	20.00	11.33
156	SPL-VLS-106	DBW71 (C)	31.67	21.79	0.00	3.00	12.00	13.69	31.67	24.00	13.66
157	SPL-VLS-107	HI1621	29.66	18.52	0.00	2.00	12.66	12.57	29.66	9.00	14.33
158	SPL-VLS-108	PBW 797	14.86	8.89	3.33	2.00	15.00	8.82	15.00	12.00	17.66
158 A	INFECTOR	Infector	48.00	33.96	3.00	3.00	18.88	21.37	48.00	32.00	22.66

Table A1-10.1b: Screening of AVT lines against foliar wheat aphid and root aphid (Year-2018-19)

Entry no.	Code	Entry	Ludhiana	Karnal	Kharibari	Niphad	Average score	Highest score	Root aphid (No./plant) Ludhiana Centre only
I. Northern Hill Zone									
1	NHTSZ-01	HPW349 (C)	4	4	5	4	4.3	5	5
2	NHTSZ-02	VL907 (C)	5	5	5	4	4.8	5	5
3	NHTSZ-03	HS507 (C)	4	4	5	4	4.3	5	5
4	NHTSZ-04	HS652	4	4	5	4	4.3	5	4
5	NHTSZ-05	HS562 (C)	5	5	5	4	4.8	5	4
6	NHLSZ-01	VL892 (C)	5	5	5	4	4.8	5	5
7	NHLSZ-02	HS490 (C)	5	5	5	4	4.8	5	5
8	NHLSZ-03	HPW468	5	5	5	4	4.8	5	5
9	NHLSZ-04	HS673	4	4	5	4	4.3	5	5
10	NHLSZ-05	VL3020	4	4	5	4	4.3	5	4
11	NHLSZ-06	UP3041	5	5	5	4	4.8	5	5
12	NHLSZ-07	HPW467	5	5	5	4	4.8	5	5
13	NHLSZ-08	HS674	5	5	5	4	4.8	5	4
14	NHLSZ-09	VL3019	5	5	5	4	4.8	5	5
15	NHLSZ-10	VL3021	5	5	5	4	4.8	5	5
II. North Western Plain Zone									
16	NW-TS-101	WH1105 (C)	5	5	4	4	4.5	5	4
17	NW-TS-102	HD3226(I) (C)	4	4	5	4	4.3	5	5
18	NW-TS-103	HD3086 (C)	4	3	4	4	3.8	4	5
19	NW-TS-104	PBW820^{M}	5	5	5	4	4.8	5	4
20	NW-TS-105	DBW 221*	5	5	4	4	4.5	5	4
20A	INFECTOR	Infector	5	5	5	5	5.0	5	5
21	NW-TS-106	DBW 222*	5	5	5	4	4.8	5	5
22	NW-TS-107	PBW550 (C)	5	5	5	4	4.8	5	5
23	NW-TS-108	PBW821^{M}	5	5	4	4	4.5	5	4
24	NW-TS-109	HD2967 (C)	5	5	4	5	4.8	5	4
25	NW-TS-110	NW 7049	5	5	4	5	4.8	5	5
26	NW-TS-111	DPW621-50 (C)	5	5	4	5	4.8	5	5
27	NW-TS-112	DBW88 (C)	5	5	5	5	5.0	5	4
28	NW-LS-201	PBW752(I) (C)	5	5	5	5	5.0	5	3
29	NW-LS-202	DBW173 (C)	5	5	5	5	5.0	5	5
30	NW-LS-203	WH1021 (C)	5	5	5	4	4.8	5	5
31	NW-LS-204	HD3059 (C)	5	5	4	4	4.5	5	5

32	NW-LS-205	WH1124 (C)	5	5	5	5	5.0	5	3
33	NW-LS-206	PBW 771*	5	5	5	5	5.0	5	4
34	NW-RI-301	HI1620(I) (C)	5	5	4	4	4.5	5	4
35	NW-RI-302	PBW 796	5	5	4	4	4.5	5	4
36	NW-RI-303	HI 1628*	5	5	4	5	4.8	5	4
37	NW-RI-304	WH1142 (C)	5	5	5	5	5.0	5	5
38	NW-RI-305	HD3043 (C)	5	5	4	5	4.8	5	5
39	NW-RI-306	PBW644 (C)	5	5	5	5	5.0	5	5
40	NW-RI-307	HD3237(I) (C)	5	5	4	5	4.8	5	5
40A	INFECTOR	Infector	5	5	5	5	5.0	5	5
41	NW-RI-308	BRW 3806*[#]	5	5	5	5	5.0	5	3
42	NW-RI-309	NIAW 3170*	5	5	4	5	4.8	5	5
43	NW-RI-310	WH1080 (C)	5	5	4	5	4.8	5	5
III. North Eastern Plain Zone									
44	NE-IR-101	HD3249*[#Q]	5	5	5	5	5.0	5	4
45	NE-IR-102	HD2733 (C)	5	5	5	5	5.0	5	5
46	NE-IR-103	PBW 781	5	5	5	4	4.8	5	5
47	NE-IR-104	DBW 257	5	5	5	5	5.0	5	5
48	NE-IR-105	DBW39 (C)	5	4	5	5	4.8	5	4
49	NE-IR-106	HD 3277	5	5	5	5	5.0	5	5
50	NE-IR-107	RAJ 4529	5	5	5	5	5.0	5	5
51	NE-IR-108	DBW187(I) (C)	5	5	5	5	5.0	5	4
52	NE-IR-109	WH 1239	5	5	5	5	5.0	5	5
53	NE-IR-110	K0307 (C)	5	5	5	5	5.0	5	5
54	NE-IR-111	HD2967 (C)	5	5	5	5	5.0	5	5
55	NE-RI-301	K1317 (C)	5	5	5	5	5.0	5	4
56	NE-RI-302	HI1612 (C)	5	5	5	5	5.0	5	4
57	NE-RI-303	HD 3293	5	4	5	5	4.8	5	5
58	NE-RI-304	HD3171 (C)	5	5	5	4	4.8	5	4
59	NE-RI-305	HD2888 (C)	5	5	5	5	5.0	5	4
60	NE-RI-306	DBW 252*[#]	5	4	5	5	4.8	5	4
60A	INFECTOR	Infector	5	5	5	5	5.0	5	5
61	NE-RI-307	K8027 (C)	5	5	5		5.0	5	5
62	NE-RI-308	DBW 273	5	5	5		5.0	5	5
IV. Central Zone									
63	CZ-TS-101	HI8713(d) (C)	5	5	5	4	4.8	5	5
64	CZ-TS-102	NIDW 1158 (d)	5	5	5	4	4.8	5	3
65	CZ-TS-103	HI 8811 (d)	5	5	5	4	4.8	5	5
66	CZ-TS-104	HD3343[M]	5	5	5	5	5.0	5	5
67	CZ-TS-105	GW322 (C)	5	5	5	5	5.0	5	3
68	CZ-TS-106	HI1544 (C)	5	5	5	4	4.8	5	5
69	CZ-TS-107	HI8737(d) (C)	5	5	5	4	4.8	5	5
70	CZ-TS-108	HI 8812 (d)	5	5	5	5	5.0	5	5
71	CZ-TS-109	GW 1348 (d)	3	4	5	4	4.0	5	4
72	CZ-TS-110	DDW 49 (d)	5	5	5	5	5.0	5	4
73	CZ-TS-111	PBW 822[B]	5	5	5	4	4.8	5	5
74	CZ-TS-112	HD 3345[B]	5	4	4	4	4.3	5	4
75	CZ-TS-113	DDW 48 (d)	5	5	4	4	4.5	5	5
76	CZ-RI-301	HI8627(d) (C)	5	5	4	5	4.8	5	5
77	CZ-RI-302	DBW110 (C)	5	5	4	4	4.5	5	5
78	CZ-RI-303	UAS 466(d)*	5	5	4	4	4.5	5	3
79	CZ-RI-304	MP3288 (C)	5	5	5	4	4.8	5	5
80	CZ-RI-305	DBW 277	5	4	4	5	4.5	5	5
80A	INFECTOR	Infector	5	5	5	5	5.0	5	5
81	CZ-RI-306	DDW 47(d)*[Q]	5	5	5	5	5.0	5	4
82	CZ-LS-201	HD2932 (C)	5	5	5	5	5.0	5	5
83	CZ-LS-202	HD2864 (C)	5	5	5	4	4.8	5	4
84	CZ-LS-203	MP3336 (C)	5	5	4	4	4.5	5	4
85	CZ-LS-204	MP4010 (C)	5	5	4	4	4.5	5	4
86	CZ-LS-205	CG1029	5	5	4	4	4.5	5	5
87	CZ-LS-206	UAS3002	5	5	4	4	4.5	5	5
88	CZ-LS-207	HI1633	5	5	4	4	4.5	5	5
89	CZ-LS-208	HI1634	5	5	4	4	4.5	5	5
90	CZ-LS-209	HI8808 (d)	5	5	4	5	4.8	5	5

91	CZ-LS-210	HI8807 (d)	5	5	4	5	4.8	5	5
V. Peninsular Zone									
92	PZ-TS-101	PBW 823[B]	5	5	5	4	4.8	5	4
93	PZ-TS-102	UAS428 (d) (C)	5	5	4	4	4.5	5	4
94	PZ-TS-103	DDW 49 (d)	5	5	4	4	4.5	5	5
95	PZ-TS-104	UAS 3001	5	5	4	4	4.5	5	5
96	PZ-TS-105	MACS3949 (d) (C)	5	5	4	4	4.5	5	5
97	PZ-TS-106	MACS6222 (C)	5	5	4	4	4.5	5	4
98	PZ-TS-107	GW 322 (C)	5	5	4	5	4.8	5	5
99	PZ-TS-108	DDW 48 (d)	5	5	5	5	5.0	5	5
100	PZ-TS-109	MACS6478 (C)	5	5	4	5	4.8	5	5
100A	INFECTOR	Infector	5	5	4	5	4.8	5	5
101	PZ-TS-110	HD3343[M]	5	5	4	5	4.8	5	5
102	PZ-TS-111	WHD 963 (d)	5	5	5	5	5.0	5	5
103	PZ-LS-201	HI8807(d)	5	5	4	5	4.8	5	4
104	PZ-LS-202	HI1633	5	5	5	4	4.8	5	5
105	PZ-LS-203	UAS 3002	5	5	4	5	4.8	5	4
106	PZ-LS-204	Raj4083 (C)	5	5	5	5	5.0	5	5
107	PZ-LS-205	HD2932 (C)	5	5	4	5	4.8	5	5
108	PZ-LS-206	GW509	5	5	5	4	4.8	5	5
109	PZ-LS-207	HD3090 (C)	5	5	4	4	4.5	5	4
110	PZ-RI-301	NIAW 3170*	5	5	4	4	4.5	5	4
111	PZ-RI-302	GW 1346(d)*	5	5	4	5	4.8	5	5
112	PZ-RI-303	MACS 4058(d)*	5	4	4	5	4.5	5	5
113	PZ-RI-304	DBW93 (C)	3	3	4	5	3.8	5	5
114	PZ-RI-305	HI 8805(d)*	5	5	4	5	4.8	5	4
115	PZ-RI-306	AKDW2997-16(d) (C)	5	5	4	4	4.5	5	3
116	PZ-RI-307	MACS 6695*	5	5	4	4	4.5	5	5
117	PZ-RI-308	UAS446(d) (C)	5	5	4	4	4.5	5	5
118	PZ-RI-309	HI1605 (C)	5	5	4	4	4.5	5	5
119	PZ-RI-310	MACS 6696*	5	5	4	4	4.5	5	5
120	PZ-RI-311	NIDW 1149(d)	5	5	4	4	4.5	5	5
120A	INFECTOR	Infector	5	5	4	5	4.8	5	5
121	PZ-RI-312	HI 8802(d)*	5	5	5	4	4.8	5	5
VI. Special Trial (Dicoccum)									
122	DIC-IR-101	DDK1029 (C)	5	5	5	5	5.0	5	5
123	DIC-IR-102	MACS5052	5	5	5	5	5.0	5	5
124	DIC-IR-103	MACS6222 (C)	5	5	5	4	4.8	5	4
125	DIC-IR-104	DDK1056	5	5	4	5	4.8	5	5
126	DIC-IR-105	HW1098 (C)	5	5	5	5	5.0	5	5
127	DIC-IR-106	MACS5053	5	5	4	5	4.8	5	5
128	DIC-IR-107	DDK1057	5	5	5	5	5.0	5	5
VII. Special Trial- SPL-HYPT									
129	SPL-HYPT-1	HD3317	5	5	5	5	5.0	5	5
130	SPL-HYPT-2	WH1254	5	5	4	4	4.5	5	4
131	SPL-HYPT-3	DBW301	5	5	5	4	4.8	5	5
132	SPL-HYPT-4	WH1270	5	5	5	4	4.8	5	5
133	SPL-HYPT-5	HD2967 (C)	5	5	4	4	4.5	5	5
134	SPL-HYPT-6	PBW824	5	5	5	4	4.8	5	5
135	SPL-HYPT-7	UP3043	3	3	5	4	3.8	5	4
136	SPL-HYPT-8	DBW187	5	4	4	4	4.3	5	5
137	SPL-HYPT-9	HD3086 (C)	5	5	4	4	4.5	5	5
138	SPL-HYPT-10	DBW303	4	4	4	4	4.0	4	3
139	SPL-HYPT-11	DBW304	5	4	3	4	4.0	5	5
140	SPL-HYPT-12	UP3042	5	5	2	4	4.0	5	5
140A	INFECTOR	Infector	5	5	4	5	4.8	5	5
141	SPL-HYPT-13	DBW302	5	5	3	5	4.5	5	5
142	SPL-HYPT-14	PBW825	5	5	3	4	4.3	5	5
143	SPL-HYPT-15	HD3347	5	5	4	5	4.8	5	5
VIII. Special Trial (SPL-AST)									
144	SPL-AST-101	WH1223	4	3	5	5	4.3	5	4
145	SPL-AST-102	KRL19 (C)	4	3	4	4	3.8	4	5

146	SPL-AST-103	Kharchia65 (C)	4	4	5	4	4.3	5	4
147	SPL-AST-104	NW 7060	5	5	4	4	4.5	5	5
148	SPL-AST-105	KRL210 (C)	5	5	5	4	4.8	5	5
149	SPL-AST-106	WH 1228	5	5	4	4	4.5	5	4
150	SPL-AST-107	NW 7062	5	5	5	4	4.8	5	5
IX. Special Trial (SPL-VLS)									
151	SPL-VLS-101	PBW757 (C)	4	3	4	4	3.8	4	5
152	SPL-VLS-102	WR544 (C)	4	4	5	4	4.3	5	4
153	SPL-VLS-103	HD3298	5	4	4	4	4.3	5	5
154	SPL-VLS-104	HD3271	5	4	5	4	4.5	5	4
155	SPL-VLS-105	DBW14 (C)	5	4	4	4	4.3	5	4
156	SPL-VLS-106	DBW71 (C)	5	4	5	4	4.5	5	5
157	SPL-VLS-107	HI1621	5	5	4	4	4.5	5	3
158	SPL-VLS-108	PBW 797	5	5	5	4	4.8	5	5
158A	INFECTOR	Infector	5	5	4	5	4.8	5	5

Table A1-10.1c: Screening of NIVT lines against foliar wheat aphids (Year-2018-19)

S.no.	Code	Entries	Foliar aphid score (1-5 scale)			Average score	Highest score
			Ludhiana	Karnal	Niphad		
NIVT-1A							
1	N-101	NW7060	5	4	4	4.33	5
2	N-102	DBW282	5	5	4	4.67	5
3	N-103	HD3086 (C)	5	5	5	5.00	5
4	N-104	HD3318	5	5	4	4.67	5
5	N-105	HD2967 (C)	4	4	5	4.33	5
6	N-106	Raj4539	4	4	4	4.00	4
7	N-107	NABIMG 09	5	5	5	5.00	5
8	N-108	HD3323	5	5	4	4.67	5
9	N-109	UP3028	5	5	4	4.67	5
10	N-110	K1801	5	5	4	4.67	5
11	N-111	WH1256	5	5	4	4.67	5
12	N-112	HUW 833	5	5	4	4.67	5
13	N-113	UP3026	5	5	5	5.00	5
14	N-114	WH1257	5	5	5	5.00	5
15	N-115	HD3319	5	4	5	4.67	5
16	N-116	HD3320	5	4	4	4.33	5
17	N-117	DBW281	5	4	5	4.67	5
18	N-118	HD3322	5	5	4	4.67	5
19	N-119	NABIMG 11	5	5	5	5.00	5
20	N-120	DBW284	5	5	5	5.00	5
20A	INFECTOR	Infector	5	5	5	5.00	5
21	N-121	Raj4537	5	5	5	5.00	5
22	N-122	PBW803	5	5	5	5.00	5
23	N-123	UP3025	5	5	5	5.00	5
24	N-124	HD3321	5	5	5	5.00	5
25	N-125	WH1255	5	5	5	5.00	5
26	N-126	DBW283	5	5	5	5.00	5
27	N-127	NABIMG 10	5	5	5	5.00	5
28	N-128	PBW805	4	4	4	4.00	4
29	N-129	NW7067	5	5	5	5.00	5
30	N-130	UP3027	5	5	5	5.00	5
31	N-131	PBW802	5	5	4	4.67	5
32	N-132	WH1258	5	5	4	4.67	5
33	N-133	PBW804	5	5	5	5.00	5
34	N-134	K1006 (C)	5	5	5	5.00	5
35	N-135	Raj4538	5	5	4	4.67	5
36	N-136	DBW88 (C)	5	5	5	5.00	5

NIVT-1B							
37	N-201	HD2967 (C)	5	4	5	4.67	5
38	N-202	HD3326	5	4	4	4.33	5
39	N-203	HUW834	5	5	5	5.00	5
40	N-204	K1803	5	5	5	5.00	5
40A	INFECTOR	Infector	5	5	5	5.00	5
41	N-205	DBW286	5	5	5	5.00	5
42	N-206	DBW287	5	5	5	5.00	5
43	N-207	UP3029	5	5	4	4.67	5
44	N-208	Raj4540	5	5	5	5.00	5
45	N-209	DBW88 (C)	5	5	5	5.00	5
46	N-210	NW7064	5	5	5	5.00	5
47	N-211	UP3031	5	5	5	5.00	5
48	N-212	PBW807	5	5	4	4.67	5
49	N-213	BRW3829	5	5	4	4.67	5
50	N-214	NWS2106	5	5	5	5.00	5
51	N-215	WH1259	5	5	5	5.00	5
52	N-216	HUW835	5	5	4	4.67	5
53	N-217	Raj4541	5	5	4	4.67	5
54	N-218	PBW808	5	5	5	5.00	5
55	N-219	DBW305	5	5	5	5.00	5
56	N-220	HD3327	5	5	5	5.00	5
57	N-221	BRW3838	4	4	5	4.33	5
58	N-222	HD3328	5	5	5	5.00	5
59	N-223	NW7057	5	5	5	5.00	5
60	N-224	DBW288	5	5	5	5.00	5
60A	INFECTOR	Infector	5	5	5	5.00	5
61	N-225	HD3086 (C)	5	5	5	5.00	5
62	N-226	NW7075	5	5	5	5.00	5
63	N-227	K1006 (C)	5	5	4	4.67	5
64	N-228	K1804	5	5	5	5.00	5
65	N-229	WH1260	5	5	5	5.00	5
66	N-230	HD3325	5	5	5	5.00	5
67	N-231	UP3030	5	5	5	5.00	5
68	N-232	DBW285	5	5	4	4.67	5
69	N-233	K1805	5	5	4	4.67	5
70	N-234	HD3324	5	5	5	5.00	5
71	N-235	KRL429	5	5	5	5.00	5
72	N-236	KRL423	5	5	4	4.67	5
NIVT-2							
73	N-301	MP3522	5	5	4	4.67	5
74	N-302	NIAW3592	5	5	5	5.00	5
75	N-303	DBW289	5	5	5	5.00	5
76	N-304	NIAW3584	5	5	5	5.00	5
77	N-305	WH1262	5	5	5	5.00	5
78	N-306	HI1636	5	5	5	5.00	5
79	N-307	HI1637	5	5	5	5.00	5
80	N-308	HI1638	5	5	5	5.00	5
80A	INFECTOR	Infector	5	5	5	5.00	5
81	N-309	TAW155	5	5	4	4.67	5
82	N-310	HI1640	5	5	4	4.67	5
83	N-311	HI1639	5	5	4	4.67	5
84	N-312	HW 1904	5	5	5	5.00	5
85	N-313	MP3521	5	5	5	5.00	5
86	N-314	RVW4265	5	5	5	5.00	5
87	N-315	MP1359	5	5	5	5.00	5
88	N-316	MP1361	5	5	5	5.00	5

89	N-317	GW322 (C)	5	5	5	5.00	5
90	N-318	UAS3006	5	5	5	5.00	5
91	N-319	MP1360	5	5	4	4.67	5
92	N-320	MACS6742	5	5	5	5.00	5
93	N-321	MACS6745	5	5	4	4.67	5
94	N-322	NWS2118	5	5	4	4.67	5
95	N-323	CG1031	5	5	4	4.67	5
96	N-324	RVW4266	5	5	4	4.67	5
97	N-325	TAW153	5	5	4	4.67	5
98	N-326	PBW810	5	5	4	4.67	5
99	N-327	UP3032	5	5	4	4.67	5
100	N-328	Raj4542	4	4	4	4.00	4
100A	INFECTOR	Infector	5	5	5	5.00	5
101	N-329	UAS3005	5	5	4	4.67	5
102	N-330	NWS2108	5	5	4	4.67	5
103	N-331	GW513	5	5	4	4.67	5
104	N-332	GW514	5	5	4	4.67	5
105	N-333	MACS6747	5	5	4	4.67	5
106	N-334	MACS6222 (C)	5	5	4	4.67	5
107	N-335	MACS6478 (C)	5	5	4	4.67	5
108	N-336	HI1544 (C)	5	5	4	4.67	5
NIVT-3A							
109	N-401	UP3033	5	5	4	4.67	5
110	N-402	WH1264	5	5	4	4.67	5
111	N-403	PBW811	5	5	4	4.67	5
112	N-404	UP3035	4	5	4	4.33	5
113	N-405	WH1263	5	5	4	4.67	5
114	N-406	PBW814	5	5	4	4.67	5
115	N-407	JKW267	5	5	4	4.67	5
116	N-408	DBW173 (C)	5	5	4	4.67	5
117	N-409	HD3329	5	5	4	4.67	5
118	N-410	HD3330	5	5	4	4.67	5
119	N-411	JAUW 673	5	5	4	4.67	5
120	N-412	HD3059 (C)	5	5	4	4.67	5
120A	INFECTOR	Infector	5	5	5	5.00	5
121	N-413	HD3334	5	5	4	4.67	5
122	N-414	Raj4544	5	5	5	5.00	5
123	N-415	DBW292	4	4	5	4.33	5
124	N-416	K1808	5	5	5	5.00	5
125	N-417	UP3034	5	5	4	4.67	5
126	N-418	JKW261	4	5	5	4.67	5
127	N-419	WH1266	5	5	5	5.00	5
128	N-420	DBW291	5	5	5	5.00	5
129	N-421	DBW107 (C)	5	5	5	5.00	5
130	N-422	JKW268	5	5	5	5.00	5
131	N-423	DBW294	5	5	5	5.00	5
132	N-424	HD3332	5	5	5	5.00	5
133	N-425	NW7062	5	5	4	4.67	5
134	N-426	HD3333	4	4	4	4.00	4
135	N-427	DBW290	5	5	4	4.67	5
136	N-428	WH1265	5	5	4	4.67	5
137	N-429	PBW812	5	5	4	4.67	5
138	N-430	PBW813	5	5	4	4.67	5
139	N-431	DBW293	5	5	4	4.67	5
140	N-432	HD3331	5	5	4	4.67	5
140A	INFECTOR	Infector	5	5	5	5.00	5
141	N-433	NW7053	5	5	4	4.67	5

142	N-434	HI1563 (C)	4	5	4	4.33	5
143	N-435	Raj4543	5	5	4	4.67	5
144	N-436	K1807	5	5	4	4.67	5
NIVT-3B							
145	N-501	CG1032	5		4	4.50	5
146	N-502	GW518	5	5	4	4.67	5
147	N-503	MACS6749	5	5	4	4.67	5
148	N-504	NIAW3578	5	5	4	4.67	5
149	N-505	UAS 3008	5	5	4	4.67	5
150	N-506	DBW295	5	5	4	4.67	5
151	N-507	MP3514	5	5	5	5.00	5
152	N-508	HI1641	5	5	4	4.67	5
153	N-509	MACS6752	5	5	5	5.00	5
154	N-510	MP3516	5	5	5	5.00	5
155	N-511	Lok75	4	5	5	4.67	5
156	N-512	AKAW 4927	5	5	5	5.00	5
157	N-513	MP1362	5	5	4	4.67	5
158	N-514	RVW4281	5	5	4	4.67	5
159	N-515	WH1267	5	5	4	4.67	5
160	N-516	GW519	4	5	5	4.67	5
160A	INFECTOR	Infector	5	5	5	5.00	5
161	N-517	HD3344	5	5	5	5.00	5
162	N-518	RVW4276	5	5	4	4.67	5
163	N-519	HI1642	5	5	4	4.67	5
164	N-520	NIAW3583	5	5	4	4.67	5
165	N-521	HD2932 (C)	5	5	4	4.67	5
166	N-522	HD2864 (C)	5	5	4	4.67	5
167	N-523	PBW815	5	5	4	4.67	5
168	N-524	HI1646	5	5	4	4.67	5
169	N-525	TAW154	5	5	4	4.67	5
NIVT-4							
170	N-601	UAS470	5	5	4	4.67	5
171	N-602	GW1351	5	5	5	5.00	5
172	N-603	HI8737 (C)	4	5	5	4.67	5
173	N-604	MPO1364	5	5	5	5.00	5
174	N-605	DDW51	5	5	5	5.00	5
175	N-606	GW1352	5	5	5	5.00	5
176	N-607	HI8822	5	5	5	5.00	5
177	N-608	UAS471	5	5	5	5.00	5
178	N-609	PDW356	5	5	4	4.67	5
179	N-610	DDW50	5	5	5	5.00	5
180	N-611	MPO1366	5	5	5	5.00	5
180A	INFECTOR	Infector	5	5	5	5.00	5
181	N-612	HI8820	5	5	5	5.00	5
182	N-613	NIDW1316	5	5	4	4.67	5
183	N-614	WHD964	5	5	4	4.67	5
184	N-615	MACS4091	5	5	4	4.67	5
185	N-616	MACS3949 (C)	5	5	4	4.67	5
186	N-617	HI8819	5	5	5	5.00	5
187	N-618	HI8713 (C)	5	5	5	5.00	5
188	N-619	NIDW1302	5	5	5	5.00	5
189	N-620	HI8821	5	5	5	5.00	5
190	N-621	RKD339	5	5	5	5.00	5
191	N-622	NIDW1293	5	5	5	5.00	5
192	N-623	MACS4090	5	5	4	4.67	5
193	N-624	MPO1365	5	5	5	5.00	5
194	N-625	HI8818	5	5	4	4.67	5

NIVT-5A							
195	N-701	BRW3847	5	5	4	4.67	5
196	N-702	UP3037	5	5	4	4.67	5
197	N-703	DBW298	5	5	4	4.67	5
198	N-704	DBW297	5	5	5	5.00	5
199	N-705	K1317 (C)	5	5	5	5.00	5
200	N-706	DBW296	5	5	4	4.67	5
200A	INFECTOR	Infector	5	5	5	5.00	5
201	N-707	JAUW672	5	5	4	4.67	5
202	N-708	WH1268	5	5	5	5.00	5
203	N-709	DBW299	5	5	5	5.00	5
204	N-710	WH1269	5	5	5	5.00	5
205	N-711	PBW817	5	5	5	5.00	5
206	N-712	NW7069	5	5	5	5.00	5
207	N-713	HD2888 (C)	5	5	5	5.00	5
208	N-714	HD3339	5	5	5	5.00	5
209	N-715	HUW838	5	5	5	5.00	5
210	N-716	K1810	5	5	5	5.00	5
211	N-717	HD3337	5	5	5	5.00	5
212	N-718	K1809	5	5	5	5.00	5
213	N-719	HD3336	5	5	5	5.00	5
214	N-720	UP3036	5	5	4	4.67	5
215	N-721	WH1142 (C)	5	5	5	5.00	5
216	N-722	PBW644 (C)	5	5	5	5.00	5
217	N-723	HD3338	5	5	5	5.00	5
218	N-724	HD3335	5	5	5	5.00	5
219	N-725	PBW816	4	5	5	4.67	5
NIVT-5B							
220	N-801	MACS6736	5	5	5	5.00	5
220A	INFECTOR	Infector	5	5	5	5.00	5
221	N-802	MACS4087(d)	5	5	4	4.67	5
222	N-803	MPO1357(d)	5	5	5	5.00	5
223	N-804	GW520	5	5	5	5.00	5
224	N-805	GW1353(d)	5	5	5	5.00	5
225	N-806	UAS472(d)	5	5	5	5.00	5
226	N-807	HI1605 (C)	5	5	5	5.00	5
227	N-808	HI8627(d) (C)	4	5	5	4.67	5
228	N-809	HI1645	5	5	5	5.00	5
229	N-810	UAS446(d) (C)	5	5	5	5.00	5
230	N-811	UAS3009	5	5	5	5.00	5
231	N-812	UAS3010	4	5	5	4.67	5
232	N-813	DBW110 (C)	5	5	5	5.00	5
233	N-814	CG1033	5	5	5	5.00	5
234	N-815	HI1643	5	5	5	5.00	5
235	N-816	HI1644	5	5	4	4.67	5
236	N-817	NIAW3643	5	5	5	5.00	5
237	N-818	NIAW3624	5	5	5	5.00	5
238	N-819	HI8823(d)	5	5	5	5.00	5
239	N-820	HI8824(d)	5	5	5	5.00	5
240	N-821	DBW300	5	5	5	5.00	5
240A	INFECTOR	Infector	5	5	5	5.00	5
241	N-822	DDW52(d)	5	5	4	4.67	5
242	N-823	MP3512	5	5	4	4.67	5
243	N-824	MP1356	5	5	4	4.67	5
244	N-825	MP1358	5	5	5	5.00	5
IVT(NHZ)							
245	NHIVT-01	HPW462	5	5	4	4.67	5

246	NHIVT-02	HPW466	5	5	5	5.00	5
247	NHIVT-03	VL2038	5	5	5	5.00	5
248	NHIVT-04	VL2037	5	5	5	5.00	5
249	NHIVT-05	HS507 (C)	5	5	5	5.00	5
250	NHIVT-06	UP3038	5	5	5	5.00	5
251	NHIVT-07	VL2035	5	5	4	4.67	5
252	NHIVT-08	HS667	5	5	4	4.67	5
253	NHIVT-09	HS668	5	5	4	4.67	5
254	NHIVT-10	HS669	5	5	5	5.00	5
255	NHIVT-11	UP3039	5	5	4	4.67	5
256	NHIVT-12	HS562 (C)	5	5	5	5.00	5
257	NHIVT-13	VL2036	5	5	4	4.67	5
258	NHIVT-14	HPW464	5	5	5	5.00	5
259	NHIVT-15	HPW463	4	4	4	4.00	4
260	NHIVT-16	HD3340	5	5	4	4.67	5
260A	INFECTOR	Infector	5	5	5	5.00	5

Table A2-10.1a: Screening of MPSN nursery against shoot fly and brown wheat mite during 2018-19

S.No.	Entry	Dharwad	Ludhiana	Niphad	Kharibari	Kanpur	Average incidence (%)	Highest incidence (%)	Brown Wheat mite (No. of mites/10 cm^2 area)	
	Sources : EPPSN 2017-18									
	A. Resistant to all three rusts									
	Source:AVT Ist Year 2016-17									
1	DBW246	18.49	12.22	1.66	2.00	9.37	8.75	18.49	28.00	11.33
2	DBW251	18.05	6.17	5.00	1.00	10.71	8.19	18.05	10.00	12.66
3	HI8791(d)	23.64	8.05	5.00	2.00	11.53	10.04	23.64	22.00	10.66
4	HS611	26.21	7.69	3.33	1.00	9.09	9.46	26.21	16.00	14.33
5	HS645	17.00	13.66	1.66	1.00	8.00	8.26	17.00	28.00	12.33
6	PBW777	24.62	6.86	1.66	1.00	7.14	8.26	24.62	12.00	13.66
7	PBW778	12.56	7.34	0.00	2.00	12.00	6.78	12.56	26.00	14.66
8	TL3011 (T)	11.71	7.45	0.00	2.00	15.00	7.23	15.00	17.00	12.33
9	TL3012 (T)	14.14	7.33	1.66	2.00	6.66	6.36	14.14	12.00	11.66
10	TL3013 (T)	20.89	7.32	1.66	3.00	4.00	7.37	20.89	20.00	14.33
11	TL3014 (T)	12.81	10.48	6.66	2.00	20.00	10.39	20.00	26.00	15.66
12	TL3015 (T)	15.93	8.57	0.00	3.00	4.00	6.30	15.93	18.00	12.33
13	UAS462(d)	22.58	7.18	0.00	2.00	8.00	7.95	22.58	25.00	16.33
14	VL1013	18.06	11.76	3.33	3.00	7.14	8.66	18.06	15.00	11.66
15	VL3014	12.59	7.93	3.33	2.00	8.00	6.77	12.59	26.00	10.33
16	WH1233	14.39	8.67	5.00	3.00	13.33	8.88	14.39	20.00	12.33
17	B622	21.89	12.20	0.00	2.00	15.78	10.37	21.89	19.00	13.66
18	HG110	17.65	7.02	0.00	3.00	20.00	9.53	20.00	22.00	10.00
	B. Resistant to Stem and Leaf rusts									
	Source:AVT Ist Year 2016-17									
19	HI1620	21.25	8.72	3.33	2.00	14.28	9.92	21.25	25.00	12.00
20	DDK1052(dic)	28.42	13.33	6.66	3.00	12.00	12.68	28.42	14.00	14.00
20A	A 9-30-1 (C) FOR FA	17.04	x	6.66	2.00	20.00	11.42	20.00	x	13.00
20B	GW 173 (C) FOR RA	34.71	x	3.33	3.00	20.00	15.26	34.71	x	x
20C	IWP 72 (C) FOR	27.27	x	0.00	2.00	26.66	13.98	27.27	33.00	21.33

	BWM									
20 D	SONALIKA (C) FOR SF	12.56	18.75	0.00	3.00	25.00	11.86	25.00	x	x
21	DDK1053(dic)	18.95	11.76	0.00	2.00	18.18	10.18	18.95	12.00	12.66
22	HS644	12.18	14.75	3.33	3.00	16.00	9.85	16.00	15.00	14.66
23	HS646	15.13	15.00	0.00	2.00	5.55	7.54	15.13	20.00	10.33
24	MACS5047	35.56	9.43	3.33	3.00	12.00	12.66	35.56	14.00	13.66
25	MACS5049	25.19	8.39	0.00	2.00	3.84	7.88	25.19	25.00	17.33
26	MACS6677	12.53	12.50	0.00	3.00	7.69	7.14	12.53	20.00	15.33
27	VL3013	12.97	8.54	3.33	2.00	7.14	6.80	12.97	24.00	12.66
28	WH1232	15.56	6.56	0.00	3.00	13.63	7.75	15.56	22.00	10.66
29	IWP 5019	13.44	12.73	0.00	2.00	14.28	8.49	14.28	15.00	13.33
30	LINE 1172	16.59	3.64	0.00	2.00	7.14	5.87	16.59	14.00	15.00
	C. Resistant to Leaf and Stripe rusts									
	Source: AVT IInd Year 2016-17									
31	HI1612	11.27	9.09	0.00	2.00	7.69	6.01	11.27	26.00	12.30
	Source:AVT Ist Year 2016-17									
32	HD3271	14.12	5.33	1.66	3.00	20.00	8.82	20.00	20.00	13.0
33	HI1619	22.44	4.71	0.00	3.00	15.38	9.11	22.44	17.00	11.3
34	HPW439	23.00	5.26	0.00	3.00	3.57	6.97	23.00	20.00	13.7
35	HS648	15.69	7.22	3.33	3.00	10.34	7.92	15.69	24.00	12.3
36	KRL370	12.17	4.71	0.00	3.00	14.28	6.83	14.28	28.00	14.7
37	PBW780	20.63	4.76	0.00	3.00	11.53	7.98	20.63	15.00	13.3
38	WH1316	14.13	8.64	0.00	3.00	12.00	7.55	14.13	38.00	15.3
38 A	A 9-30-1 (C) FOR FA	11.43	x	5.00	3.00	10.71	7.53	11.43	x	11.33
38B	GW 173 (C) FOR RA	33.60	x	3.33	3.00	12.00	12.98	33.60	x	x
38C	IWP 72 (C) FOR BWM	17.78	x	0.00	3.00	16.66	9.36	17.78	42.00	22.66
38 D	SONALIKA (C) FOR SF	12.70	16.28	0.00	3.00	12.50	8.90	16.28	x	x

Table A2-10.1b: Screening of MPSN nursery against foliar aphid and root aphid during 2018-19

S.No.	Entry	Aphid score (1-5 scale)						
		Ludhiana	Niphad	Kharibari	Karnal	Average score	Highest score (%)	Root aphid (Ludhiana centre only)
Sources : EPPSN 2017-18								
A. Resistant to all three rusts								
Source:AVT Ist Year 2016-17								
1	DBW246	5	4	5	4	4.50	5	5
2	DBW251	5	4	2	4	3.75	5	4
3	HI8791(d)	5	4	3	5	4.25	5	4
4	HS611	5	4	5	5	4.75	5	5
5	HS645	4	5	5	5	4.75	5	5
6	PBW777	5	4	5	4	4.50	5	5
7	PBW778	4	4	5	4	4.25	5	4
8	TL3011 (T)	5	4	5	4	4.50	5	5
9	TL3012 (T)	5	4	5	5	4.75	5	5
10	TL3013 (T)	4	4	5	4	4.25	5	4
11	TL3014 (T)	5	4	5	4	4.50	5	5

12	TL3015 (T)	4	4	5	4	4.25	5	5
13	UAS462(d)	5	5	5	4	4.75	5	4
14	VL1013	4	5	4	5	4.50	5	5
15	VL3014	5	5	4	5	4.75	5	5
16	WH1233	5	5	4	5	4.75	5	4
17	B622	5	5	4	5	4.75	5	3
18	HG110	5	5	4	5	4.75	5	5
B. Resistant to Stem and Leaf rusts								
Source:AVT Ist Year 2016-17								
19	HI1620	5	5	4	4	4.50	5	5
20	DDK1052(dic)	5	5	5	5	5.00	5	5
20A	A 9-30-1 (C) FOR FA	x	5	4	5	4.67	5	x
20B	GW 173 (C) FOR RA	x	5	5	5	5.00	5	5
20C	IWP 72 (C) FOR BWM	x	5	4	5	4.67	5	x
20D	SONALIKA (C) FOR SF	x	4	5	4	4.33	5	x
21	DDK1053(dic)	5	5	4	5	4.75	5	5
22	HS644	5	4	4	4	4.25	5	4
23	HS646	5	5	4	5	4.75	5	4
24	MACS5047	5	5	4	5	4.75	5	5
25	MACS5049	5	5	5	5	5.00	5	5
26	MACS6677	5	4	5	4	4.50	5	5
27	VL3013	5	4	3	4	4.00	5	5
28	WH1232	5	5	3	5	4.50	5	5
29	IWP 5019	5	4	3	4	4.00	5	5
30	LINE 1172	5	5	4	5	4.75	5	4
C. Resistant to Leaf and Stripe rusts								
Source:AVT IInd Year 2016-17								
31	HI1612	5.0	4	4	4	4.25	5	5
Source:AVT Ist Year 2016-17								
32	HD3271	5	4	4	4	4.25	5	5
33	HI1619	5	5	4	4	4.50	5	5
34	HPW439	5	4	4	4	4.25	5	3
35	HS648	5	4	4	4	4.25	5	5
36	KRL370	5	5	3	5	4.50	5	4
37	PBW780	4	4	3	4	3.75	4	5
38	WH1316	5	4	4	4	4.25	5	5
38A	A 9-30-1 (C) FOR FA	5	5	3	5	4.50	5	x
38B	GW 173 (C) FOR RA	x	5	4	5	4.67	5	5
38C	IWP 72 (C) FOR BWM	x	5	3	5	4.33	5	x
38D	SONALIKA (C) FOR SF	x	4	4	4	4.00	4	x

10.2 (B). INTEGRATED PEST MANAGEMENT

B1: Survey and surveillance of insect-pests and their natural enemies in wheat and barley cropping systems *(All centres)*

Roving surveys wewre carried out at fortnightly intervals during the cropping season in wheat and barley crops for insect-pests and their natural enemies. Population and damage levels of different insect-pests will be recorded and indicated as grades or percent damage inflicted to crop. The peak period of pest activity and its severity of damage will also be recorded.

Centre: Ludhiana

In order to monitor the insect pest of wheat, survey of Punjab state were undertaken during 2018-19 crop season. The aphid incidence was above economic threshold level in some places viz. village Mullanpur & Jagraon (Ludhiana), Ajitwal & Dagru (Moga) and Salabatpura (Bhatinda) during the second and third week of March. The natural enemies viz. grubs and adults of coccinellid beetles, syrphid fly and chrysoperla were observed in some of the fields infested with aphids. Minor incidence

of pink stem borer (3-5 %) was also observed in one patch of 0.5 acre in the fields of S. Sukhchain Singh village Farwahi (Barnala).
Some news appeared in different newspapers regarding the incidence of armyworm in different parts of Punjab during the month of December-Janaury. Intensive surveys were carried out in the state of Punjab to monitor the pest prevalence. The incidence of armyworm was observed in patches and within patches the armyworm damage varied from 1-5 per cent except one field in village Kheri Malan where it was 15-20 per cent. Following is the detail of armyworm damage observed in some parts of Punjab: (Table B1-10.2a):

Table B1-10.2a: Incidence of pink stem in Punjab

District	Village	Name of the Farmer	Armyworm incidence
Patiala	Kheri Malan	S. Jaswinder Singh	15-20 %
	Mehandpur	S. Narpinder Singh	2-3% incidence in 4-5 acres
Fatehgarh Sahib	Lahori	S. Jasvir Singh	1-2% incidence in 2 acres
Sangrur	Maanwala	S. Satbir Singh	2-3% incidence
	Benera	Kamal	Less than 1% incidence

Centre: Niphad

In rabi season 2018-19, sowing of wheat crop was completed in second fortnight of December. Sowing of wheat trials and seed production programme of Rabi 2018-19 has been completed in the first week of December 2018. Appearance of aphid at the farm of Agricultural Research Station, Niphad on early sown wheat was noticed in 50th MW i.e. 10 to 16/12/2018 and populations of jassids were recorded in 47th MW i.e.19 to 25/11/2018. The increase in population of aphids and jassids after 50th & 47th MW were observed. Peak population of aphids is observed in 3rd MW and it was above ETL.The incidence of jassid was recorded in medium to heavy intensity on wheat at 15 to 20 days after sowing. The incidence of stem borer was also recorded in traces on farmers field(Table B1-10.2b).

Centre: Vijapur

Survey of wheat & barley fields were carried out in the state during the crop season. The termite damage in wheat fields remained low throughout the crop season. While, the incidence of aphids was low to moderate during ear head stage of the crop. The population of *H. armigera*, pink stem borer and surface grasshopper were very low. The appearance of minor pests like spodoptera, thrips, shoot fly, brown mite, jassids and cut worm were in occasional and in negligible form. Besides, in barley fields the aphid population was moderate to high. Among natural enemies, *Campoletis chlorideae,* a larval parasite of *H.armigera* was observed. Predators like coccinellid beetles, chrysoperla and syrphid fly were frequently noticed predating on wheat and barley aphids.

Centre: Kanpur

Survey was made at Sikandarpur (Mathura) dated 04.01.2019.The incidence of shootfly was observed 2 per cent for wheat variety 3036. The incidence of pink stem borer was observed in irrigated crop 1 per cent in same varieties of wheat. The survey was done on dated 30.01.2019 and the termite infestation was observed 10% in wheat varieties namely, DBW 39 and HUW 234 at both the village Arol (Kanpur). The Barley infestation was observed highly susceptible in barley variety namely, Barley Local at the village Arol (Kanpur). The survey was done on dated 08.02.2019 and the termite infestation was observed 12% in wheat varieties namely, PBW 343 and DBW 17. The shootfly infestation was observed 2%. The aphid infestation was observed 50-60 aphids/plant, on variety K 551 (Table B1-10.2c).

Centre: Karnal

Moderate to severe incidence of wheat aphid and pink stem borer was observed in villages Ladwa, Yamunanagar, Kunjpura, Subhari, Racina and Hajwana etc of Karnal. The grubs and adults of coccinellid beetles were seen frequently in fields infested with aphids.The incidence of foliar aphid was recored 7-18% while incidence was of pink stem stemborer was less than 10%.The termite damge was between 4-8% in the surveyed areas.At few places in Amabala andKurukshetra, damge of armyworm was recorded and it was recorded to be between 1-2%.

B1-10.2b: Survey of wheat and barley pests and their natural enemies during 2018-19 (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	
Lakhalgaon, Chehedi, Chitegaon, Chandori and Nagapur Tal. Niphad 11.01.2019	Irrigated	45	Ajit 102, Mohan wonder, LOK-1, Nirmal, Ankur kedar Vegetative, Booting, flowering	Aphids Jassids	Major Minor	Heavy	*Coccinellids* Beetles and syrphid fly
Raulas, Kundewadi, Wadali najik, Konkangaon, Shirasgaon Tal. Niphad 24.01.2019	Irrigated	32	Phule Samadhan, LOK-1, Ajit 102, Ajit 72, Private companies, Daptari Booting, flowering	Aphids Jassids	Major Minor	Heavy	*Coccinellids* Beetles
Aadgaon, Nasik Tal. Nasik, Ozar, Sakore Tal. Niphad 30.01.2019	Irrigated	45	Phule Samadhan, HD 2189, NIAW 34, Ajit 72, Nirmal Booting, Flowering, grain filling	Aphids	Major	Heavy	*Coccinellids* Beetles
Masrul, Aadgaon, Girnare, Makhmalabad Tal. Nashik 18.02.2019	Irrigated	35	Private companies, HD 2189, Mohan wonder, Ajit 72, Ankur, Nirmal Flowering, grain filling	Aphids Stem borer	Major Minor	Heavy	*Coccinellids* Beetles

Table B1-10.2c: Survey of wheat and barley pests and their natural enemies during 2018-19 (Centre: Kanpur)

Locality and date of visit	Rainfed / Irrigated	No. of samples	Variety and stage of growth	Crop pest			Natural enemies	
				Name	Status	Intensity (Attack % damage or population)	Name	Stage Parastization / Predation
04.01.2019 Vill.- Sikandarpur Block- Mat Distt.- Mathura	Irrigated	10	3086 Crown root initiation	Larvae of pink stem borer Shootfly infestation	Minor Minor	1% 2%	Swan -	Adult -
31.01.2019 Arol (Kanpur)	Irrigated Irrigated	10 10	DBW 39 HUW 234 Barley-local	Termite Barley aphid	Major Major	10% 25-30 aphid/plant	- *Coccinella septumpuntata*	- Adult
08.02.2019 Daleep Nagar (Kanpur Dehat)	Irrigated Irrigated Irrigated	10 10 10	PBW343 & DBW17 Barley-K551 PBW343	Termite Barley aphid Shootfly	Major Major Minor	12% 50-60 aphid 2%	-	-
04.01.2019 Vill.- Sikandarpur Block- Mat Distt.- Mathura	Irrigated	10	3086 Crown root initiation	Larvae of pink stam borer Shootfly infestation	Minor Minor	1% 2%	Swan -	Adult -

Table B1-10.2d: Survey of wheat insect- pests and their natural enemies during 2018-19 (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.19 (2018)	Bhakatgaon, Nagaon	Irrigated	2	Vegetative Stage	Sporadic infestation of Cutworm, Field Cricke tand Flea Beetle	*Micraspis discolor* ,*Coccinella repanda*, *Cccinella septempuncta ta* are the predators recorded in the wheat fields in the reproductive stage of the crop. *M. Discolor* (21/sq.m) and *C. repanda* (7/sq.m)are the common predators of aphid. Sporadic Syrphid larvae are also recorded. Moreover, various types of spiders are also observed.
	Shillongani, Nagaon	- do-	2	Variety HD 2967	- do -	
	Jaluguti, Morigaon	- do-	2	- do -	- do -	
1 FN, Jan.,13 (2019)	Bhakatgaon, Nagaon	Irrigated	2	do -		
	Shillongani, Nagaon	- do-	2	- do -	-	
	Jaluguti, Morigaon	- do-	2	- do -	-	
2 FN, Feb., 21 (2019)	Bhakatgaon, Nagaon	Irrigated	2	Reproductive Stage	Aphid infestation 8 %. Sporadic infestation of *Nezara viridula* and painted bug is noticed .	
	Shillongani, Nagaon	- do-	2	do -	Aphid infestation 13% Sporadic infestation of *Heliothis armigera* larvae, *Nezara viridula* and painted bug isnoticed .	
	Jaluguti, Morigaon	- do-	2	- do -	Aphid (*Sitobion miscanthi*) infestation 17 %, White Ear Head (WEH) 5%. Sporadic infestation of *Heliothis armigera* larvae, *Nezara viridula* and painted bug isnoticed .	
1 FN, Mar., 08 (2019)	Bhakatgaon, Nagaon	Irrigated	2	- do -	Aphid infestation 7 %, WEH 9% Sporadic population of Painted bug & Nezara viridula noticed	
	Shillongani, Nagaon	- do-	2	- do -	WEH 10 %, Aphid infestation 4 % Sporadic population of *H. armigera*, Painted bug & Nezara viridula noticed	
	Jaluguti, Morigaon	- do-	2	- do -	Aphid infestation11 %, WEH 9 %. Sporadic population of Painted bug & Nezara viridula noticed	

B2. Influence of sowing time on the incidence and population build-up of major insect pest of wheat (Centres: Ludhiana, Niphad, Karnal, Kharibari)

Centre: Ludhiana

The studies was conducted in the irrigated fields at Expermental area of Department of Plant Breeding and Genetics, PAU, Ludhiana. The wheat variety PBW 725 was sown at four different dates of sowing at 15 days interval and no insecticide was applied for the control any pest in this trial (Table B2-10.2a).

1. **Termite damage**: The termite damage recorded at seedling stage in different dates of sowing indicated that early sown crop (1 Nov. 2018) suffered more termite damage as compared to timely, late and very late sown crop. 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 first week of January in early sown crop and third week of January in 15 Nov. sown crop while it appeared in last week of February in other two sowing times. The data recorded indicated that the aphid incidence got delayed with the delay in sowing time. The peak of aphid incidence was recorded in 10^{th}, standard meteorological weeks (SMW) of 2019 in early sown wheat it was 11^{th} SMW for all other sowing dates.
3. **Pink stem borer Damage**: The pink stem borer damage was higher in early and timely sown crop as compared to late and very late sown crop on all dates of observations.

Centre: Karnal

The experiment was conducted at Research farm of ICAR-IIWBR, Karnal under irrigated conditions.The wheat variety,HD 2967 was sown at four different dates of sowing at 15 days interval and no insecticide was applied for management of any insect-pest(Table B2-10.2b).

1.**Aphid incidence:**The data revealed indicated that the incidence of aphids were first started appearing on wheat crop sown on 1^{st} Nov. (D1), and 16^{th} Nov. (D2) with aphids per incidenece of 0.8 and 0.7 aphids/plant, respectively during 51^{st} standard week. The population reached to its peak during 8^{th} Standard week on D1 (29.3 aphids/plant) and during 9^{th} standard week on D2 sown crop (22.9 aphids/plant) in the month of February. In case of D3 (1^{st} Dec.) and D4 (31 Dec.) sown crops, the aphid appeared during 1^{st}standard week with incidence of 1.0 and 0.1 aphids/plant, respectively. The aphid population reached peaked during10^{th} standard week on D3 and D4 sown crops with aphid incidence as 19.3 and 17.7 aphids/plant, respectivey. The aphid population was highest on 6.43 aphids/plant on early sown crop and lowest (5.03 aphids/plant) on late sown crop (D4)(Table B2-11.2c).

2.**Termite damage:** The termite damage was first recorded at seedling stage on D1 and D2 sown crops with infestation ranged from 3.2 to 5.0% damaged effective tillers / m row during 50^{th} to 52^{nd} standard weeks. Termite infestation was highest on D1 (5.0 damaged effective tillers/ m row followed by D2 (4.7 damaged effective tillers/ m row), D3 (3.9 damaged effective tillers/ m row) and D4 (3.7 damaged effective tillers/ m row) sown crops (Table B2-11.2c).

Centre: Kharibari

An experiment was conducted at Regional Research sub-station (Terai Zone) UBKV, Kharibari, Darjeeling. The wheat variety HD2967 was sown on 1st December'2018, 15th December'2018 and 01st January'2019. The experiment was laid out in Randomized Block Design with four replication and the plots of 5m X 4m length.

The mean number of aphid population was record from randomly selected fifteen tagged plants per plot taking their 10 cm twigs. The observations were taken at weekly intervals starting from 46th standard week and continuing upto 14th standard week. These recorded data were correlated with various abiotic parameters like temperature (Maximum and Minimum), Relative Humidity (Maximum and Minimum) and rainfall for determining the relationship of prevailing environmental factors with population fluctuation of aphid. (Table B2-10.2c).

Table B2-10.2a: Effect of sowing dates on population build of major insect-pests in wheat during 2018-19 (Centre-Ludhiana)

Standard Weeks	Rainfall (mm)	Temperature (^{0}C)		Relative humidity (%)		Mean Aphid incidence (Aphids/plant/tiller)				Stem borer/Termites (% affected tillers/meter row)			
		Max	Min	Max	Min	Ist DOS (01-NOV.)	IIndDOS (16-NOV.)	IIIrd DOS (01-DEC.)	IVth DOS (16-DEC.)	Ist DOS (01-NOV.)	IIndDOS (16-NOV.)	IIIrd DOS (01-DEC.)	IVth DOS (16-DEC.)
50(10Dec-16Dec)	0.0	20.3	7.4	93.0	50.0	-	-	-	-	3.46	3.10	-	-
51(17Dec-23Dec)	0.0	20.3	3.6	93.0	39.0	0	0	0	0	3.69	3.59	2.76	-
52(24Dec-31Dec)	0.0	18.4	2.8	95.0	42.0	0	0	0	0	3.88	3.57	2.83	2.08
1(1Jan-7Jan)	2.0	18.2	6.7	92	53	0.2	0	0	0	-	-	2.72	2.10
2(8Jan-14Jan)	2.0	19.8	6.0	91	45	0	0	0	0	-	-	-	1.95
3(15Jan-21Jan)	46.4	19.3	6.2	91	48	0.4	0.2	0	0	-	-	-	-
4(22Jan-29Jan)	15.6	17.2	5.9	94	53	1.2	0.6	0.2	0.2	-	-	-	-
5(29 Jan-4Feb)	0.0	19.1	6.3	93	52	0	0	0	0	-	-	-	-
6(5Feb-11Feb)	68.4	19.4	8.4	92	58	0.4	0.6	0	0	-	-	-	-
7(12Feb-18Feb)	16.4	19.9	10.6	91	62	1.6	1.2	0	0	-	-	-	-
8(19Feb-25Feb)	5.4	21.1	10.3	91	58	3.4	2.6	0.8	0.4	2.81	2.69	2.74	/2.11
9(26 Feb-4Mar)	11.4	20.0	9.6	89	55	5.8	4.2	2.4	1.8	-	-	-	-
10(5Mar-11Mar)	1.4	22.7	10.0	87	50	10.9	7.4	5.2	6.4	-	-	-	-
11(12Mar-18Mar)	0.0	24.6	10.7	90	45	8.2	10.4	11.2	12.0	-	-	-	-
12(19Mar-25Mar)	0.0	26.9	12.9	87	42	1.2	3.2	4.6	5.8	-	-	-	-
13(26 Mar-1Apr)	0.0	31.1	14.7	88	38	0.8	2.4	8.4	9.8	-	-	-	-
14(2Apr-8Apr)	0.0	34.3	18.3	83	33	0	0	1.4	1.2	-	-	-	-

Table B2-10.2b: Effect of sowing dates on population build of major insect-pests in wheat 2018-19 (Centre-Karnal)

Standard Weeks	Rain fall (mm)	Temperature (^{0}C)		Relative Humidity (%)		Mean aphid incidence (Aphids/plant/tiller)				Termites (% affected tillers/meter row)			
		Max	Min.	Max.	Min.	Ist DOS (1st Nov.)	IInd DOS (16th Nov.)	IIIrd DOS (1st Dec.)	IVth DOS (16th Dec.)	Ist DOS (1st Nov.)	IInd DOS (16th Nov.)	IIIrd DOS (1st Dec.)	IVth DOS (16th Dec.)
50(10Dec-16Dec)	14.8	20.6	7.7	96.9	56.9	-	-	-	-	5.0	4.7	-	-
51(17Dec-23Dec)	0.0	20.1	4.2	99.1	53.0	0.8	0.7	0.0	0.0	4.1	4.0	3.7	
52(24Dec-31Dec)	0.0	18.4	3.2	100.0	48.0	0.7	1.0	0.0	0.0	4.2	3.9	3.9	3.7
1(1Jan-7Jan)	0.0	18.8	5.6	98.6	58.1	0	1.2	1.6	0.8	-	-	-	-
2(8Jan-14Jan)	0.0	19.8	6.1	98.7	53.3	2.5	2.3	1.9	1.6	-	-	-	-
3(15Jan-21Jan)	0.0	20.2	5.7	96.6	53.4	2.9	2.9	2.5	2.5	-	-	-	-
4(22Jan-29Jan)	28.4	16.7	8.2	100.0	61.1	3.2	3.1	1.2	2.7	-	-	-	-
5(29 Jan-4Feb)	0.0	17.3	6.9	95.6	72.4	5.9	3.5	2.5	2.3	-	-	-	-
6(5Feb-11Feb)	5.4	19.4	8.1	98.0	64.9	10.9	5.8	3.6	3.5	-	-	-	-
7(12Feb-18Feb)	2.4	20.4	9.6	97.4	66.0	20.3	8.9	8.5	3.7	-	-	-	-
8(19Feb-25Feb)	2.8	21.8	10.8	94.0	61.7	29.3	12.7	8.9	12.5	4.5	3.6	3.5	2.9
9(26 Feb-4Mar)	15.6	21.6	8.5	99.1	65.3	11.9	22.9	13.5	13.6	3.2	2.7	2.5	1.8
10(5Mar-11Mar)	0.0	23.2	8.8	94.3	52.4	8.8	17.5	19.3	17.7	-	-	-	-
11(12Mar-18Mar)	2.0	23.7	9.9	92.1	58.7	4.6	8.7	13.8	10.2	-	-	-	-
12(19Mar-25Mar)	0.0	27.7	12.6	89.7	49.3	1.0	2.9	6.6	8.3	-	-	-	-
13(26 Mar-1Apr)	0.0	30.0	13.7	90.4	46.3	0	1	1	5.5	-	-	-	-
14(2Apr-8Apr)	14.8	33.9	16.8	85.1	40.3	0	1	1	1	-	-	-	-
Average						6.43	6.01	5.38	5.03				
Yield q/ha						54.36	53.2	51.23					

Table B2-10.2c: Effect of sowing dates on population build of major insect pests in wheat 2018-19 (Centre-Kharibari)

Standard Weeks	Rainfall (mm)	Relative humidity		Temperature ^{0}C		Aphid incidence (Aphids/tiller)		
		Max RH	Min RH	Max Temp	Min Temp	Date of sowing 01.12.18	Date of sowing 16.12.18	Date of sowing 01.01.19
48	0.00	90.14	45.29	28.27	12.70	0	0	0
49	0.00	90.86	48.14	27.30	12.13	0	0	0
50	0.00	89.71	41.71	28.21	11.11	16	0	0
51	0.97	94.43	53.00	24.43	11.60	19.75	0	0
52	0.00	90.43	51.00	24.44	9.39	41.30	22.15	0
53	0.00	91.43	41.57	25.06	7.69	65.25	45.95	0
1	0.00	89.71	39.29	25.93	8.64	107.21	85.26	0
2	0.00	91.00	40.57	26.80	9.47	135.45	95.45	12.25
3	0.00	89.71	43.14	26.70	10.56	182.36	155.45	55.26
4	0.00	90.71	38.71	25.99	10.84	280.75	255.68	102.54
5	1.60	91.57	52.71	25.60	11.20	325.46	275.35	165.55
6	0.29	89.86	39.14	27.71	11.54	210.56	225.15	209.10
7	0.00	89.86	57.43	25.30	13.33	142.12	185.35	175.50
8	2.69	91.14	61.43	24.80	12.41	95.24	140.20	110.25
9	0.40	88.86	47.43	26.54	12.13	59.35	95.10	87.85
10	0.00	87.43	40.14	30.97	15.06	34.85	55.25	52.45
11	0.46	87.29	38.86	31.49	15.17	16.30	30.30	32.20
12	1.23	87.57	48.14	31.07	15.76	9.55	15.65	15.60
13	8.83	89.43	54.14	29.64	16.07	4.35	8.45	7.95
14	0.21	87.71	48.00	28.27	12.70	2.10	3.20	3.10
Yield qt/ha						**23.50**	**18.55**	**16.45**

B3. Evaluation of trapping efficiency of different type of insect-traps for aphids (**Centres:** Ludhiana, Niphad, Karnal)

Different types of traps viz., tray-traps, sticky-traps and pheromone lures and their placement in the crop will be tested to determine the efficiency of traps to capture aphids in the field. The criterion of trap colour, material and cost of trap will be considered for selection of traps for the experiment. The population of alate (winged) and wingless forms of aphids captured in traps will be recorded during the season.

Treatment Details:

Treatment no.	Treatment details
T1	Yellow sticky trap X 60 cm height
T2	Yellow sticky trap X 120 cm height
T3	Blue sticky trap X 60 cm height
T4	Blue sticky trap X 120 cm height
T5	Yellow tray trap X 10 cm height
T6	Yellow tray trap X 20 cm height
T7	Blue tray trap X 10 cm height
T8	Blue tray trap X 20 cm height

Observations:

1. The population of alate (winged) and wingless forms of aphids captured in traps were recorded at weekly interval during the season.

Centre: Ludhiana

The effiectiveness of different types of traps viz. sticky-traps and tray-traps to capture aphids and their placement height in the crop was tested in the fields of Experimental Area of Department of Plant Breeding and Genetics, PAU, Ludhiana. The population of alate (winged) and apterous forms of aphids captured in traps were recorded at weekly interval during the peak period of their activity.

The observation recorded indicated that the higher number of aphids were trapped in yellow coloured traps as compared to blue colour traps. The efficiency of sticky traps was relatively better than water traps. The 100 cm higher traps matched with the canopy of crop and recorded more aphids as compared with 150 cm high traps (Table B3-10.2a).

Centre: Niphad

The data revealed significant differences among various treatments regarding captured number of aphids and jassids. Yellow sticky trap installed at 60 cm height recorded maximum (48.67, 194.33, 241.67, 356.33, 388.00 and 451.00) number of captured aphids at 40, 47, 54, 61, 68 and 75 days after sowing as against the minimum number of captured aphids were recorded in blue tray trap installed at 20 cm height (9.67, 27.00, 34.00, 40.67, 44.33 and 0.00). At 75, 82, 89 and 96 days after sowing the yellow sticky traps installed at 120 cm height recorded highest of 663.67, 340.00, 342.00 and 47.67 number of captured aphids. It is indicated from the results that the yellow sticky traps installed at 60 cm height was found to be effective for aphids capturing in early growing stage of the crop i.e. up to 75 days after sowing and same coloured trap was found effective after 75 days of the crop when installed at 120 cm height. Both yellow and blue colored tray trap installed at 10 and 20 cm height were found in effective for capturing the population of aphids(Table B3-10.2b).

Data presented in Table 3 revealed that the highest (2379.67) seasonal total number of captured aphids were recorded in yellow sticky trap installed at 120 cm height while lowest of 155.67 were recorded in blue tray traps installed at 20cm height.

Data regarding captured jassids in various types of traps are presented in Table 4. It revealed that the highest (886.33) seasonal total captured jassids were recorded in yellow sticky trap installed at 60 cm height. The population of the jassids was not observed in blue colored tray trap during growing season of the crop installed at 10 and 20 cm height. Blue sticky trap installed at 120cm height recorded very less of 7.33 number of captured jassids. It

indicated that the tray trap of both blue and yellow coloured installed at 10 and 20 cm height and also blue sticky trap installed at 60 and 120 cm height were found ineffective for attraction of jassids.

Data regarding natural enemies are presented in Table 5 revealed that the maximum (3.00) season's total captured natural enemies were recorded on yellow sticky trap installed at 60 cm height. It showed that the yellow colored traps were also preferred by natural enemies.

Data regarding grain yield are presented in Table 6 revealed that the various traps showed the non significant differences for yield. The yellow sticky traps installed at 60 cm height recorded highest (43.75) grain yield. It was followed by the treatment of yellow sticky traps installed at 120cm height (42.92). The tray trap of yellow colored installed at 20cm height recorded minimum yield of 36.11 q/ha.

Centre: Karnal

The data revealed significant differences among various treatments regarding captured number of aphids. Yellow sticky trap installed at 60 cm height recorded maximum average number of aphids i.e 199.4 as against the minimum average number of captured aphids i.e 13.6 aphids recorded in blue tray trap installed at 20 cm height. The highest (2393.36aphids) seasonal total captured aphids were recorded in yellow sticky trap installed at 60 cm height while minimum (163.2 aphids) were recorded in blue tray trap installed at 20 cm height(Table B3-11.2e).The maximum season's total number of natural enemies (157.9) was captured on yellow sticky trap installed at 60 cm height. It indicated that the yellow colored traps were also preferred by natural enemies(Table B3-10.2f).

The observation recorded clearly revealed that the number of aphids trapped more in yellow coloured traps were relatively higher than blue colour traps on all dates of observations. The efficiency of sticky traps was relatively better than tray traps.

Table B3-10.2a: Relative abundance of aphids captured in different types of trap during 2018-19 (Centre: Ludhiana)

Treatment	Number of aphids captured per trap at different dates of observation								Season total	Av. Mean
	6 SMW (7-2-19)	7 SMW (14-2-19)	8 SMW (21-2-19)	9 SMW (1-3-19)	10 SMW (8-3-19)	11 SMW (15-3-19)	12 SMW (1-4-19)	6 SMW (9-4-19)		
Yellow sticky trap X 100 cm height	0	14	50	74	95	120	90	45	488	61.0
Yellow sticky trap X 150 cm height	0	10	42	48	74	99	66	40	379	47.4
Blue sticky trap X 100 cm height	0	10	33	45	75	97	62	34	356	44.5
Blue sticky trap X 150 cm height	0	6	25	32	58	82	33	16	252	31.5
Yellow tray trap X 100 cm height	0	12	40	65	90	96	75	38	416	52.0
Yellow tray trap X 150 cm height	0	8	26	44	74	85	60	21	318	39.8
Blue tray trap X 100 cm height	0	5	15	25	41	49	37	25	197	24.6
Blue tray trap X 150 cm height	0	1	12	10	28	31	28	9	119	14.9

Table B3-10.2b: Relative abundance of aphids captured in different types of trap during 2018-19 (Centre: Niphad)

TN	Treatment Details	Number of aphids captured per trap at												Season total	Av. Mean
		19 DAS	26 DAS	33 DAS	40 DAS	47 DAS	54 DAS	61 DAS	68 DAS	75 DAS	82 DAS	89 DAS	96 DAS		
T1	Yellow sticky trap X 60 cm height	0.00 (1.00)	0.00 (1.00)	0.00 (1.00)	48.67 (7.04)	194.33 (13.98)	241.67 (15.58)	356.33 (18.90)	388.00 (19.72)	451.00 (21.26)	125.67 (11.25)	198.33 (14.12)	30.33 (5.59)	2034.33	169.53
T2	Yellow sticky trap X 120 cm height	0.00 (1.00)	0.00 (1.00)	0.00 (1.00)	39.00 (6.32)	149.67 (12.27)	212.00 (14.59)	271.67 (16.51)	314.00 (17.75)	663.67 (25.78)	340.00 (18.46)	342.00 (18.52)	47.67 (6.97)	2379.67	198.31
T3	Blue sticky trap X 60 cm height	0.00 (1.00)	0.00 (1.00)	0.00 (1.00)	32.67 (5.80)	134.67 (11.65)	135.00 (11.66)	219.67 (14.85)	240.00 (15.52)	34.67 (5.97)	0.00 (1.00)	0.00 (1.00)	0.00 (1.00)	796.67	66.39
T4	Blue sticky trap X 120 cm height	0.00 (1.00)	0.00 (1.00)	0.00 (1.00)	24.33 (5.03)	121.00 (11.04)	123.00 (11.13)	199.33 (14.15)	211.00 (14.56)	40.67 (6.45)	0.00 (1.00)	0.00 (1.00)	0.00 (1.00)	719.33	59.94
T5	Yellow tray trap X 10 cm height	0.00 (1.00)	0.00 (1.00)	0.00 (1.00)	17.67 (4.32)	67.67 (8.29)	94.00 (9.74)	114.00 (10.72)	122.00 (11.09)	11.00 (3.46)	0.00 (1.00)	0.00 (1.00)	0.00 (1.00)	426.33	35.53
T6	Yellow tray trap X 20 cm height	0.00 (1.00)	0.00 (1.00)	0.00 (1.00)	12.33 (3.65)	51.00 (7.21)	63.00 (8.00)	85.33 (9.29)	89.67 (9.52)	14.00 (3.87)	0.00 (1.00)	0.00 (1.00)	0.00 (1.00)	315.33	26.28
T7	Blue tray trap X 10 cm height	0.00 (1.00)	0.00 (1.00)	0.00 (1.00)	10.00 (3.32)	34.67 (5.97)	35.33 (6.03)	52.00 (7.28)	53.33 (7.37)	0.00 (1.00)	0.00 (1.00)	0.00 (1.00)	0.00 (1.00)	185.33	15.44
T8	Blue tray trap X 20 cm height	0.00 (1.00)	0.00 (1.00)	0.00 (1.00)	9.67 (3.27)	27.00 (5.29)	34.00 (5.91)	40.67 (6.45)	44.33 (6.73)	0.00 (1.00)	0.00 (1.00)	0.00 (1.00)	0.00 (1.00)	155.67	12.97
	SE +	--	--	--	**0.26**	**0.29**	**0.28**	**0.33**	**0.26**	**0.18**	**0.35**	**0.33**	**0.07**	--	--
	CD at 5%	--	--	--	**0.79**	**0.89**	**0.88**	**1.00**	**0.80**	**0.57**	**1.07**	**0.99**	**0.21**	--	--

DAS=Days after sowing Figures in parentheses indicate arc sin values

Table B3-10.2c: Relative abundance of jassids captured in different types of trap during 2018-19 (Centre: Niphad)

TN	Treatment Details	Number of jassids captured per trap at												Season total	Av. Mean
		19 DAS	26 DAS	33 DAS	40 DAS	47 DAS	54 DAS	61 DAS	68 DAS	75 DAS	82 DAS	89 DAS	96 DAS		
T1	Yellow sticky trap X 60 cm height	125.67 (11.25)	230.33 (15.21)	123.33 (11.15)	135.00 (11.66)	90.67 (9.57)	81.33 (9.07)	64.67 (8.10)	13.33 (3.78)	22.00 (4.79)	0.00 (1.00)	0.00 (1.00)	0.00 (1.00)	886.33	73.86
T2	Yellow sticky trap X 120 cm height	74.33 (8.68)	166.67 (12.95)	70.33 (8.45)	72.33 (8.56)	54.33 (7.44)	60.67 (7.85)	41.00 (6.48)	10.67 (3.41)	14.33 (3.91)	0.00 (1.00)	0.00 (1.00)	0.00 (1.00)	564.67	47.06
T3	Blue sticky trap X 60 cm height	11.00 (3.46)	13.00 (3.74)	10.00 (3.32)	9.00 (3.16)	6.33 (2.70)	0.00 (1.00)	0.00 (1.00)	0.00 (1.00)	0.00 (1.00)	0.00 (1.00)	0.00 (1.00)	0.00 (1.00)	49.33	4.11
T4	Blue sticky trap X 120 cm height	0.00 (1.00)	0.00 (1.00)	0.00 (1.00)	4.33 (2.31)	3.00 (2.00)	0.00 (1.00)	0.00 (1.00)	0.00 (1.00)	0.00 (1.00)	0.00 (1.00)	0.00 (1.00)	0.00 (1.00)	7.33	0.61
T5	Yellow tray trap X 10 cm height	9.00 (3.16)	12.33 (3.65)	7.33 (2.89)	9.00 (3.16)	5.33 (2.51)	4.33 (2.30)	6.33 (2.70)	2.00 (1.73)	0.00 (1.00)	0.00 (1.00)	0.00 (1.00)	0.00 (1.00)	55.67	4.64
T6	Yellow tray trap X 20 cm height	6.00 (2.65)	7.33 (2.89)	3.33 (2.08)	4.67 (2.38)	4.00 (2.23)	2.00 (1.73)	3.33 (2.08)	0.67 (1.29)	0.00 (1.00)	0.00 (1.00)	0.00 (1.00)	0.00 (1.00)	31.33	2.61
T7	Blue tray trap X 10 cm height	0.00 (1.00)	0.00 (1.00)	0.00 (1.00)	0.00 (1.00)	0.00 (1.00)	0.00 (1.00)	0.00 (1.00)	0.00 (1.00)	0.00 (1.00)	0.00 (1.00)	0.00 (1.00)	0.00 (1.00)	0.00	0.00
T8	Blue tray trap X 20 cm height	0.00 (1.00)	0.00 (1.00)	0.00 (1.00)	0.00 (1.00)	0.00 (1.00)	0.00 (1.00)	0.00 (1.00)	0.00 (1.00)	0.00 (1.00)	0.00 (1.00)	0.00 (1.00)	0.00 (1.00)	0.00	0.00
	SE +	**0.11**	**0.12**	**0.14**	**0.16**	**0.17**	**0.14**	**0.18**	**0.16**	**0.12**	**--**	**--**	**--**	**--**	**--**
	CD at 5%	**0.33**	**0.37**	**0.42**	**0.49**	**0.50**	**0.42**	**0.56**	**0.48**	**0.37**	**--**	**--**	**--**	**--**	**--**

DAS=Days after sowing Figures in parentheses indicate arc sin values

Table B3-10.2d: Relative abundance of natural enemies captured in different types of traps during 2018-19 (Centre: Niphad)

TN	Treatment Details	Number of natural enemies captured per trap at												Season total	Av. Mean
		19 DAS	26 DAS	33 DAS	40 DAS	47 DAS	54 DAS	61 DAS	68 DAS	75 DAS	82 DAS	89 DAS	96 DAS		
T1	Yellow sticky trap X 60 cm height	0.00 (1.00)	0.00 (1.00)	0.00 (1.00)	0.00 (1.00)	0.00 (1.00)	0.67 (1.29)	0.33 (1.15)	1.33 (1.53)	0.67 (1.29)	0.00 (1.00)	0.00 (1.00)	0.00 (1.00)	3.00	0.25
T2	Yellow sticky trap X 120 cm height	0.00 (1.00)	0.00 (1.00)	0.00 (1.00)	0.00 (1.00)	0.00 (1.00)	0.67 (1.29)	0.33 (1.15)	0.67 (1.29)	0.67 (1.29)	0.00 (1.00)	0.00 (1.00)	0.00 (1.00)	2.33	0.19
T3	Blue sticky trap X 60 cm height	0.00 (1.00)	0.00 (1.00)	0.00 (1.00)	0.00 (1.00)	0.00 (1.00)	0.00 (1.00)	0.00 (1.00)	0.00 (1.00)	0.00 (1.00)	0.00 (1.00)	0.00 (1.00)	0.00 (1.00)	0.00	0.00
T4	Blue sticky trap X 120 cm height	0.00 (1.00)	0.00 (1.00)	0.00 (1.00)	0.00 (1.00)	0.00 (1.00)	0.00 (1.00)	0.00 (1.00)	0.33 (1.15)	0.33 (1.15)	0.00 (1.00)	0.00 (1.00)	0.00 (1.00)	0.67	0.06
T5	Yellow tray trap X 10 cm height	0.00 (1.00)	0.00 (1.00)	0.00 (1.00)	0.00 (1.00)	0.00 (1.00)	0.00 (1.00)	0.00 (1.00)	0.00 (1.00)	0.00 (1.00)	0.00 (1.00)	0.00 (1.00)	0.00 (1.00)	0.00	0.00
T6	Yellow tray trap X 20 cm height	0.00 (1.00)	0.00 (1.00)	0.00 (1.00)	0.00 (1.00)	0.00 (1.00)	0.00 (1.00)	0.00 (1.00)	0.00 (1.00)	0.00 (1.00)	0.00 (1.00)	0.00 (1.00)	0.00 (1.00)	0.00	0.00
T7	Blue tray trap X 10 cm height	0.00 (1.00)	0.00 (1.00)	0.00 (1.00)	0.00 (1.00)	0.00 (1.00)	0.00 (1.00)	0.00 (1.00)	0.00 (1.00)	0.00 (1.00)	0.00 (1.00)	0.00 (1.00)	0.00 (1.00)	0.00	0.00
T8	Blue tray trap X 20 cm height	0.00 (1.00)	0.00 (1.00)	0.00 (1.00)	0.00 (1.00)	0.00 (1.00)	0.00 (1.00)	0.00 (1.00)	0.00 (1.00)	0.00 (1.00)	0.00 (1.00)	0.00 (1.00)	0.00 (1.00)	0.00	0.00
	SE +	--	--	--	--	--	--	**0.07**	**0.07**	**0.12**	--	--	--	--	--
	CD at 5%	--	--	--	--	--	--	**NS**	**0.22**	**NS**	--	--	--	--	--

DAS=Days after sowing Figures in parentheses indicate arc sin values

Table B3-10.2e: Relative abundance of jassids captured in different types of trap during 2018-19 (Centre: Karnal)

TN	Treatment Details	Number of aphids captured per trap at												Season total	Av. Mean
		19 DAS	26 DAS	33 DAS	40 DAS	47 DAS	54 DAS	61 DAS	68 DAS	75 DAS	82 DAS	89 DAS	96 DAS		
T1	Yellow sticky trap X 60 cm height	0.00 (1.00)	0.00 (1.00)	0.00 (1.00)	40.52 (6.44)	151.19 12.34)	213.52 (14.65)	273.19 (16.56)	315.52 (17.79)	665.19 (25.81)	341.52 18.51	343.52 18.56	49.19 (7.08)	2393.36	199.4
T2	Yellow sticky trap X 120 cm height	0.00 (1.00)	0.00 (1.00)	0.00 (1.00)	50.19 (7.15)	195.85 (14.03)	243.19 (15.63)	357.85 (18.94)	389.52 (19.76)	452.52 (21.30)	127.19 (11.32)	199.85 (14.17)	31.85 (5.73)	2048.0	170.7
T3	Blue sticky trap X 60 cm height	0.00 (1.00)	0.00 (1.00)	0.00 (1.00)	34.19 (5.93)	136.19 (11.71)	136.52 11.73)	221.19 (14.91)	241.52 15.57)	36.19 (6.10)	0.00 (1.00)	0.00 (1.00)	0.00 (1.00)	805.8	67.2
T4	Blue sticky trap X 120 cm height	0.00 (1.00)	0.00 (1.00)	0.00 (1.00)	25.85 (5.18)	122.52 (11.11)	124.52 11.20)	200.85 (14.21)	212.52 (14.61)	42.19 (6.57)	0.00 (1.00)	0.00 (1.00)	0.00 (1.00)	728.45	60.7
T5	Yellow tray trap X 10 cm height	0.00 (1.00)	0.00 (1.00)	0.00 (1.00)	19.19 (4.49)	69.19 (8.38)	95.52 (9.82)	115.52 (10.79)	123.52 (11.16)	12.52 (3.68)	0.00 (1.00)	0.00 (1.00)	0.00 (1.00)	435.46	36.3
T6	Yellow tray trap X 20 cm height	0.00 (1.00)	0.00 (1.00)	0.00 (1.00)	13.85 (3.85)	52.52 (7.32)	64.52 (8.09)	86.85 (9.37)	91.19 (9.60)	15.52 (4.06)	0.00 (1.00)	0.00 (1.00)	0.00 (1.00)	324.45	27.0
T7	Blue tray trap X 10 cm height	0.00 (1.00)	0.00 (1.00)	0.00 (1.00)	11.52 (3.54)	36.19 (6.10)	36.85 (6.15)	53.52 (7.38)	54.85 (7.47)	0.00 (1.00)	0.00 (1.00)	0.00 (1.00)	0.00 (1.00)	192.93	16.1
T8	Blue tray trap X 20 cm height	0.00 (1.00)	0.00 (1.00)	0.00 (1.00)	11.19 (3.49)	28.52 (5.43)	35.52 (6.04)	42.19 (6.57)	45.85 (6.84)	0.00 (1.00)	0.00 (1.00)	0.00 (1.00)	0.00 (1.00)	163.27	13.6
	SE +	--	--	--	1.78	1.81	1.80	1.85	1.78	1.70	1.87	1.85	1.59		
	CD at 5%	--	--	--	2.31	2.41	2.40	2.52	2.32	2.09	2.59	2.51	1.73		

DAS=Days after sowing Figures in parentheses indicate arc sin values

Table B3-10.2f: Relative abundance of natural enemies captured in different types of traps during 2018-19 (Centre: Karnal)

TN	Treatment Details	Number of natural enemies captured per trap at												Season total	Av. Mean
		19 DAS	26 DAS	33 DAS	40 DAS	47 DAS	54 DAS	61 DAS	68 DAS	75 DAS	82 DAS	89 DAS	96 DAS		
T1	Yellow sticky trap X	6.91	11.01	11.71	16.41	18.41	24.31	25.41	27.21	8.21	4.91	2.21	1.21	157.92	13.16
	60 cm height	(2.81)	(3.47)	3.57	4.17	4.41	5.03	5.14	5.31	3.03	2.43	1.79	1.49		
T2	Yellow sticky trap X	2.41	4.71	4.71	7.71	11.21	18.21	21.41	24.31	6.91	3.71	3.41	2.21	110.92	9.24
	120 cm height	(1.85)	(2.39)	2.39	2.95	3.49	4.38	4.73	5.03	2.81	2.17	2.10	1.79		
T3	Blue sticky trap X	0.00	0.00	1.91	2.91	2.91	4.51	4.91	5.91	3.51	2.51	1.21	1.21	31.5	2.63
	60 cm height	(1.00)	(1.00)	1.71	1.98	1.98	2.35	2.43	2.63	2.12	1.87	1.49	1.49		
T4	Blue sticky trap X	2.21	1.91	2.21	1.91	2.51	3.91	4.51	5.21	4.91	2.91	1.21	1.21	34.62	2.89
	120 cm height	(1.79)	(1.71)	1.79	1.71	1.87	2.22	2.35	2.49	2.43	1.98	1.49	1.49		
T5	Yellow tray trap X	0.00	0.00	0.00	0.00	0.00	0.00	1.51	2.81	0.00	0.00	0.00	0.00	4.32	0.36
	10 cm height	(1.00)	(1.00)	1.00	1.00	1.00	1.00	1.58	1.95	1.00	1.00	1.00	1.00		
T6	Yellow tray trap X	1.81	0.00	0.00	0.00	0.00	0.00	0.00	2.21	1.91	0.00	0.00	0.00	5.93	0.49
	20 cm height	(1.68)	(1.00)	1.00	1.00	1.00	1.00	1.00	1.79	1.71	1.00	1.00	1.00		
T7	Blue tray trap X	0.00	0.00	0.00	0.00	1.71	0.00	0.00	0.00	0.00	0.00	0.00	0.00	1.71	0.14
	10 cm height	(1.00)	(1.00)	1.00	1.00	1.65	1.00	1.00	1.00	1.00	1.00	1.00	1.00		
T8	Blue tray trap X	0.00	0.00	0.00	0.00	0.00	0	0.00	0.00	0/00	0.00	1.21	1.21	2.42	0.20
	20 cm height	(1.00)	(1.00)	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.49	1.49		
	SE +	0.1	0.1	0.1	0.2	0.2	0.1	0.1	0.2	0.2	0.1	--	0.1	--	0.4
	CD at 5%	0.3	0.5	0.6	0.7	0.4	0.4	0.4	0.5	0.4	0.2	--	0.3	--	0.9

DAS=Days after sowing Figures in parentheses indicate arc sin values

B4. Effect of varied nitrogen fertilization on aphid and termite infestation in wheat (**Centres:** Ludhiana, Niphad,Karnal)

Impact of three different doses (low, medium & high) of nitrogen application on population abundance of foliar aphid and termites was investigated in wheat. The nitrogen doses for NWPZ locations will be 0, 75,150 and 225 kg/ha while for PZ location, it will be 0, 60,120 and 180 kg/ha.

Observations:

1. Aphid: Population of aphids per plant, natural enemies (adult and grubs) per plot
2. Termite: Plant population per meter row length, per cent damaged shoots and effective tillers in each treatment
3. Yield q/ha
4. Nitrogen status of plants at flag leaf stage and at the time of harvest

Treatment details

Ludhiana centre	
Main plot (Nitrogen rate kg/ha)	**Sub plot (Varieties)**
N0 -- (Control/without nitrogen)	V1—HD 2967,
N75 --(50% less than recommended dose)	V2—PBW 660
N150 -- (Recommended dose)	
N225 -- (50% more than recommended dose)	
Niphad centre	
Main plot (Nitrogen rate kg/ha)	**Sub plot (Varieties)**
N0 -- (Control/without nitrogen)	V1-- NIAW 1994,
N60 --(50% less than recommended dose)	V2-- MACS 6222
N120 -- (Recommended dose)	V3--A-9-30-1
N180 -- (50% more than recommended dose)	
Karnal centre	
Main plot (Nitrogen rate kg/ha)	**Sub plot (Varieties)**
N0 -- (Control/without nitrogen)	V1—HD 2967,
N75 --(50% less than recommended dose)	V2—HD 3036
N150 -- (Recommended dose)	V3--A-9-30-1
N225 -- (50% more than recommended dose)	

Centre: Ludhiana

Effect of varied level of nitrogen fertilzer (low, medium & high) on population dynamics of foliar aphid was investigated in wheat. The nitrogen doses were 0, 75, 150 and 225 kg/ha. Populations of aphids per plant, natural enemies (adult and grubs) per square meter were recorded at fortnightly intervals. The population of aphid and their natural enemies was very low for statistically analysis on most of the date of observations, however clear differences were observed at peak period of their activity. The yield of each treatment was recorded to determine the individual effect of every dose of nitrogen application on aphid abundance (Table B4-10.2a).

Centre: Karnal

Impact of three different doses (low, medium & high) of nitrogen application on population abundance of foliar aphid was investigated in wheat. The nitrogen doses were 0, 75,150 and 225 kg/ha. Populations of aphids per plant, natural enemies (adult and grubs) per square meter were recorded at fortnightly intervals. The highest number of aphids were recorded in treatment of 225 kg/ha nitrogen application. The population was 30.21,28.54 and 33.26 aphids/plant in variety HD 2967, HD 3086 and A-9-30-1, respectively.Similarly, the natural enemy population was also higher in treatment which received 225 kg/ ha nitrogen. The population of coccinellids was recored to be 12.52 13.24 and 11.37 beetles per square meter, respectively. Among nitrogen fertilization and varieties the highest (60.01 q/ha) grain yield was recorded in variety HD 2967 fertilized with Nitrogen 225 kg/ha i.e. recommended dose. The lowest (34.57 q/ha) grain yield was recorded the variety A-9-30-1 with

Nitrogen 0 kg/ha i.e. without nitrogen fertilization. The incidence of aphids and their natural enemies increased significantly with the increase in dosages of nitrogen level (Table B4-11.2e).

Centre: Niphad

Aphids:

Nitrogen fertilization: Data differed significantly in their degree of infestation with aphids according to dose of nitrogen fertilization. The maximum (39.60) number of aphids/shoot/plant were recorded in treatment with Nitrogen 180 kg/ha i.e. 50% more than recommended dose as against the minimum (12.94) number of aphids/shoot/plant were recorded in treatment with Nitrogen 0 kg/ha i.e. without nitrogen. The increase in population of aphids was observed as the dose of nitrogen increased. It indicated that the aphid attraction/preference was more towards the higher dose of nitrogen fertilization. This high level of nitrogen results in greenish crop but also attract the more number of aphids. The present study depicted low aphid population at zero nitrogen fertilization to the crop while more application nitrogen fertilization over recommended dose increases the aphid population.

Varieties: Data presented in Table 7 revealed significant differences among each other. The variety NIAW 1994 showed significantly less (10.21) number of aphids/shoot/plant whereas the maximum (43.92) were recorded in variety A-9-30-1(Table B4-10.2c).

Nitrogen fertilization x varietal interaction: Among interaction of nitrogen fertilization and variety, the minimum (6.12) number of aphids/shoot/plant were recorded in variety NIAW 1994 with Nitrogen 0 kg/ha i.e. without nitrogen fertilization. The highest (67.77) number of aphids/shoot/plant were recorded in variety A-9-30-1 with Nitrogen 180 kg/ha i.e. 50% more than recommended dose.

Jassids:

Nitrogen fertilization: Data regarding population of jassids are presented in Table 8. The maximum (12.32) number of jassids/plant were recorded in treatment with Nitrogen 180 kg/ha i.e. 50% more than recommended dose as against minimum (11.55) number of jassids/plant were recorded in Nitrogen 0 kg/ha i.e. without nitrogen fertilization (Table B4-10.2d).

Varieties: Data revealed significant differences among each other. The variety NIAW 1994 showed significantly minimum (11.70) number of jassids/plant whereas the maximum (12.32) were recorded in variety A-9-30-1.

Nitrogen fertilization x varietal interaction: Among interaction of nitrogen fertilization and variety, the minimum (11.27) number of jassids/plant were recorded in variety NIAW 1994 with Nitrogen 0 kg/ha i.e. without nitrogen fertilization. The highest (12.59) number of jassids/plant were recorded in variety A-9-30-1 with Nitrogen 180 kg/ha i.e. 50% more than recommended dose.

Shoot fly:

Nitrogen fertilization: Data regarding per cent infestation of shoot fly are presented in Table 9. The maximum (2.06) per cent infestation of shoot fly were recorded in treatment with Nitrogen 120 kg/ha i.e. recommended dose as against minimum (0.96) per cent infestation of shoot fly was recorded in Nitrogen 0 kg/ha i.e. without nitrogen fertilization(Table B4-10.2e).

Varieties: Data revealed significant differences among each other. The variety NIAW 1994 showed significantly minimum (0.94) percent infestation of shoot fly whereas the maximum (2.32) was recorded in variety A-9-30-1.

Nitrogen fertilization x varietal interaction:

Among interaction of nitrogen fertilization and variety, the minimum (0.00) percent infestation of shoot fly was recorded in variety NIAW 1994 with Nitrogen 0 kg/ha i.e. without nitrogen fertilization and Nitrogen 60 kg/ha. The highest (2.85) percent infestation of shoot fly was recorded in variety A-9-30-1 with Nitrogen 180 kg/ha i.e. 50% more than recomm dose (Table B4-10.2f).

Yield:

Nitrogen fertilization: The treatment with Nitrogen 120 kg/ha i.e. recommended dose recorded highest of 36.20 q/ha grain yield whereas Nitrogen 0 kg/ha i.e. without nitrogen fertilization recorded minimum of 24.30 q/ha. It indicated that the grain yield was affected by both of nitrogen fertilization and population of aphids, hence the treatment with Nitrogen 180 kg/ha i.e. 50% more than recommended dose recorded less grain yield than Nitrogen 120 kg/ha i.e. recommended dose of nitrogen because of maximum population of aphids appeared on it and again control without nitrogen recorded less grain yield than Nitrogen 120 kg/ha i.e. recommended dose of nitrogen even though recorded minimum number of aphids than Nitrogen 120 kg/ha i.e. recommended dose but aphid affected in it due to less supply of nitrogen to the crop(Table B4-10.2f).

Varieties: In case of varieties the highest grain yield of 36.30 q/ha was recorded in variety NIAW 1994 followed by MACS 6222 (35.18 q/ha). The minimum yield of 21.47 q/ha was recorded in variety A-9-30-1.

Nitrogen fertilization x varietal interaction: Among nitrogen fertilization and varieties the highest (42.22 q/ha) grain yield was recorded in variety NIAW 1994 fertilized with Nitrogen 120 kg/ha i.e. recommended dose. The lowest (18.38 q/ha) grain yield was recorded in variety A-9-30-1 with Nitrogen 0 kg/ha i.e. without nitrogen fertilization.

B5. Basic studies for development of IPM strategies (Centres: Vijapur, Ludhiana, Niphad, Karnal,Kharibari)

The study was conducted to generate region-wise data on population dynamics of major insect-pests of wheat and barley for developing pest-forcasting models. Weather parameters of a location will be correlated with insect population to determine the effect of climatic variations on the pest population dynamics under changing climate scenario.

Centre: Vijapur

Seasonal incidence of *H. armigera*

Study on seasonal incidence of *H. armigera* was undertaken at Wheat Research Station, Vijapur. For this, wheat crop was observed at weekly interval for the presence of larval population right from germination to harvesting stage of crop. Data presented revealed that the first appearance of the pests was noticed in the fourth week of January that continued till the second week of March with peak incidence during third week of February.

Studies on parasites of wheat crop pests

With a view to know the naturally presence of parasites of wheat pests, 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 indicated that 10.39 per cent parasitism by Campolatis chlorideae on H. armigera larvae (Table B5-10.2a).

Table B4-10.2a: Effect of nitrogen fertilization on aphid abundance in various wheat varieties (Centre: Ludhiana)

S. No.	Nitrogen dosages	Variety	Aphid population per earhead		Coccinellids population per square meter		Grain Yield (q/ha)
			8-3-2018	15-3-2018	15-3-2018	28-3-2018	
1	0 (Control/without nitrogen)	HD2967	8.90 (3.14)	9.36 (3.21)	2.83 (1.94)	5.13 (2.47)	41.42
2	0 (Control/without nitrogen)	PBW 660	8.86 (3.12)	9.03 (3.16)	1.76 (1.66)	5.86 (2.61)	39.06
3	75(50% less than recommended dose)	HD2967	14.23 (3.89)	16.56 (4.18)	3.93 (2.21)	7.30 (2.87)	52.48
4	75(50% less than recommended dose)	PBW 660	11.73 (3.56)	16.66 (4.20)	3.56 (2.13)	7.19 (2.86)	49.95
5	150(Recommended dose)	HD2967	20.30 (4.61)	26.26 (5.21)	4.76 (2.40)	7.43 (2.90)	59.37
6	150(Recommended dose)	PBW 660	18.63 (4.42)	22.63 (4.85)	4.63 (2.37)	7.63 (2.93)	59.77
7	225(50% more than recommended dose)	HD2967	27.63 (5.34)	31.20 (5.67)	6.16 (2.67)	9.06 (3.12)	63.24
8	225(50% more than recommended dose)	PBW 660	26.66 (5.25)	28.06 (5.39)	6.83 (2.79)	9.53 (3.24)	62.77
CD (p=0.05)			(0.43)	(0.28)	(0.25)	(0.20)	3.59

* Figures within parentheses are transformed means

Date of sowing : 21.11.2018 Plot size : 7.5 m^2
Date of harvest : 29.04.2019 Replications : Three

Table B4-10.2b: Effect of nitrogen fertilization on aphid abundance in various wheat varieties (Centre:Karnal)

S. No.	Nitrogen dosages	Variety	Aphid population per earhead		Coccinellids population per square meter		Grain Yield (q/ha)
			6-3-2019	17-3-2019	23-3-2019	29-3-2019	
1	0 (Control/without nitrogen)	HD2967	13.66 (3.83)	14.11 (3.89)	4.94 (2.44)	8.01 (3.00)	39.01 (6.33)
2	0 (Control/without nitrogen)	HD3086	12.89 (3.73)	12.24 (3.64)	4.87 (2.42)	8.97 (3.16)	38.07 (6.25)
3	0 (Control/without nitrogen)	A-9-30-1	21.24 (4.72)	17.37 (4.29)	4.53 (2.35)	7.24 (2.87)	34.57 (5.96)
4	75(50% less than recommended)	HD2967	21.24 (4.72)	22.53 (4.85)	6.54 (2.75)	10.31 (3.36)	48.69 (7.05)
5	75(50% less than recommended)	HD3086	19.74 (4.55)	20.61 (4.65)	5.61 (2.57)	10.2 (3.35)	47.87 (6.99)
6	75(50% less than recommended)	A-9-30-1	27.37 (5.33)	24.54 (5.05)	5.23 (2.50)	9.7 (3.27)	38.63 (6.30)
7	150(Recommended dose)	HD2967	24.36 (5.04)	27.43 (5.33)	7.93 (2.99)	10.44 (3.38)	53.41 (7.38)
8	150(Recommended dose)	HD3086	22.37 (4.83)	25.46 (5.14)	7.24 (2.87)	10.64 (3.41)	52.24 (7.30)
9	150(Recommended dose)	A-9-30-1	30.04 (5.57)	31.37 (5.69)	7.01 (2.83)	9.55 (3.25)	39.54 (6.37)
10	225(50% more than recommended)	HD2967	27.64 (5.35)	30.21 (5.59)	9.01 (3.16)	12.52 (3.68)	60.01 (7.81)
11	225(50% more than recommended)	HD3086	25.57 (5.15)	28.54 (5.44)	9.24 (3.20)	13.24 (3.77)	59.33 (7.77)
12	225(50% more than recommended)	A-9-30-1	31.38 (5.69)	33.26 (5.85)	8.26 (3.04)	11.37 (3.52)	41.24 (6.50)
CD (p=0.05)			1.42	1.69	1.72	1.77	5.6

* Figures within parentheses are transformed means

Date of sowing : 20.11.2018 Plot size : 7.5 m^2

Date of harvest : 20.04.2019 Replications : Three

Table B4-10.2c: Effect of nitrogen fertilization on aphid abundance in various wheat varieties (Centre: Niphad)

SN	Treatments	NIAW 1994	MACS 6222	A-9-30-1	Mean
1	0 (Control/without nitrogen)	6.12 (2.67)	12.20 (3.63)	20.51 (4.64)	12.94 (3.73)
2	60 (50% less than recomm. dose)	7.52 (2.92)	14.93 (3.99)	25.56 (5.15)	16.00 (4.12)
3	120 (Recomm. dose)	11.03 (3.47)	23.03 (4.90)	61.84 (7.93)	31.97 (5.74)
4	180 (50% more than recomm. dose)	16.17 (4.14)	34.87 (5.99)	67.77 (8.29)	39.60 (6.37)
	Mean	10.21 (3.35)	21.26 (4.72)	43.92 (6.70)	
	Factors	**SE ±**	**CD at 5%**		
	Nitrogen fertilization (N)	**0.02**	**0.06**		
	Varieties (V)	**0.013**	**0.039**		
	Interaction (NxV)	**0.03**	**0.09**		

Table B4-10.2d: Effect of nitrogen fertilization on jassid abundance in various wheat varieties (Centre: Niphad)

SN	Treatments	NIAW 1994	MACS 6222	A-9-30-1	Mean
1	0 (Control/without nitrogen)	11.27 (3.50)	11.39 (3.52)	11.99 (3.60)	11.55 (3.54)
2	60 (50% less than recomm. dose)	11.56 (3.54)	11.72 (3.57)	12.15 (3.63)	11.81 (3.58)
3	120 (Recomm. dose)	11.84 (3.58)	12.12 (3.62)	12.56 (3.68)	12.17 (3.63)
4	180 (50% more than recomm. dose)	12.13 (3.62)	12.23 (3.64)	12.59 (3.69)	12.32 (3.65)
	Mean	11.70 (3.56)	11.87 (3.59)	12.32 (3.65)	
	Factors	**SE ±**	**CD at 5%**		
	Nitrogen fertilization (N)	**0.006**	**0.022**		
	Varieties (V)	**0.005**	**0.016**		
	Interaction (NxV)	**0.011**	**NS**		

Table B4-10.2e: Effect of nitrogen fertilization on shootfly in various wheat varieties (Centre: Niphad)

SN	Treatments	NIAW 1994	MACS 6222	A-9-30-1	Mean
1	0 (Control/without nitrogen)	0.00 (1.00)	1.10 (1.45)	1.77 (1.66)	**0.96 (1.40)**
2	60 (50% less than recomm. dose)	0.00 (1.00)	2.63 (1.90)	1.55 (1.60)	**1.39 (1.54)**
3	120 (Recomm. dose)	2.22 (1.79)	2.63 (1.90)	3.11 (2.03)	**2.65 (1.91)**
4	180 (50% more than recomm. dose)	1.55 (1.60)	1.77 (1.66)	2.85 (1.96)	**2.06 (1.75)**
	Mean	**0.94 (1.39)**	**2.03 (1.74)**	**2.32 (1.82)**	
	Factors	**SE ±**	**CD at 5%**		
	Nitrogen fertilization (N)	**0.35**	**1.25**		
	Varieties (V)	**0.23**	**0.69**		
	Interaction (NxV)	**0.52**	**1.68**		

Table B4-10.2f: Effect of nitrogen fertilization on yield in various wheat varieties (Centre: Niphad)

SN	Treatments	NIAW 1994	MACS 6222	A-9-30-1	Mean
1	0 (Control/without nitrogen)	27.59	26.94	18.38	**24.30**
2	60 (50% less than recomm. dose)	32.50	31.29	18.88	**27.56**
3	120 (Recomm. dose)	42.87	41.57	24.81	**36.20**
4	180 (50% more than recomm. dose)	42.22	40.92	23.80	**35.86**
	Mean	**36.30**	**35.18**	**21.47**	
	Factors	**SE ±**	**CD at 5%**		
	Nitrogen fertilization (N)	**0.99**	**3.49**		
	Varieties (V)	**0.94**	**2.85**		
	Interaction (NxV)	**1.83**	**NS**		

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

Table B5-10.2a: Seasonal activity of *H .armigera* and its natural parasitism (Location: Vijapur)

Sr. No.	Date of observation	No. of larvae/ 50 plant	No. of larvae observed	No. of larvae parasitized	Percent parasitism	Name of parasite
1.	29/01/19	1	4	0	10.39	*Campoletis chlorideae*
2.	05/02/19	1	10	1		
3.	12/02/19	2	15	1		
4.	19/02/19	3	20	2		
5.	26/02/19	2	17	2		
6.	05/03/19	1	6	1		
7.	12/03/19	1	5	1		
8.	19/03/19	0	0	0		
9.	26/03/19	0	0	0		

Centre: Ludhiana

Population dynamics of Wheat aphid: The aphid first appeared on 08.02.2019 on wheat crop and it started rising and reached its peak on 15.03.2019 (Table B5-10.2b). Thereafter population of wheat aphid started declining and it drastically decreased after 05.04.2019. The population of Coccinellid beetle remained low up to 15.03.2019 and thereafter it started rising and reach its peak on 29.03.2019 (two weeks after the peak period of activity of wheat aphid).

Population dynamics of barley aphid: The aphid population first appeared on 01.02.2019 on barley crop and it started rising and reached its peak on 15.03.2019 (B5-10.2c). Thereafter aphid population started declining and became very low after 05.04.2019. The population of coccinellid beetles remained low up to 15.03.2019 and thereafter it stated rising and reached its peak on 29.03.2019.

Thus, it can be concluded from the data that coccinellid beetle appeared after the peak period of aphid infestation on wheat and barley crop.

Centre: Niphad

The weekly observations on wheat aphids were recorded along with different weather parameters. Data presented in Table B5 10.1d revealed that the maximum (158.40) number of aphids/shoot/plant were observed in 3rd Meteorological week when the maximum and minimum temperatures were 30.7 and 8.7 °C, respectively and average relative humidity was 53 per cent. The incidence of jassids on wheat was also recorded. The maximum (21.60) population of the jassids/plant were recorded in 51st Meteorological week when the maximum and minimum temperatures were 27.3 and 7.5 °C, respectively (B5-10.2e). The maximum (4.0) natural enemies/m^2 was recorded in 3rd MW when maximum and minimum temperature were 30.7 and 8.7°C, respectively and average humidity was 53 per cent (B5-10.2f).

Centre: Karnal

*Population dynamics of Wheat aphid:*The aphid first appeared on 17.1.2019 on wheat crop and it started rising and reached its peak (66.5 aphids/plant) on 16.02.2019 (Table B5-10.2g.). Thereafter population of wheat aphid started declining. The population of Coccinellid beetle started from 27-01-2018 and reaches its peak (9.5 beetles/m^2) on 02.03.2019.

Population dynamics of barley aphid: The aphid population was high as compared to wheat during the whole crop season (Table B5-10.2h.). It first appeared on 17.1.2019on barley crop and it started rising and reached its first peak (117.0 aphids/plant) on 16.02.2019. The population of coccinellid beetles remained low up to 25.02.2019 (the peak period of activity of barley aphid) and thereafter it stated rising and reached its peak (8.5 beetles/m^2) on 02.03.2019. Thereafter its population started declining. 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.

B6. Zone specific IPM modules (Centres: Karnal, Ludhiana, Niphad, Kanpur)
The integrated pest modules consisting of effective cultural, physical, biological and chemical components of integrated pest management were formulated and tested against major pests of wheat viz., foliar aphids, shootfly and termites.

Centre: Ludhiana

There were some differences in aphid incidence, termite and pink stem borer (PSB) damage between IPM module and farmer's practices. The termite damage was around 2.70-2.80 per cent in farmer's practices while it was 0.17-0.65 per cent in IPM field. Similarly there was 1.04-1.78 per cent PSB damaged plants in farmer's practice while it was 0.32-0.63 in IPM field. The aphid incidence remained below economic threshold level of 5 aphids per earhead in IPM field while it ranged from 4.03 to 10.33 aphid/tiller in farmer's practice. The insecticides were sprayed in IPM field when incidence of aphid was observed in the border strip of field which prevented it's further spread into the interiors of the field. The numbers of plants infested with aphids were also higher in farmer's practice. However, the difference in the coccinellid beetles/m^2 was non-siginifcant between IPM field and farmer's practice. The incidence of brown wheat mite was compartively hiher in farmer's practice as compared to IPM plots (Table B6.10.2a)

Centre: Niphad

The data revealed that the IPM module recorded least (7.50) number of aphids/shoot/plant at 75 days after sowing whereas it was 78.40 in farmer practices treated plot. The population of aphid in IPM module plot was not observed upto 75 days after sowing. The population of jassids was not recorded in IPM module at 45, 60, 75 and 90 days after sowing as against farmers practice plot it was 15.60, 23.30, 0.70 and 0.00. Population of natural enemies was recorded in plot of farmer practices since 60 days after sowing. Incidence of termite and stem borer was not recorded in IPM treated as well as farmer practices plot. The infestation of stem borer (4.1%) was recorded in farmers practice plot at 60 days after sowing. The highest grain yield of 68.05 q/ha was recorded in IPM treated plot and lowest (42.36 q/ha) in farmers practice plot (Table B6-10.2b).

Centre: Karnal

The data indicated that population of aphid, termite and pink stem borer was comapartively lower in IPM treatment as compared to Farmer practice. However, in FP treatment the population of natural enemies was little higher than IPM treatment. The highest population of aphids was recored after 50 days i.e 155.0 aphids/shoot in IPM treatment as compared to 78.0 aphids/shoot in FP treatment. The highest grain yield of 56.48 q/ha was recorded in IPM treated plot and lowest (42.56 q/ha) in farmers practice plot (Table B6-10.2c).

Centre: Kharibari

The data indicated that the population of insect-pests in IPM module treatment was higher than Farmer's practice treatment (Table B6-10.2d).

Table B5-10.2b: Pest modeling for foliage aphids and their natural enemies (Centre: Ludhiana)

Date	Plant No.(No. of aphids/tiller)											Collateral host (Barley)			
	P1	P2	P3	P4	P5	P6	P7	P8	P9	P10	Avg.	P1	P2	P3	Avg.
18.01.2019	0	0	0	0	0	0	0	0	0	0	**0**	0	0	0	**0.00**
25.01.2019	0	0	0	0	0	0	0	0	0	0	**0**	0	0	0	**0.00**
01.02.2019	0	0	0	0	0	0	0	0	0	0	**0**	0	0	0	**0.00**
08.02.2019	0	0	0	0	0	0	1	0	0	0	**0.1**	0	0	0	**0.00**
15.02.2019	0	0	2	0	0	4	0	0	0	0	**0.6**	0	4	0	**1.33**
22.02.2019	4	0	2	0	2	1	5	4	0	0	**1.8**	8	0	7	**5.00**
01.03.2019	8	4	5	8	1	2	5	7	5	8	**5.3**	7	5	8	**6.67**
08.03.2019	4	5	9	7	8	5	7	4	9	8	**6.6**	11	15	10	**12.00**
15.03.2019	7	12	9	8	11	15	10	9	11	7	**9.9**	10	18	10	**12.67**
22.03.2019	8	7	8	10	6	8	7	5	4	8	**7.1**	10	7	8	**8.33**
29.03.2019	4	5	8	2	4	7	0	0	5	8	**4.3**	7	2	8	**5.67**
05.04.2019	0	0	0	1	0	0	0	0	0	0	**0.1**	0	0	4	**1.33**
Date	**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.**
18.01.2019	0	0	0	0	0	0	0	0	0	0	**0**	0	0	0	**0.00**
25.01.2019	0	0	0	0	0	0	0	0	0	0	**0**	0	0	0	**0.00**
01.02.2019	0	0	0	0	0	0	0	0	0	0	**0**	0	0	0	**0.00**
08.02.2019	0	0	0	0	0	0	0	0	0	0	**0**	0	0	0	**0.00**
15.02.2019	0	0	0	0	0	0	0	0	0	0	**0**	0	0	0	**0.00**
22.02.2019	0	0	0	0	0	0	0	0	0	0	**0**	0	0	0	**0.00**
01.03.2019	0	1	1	0	0	0	0	0	1	0	**0.3**	0	2	0	**0.00**
08.03.2019	0	2	2	0	0	0	2	2	0	1	**0.9**	1	0	2	**0.67**
15.03.2019	0	0	0	0	4	0	0	4	0	2	**1**	2	0	0	**1.00**
22.03.2019	4	0	2	4	0	5	0	7	0	4	**2.6**	2	4	8	**0.67**
29.03.2019	4	5	4	7	5	0	0	4	5	7	**4.1**	0	4	4	**4.67**
05.04.2019	0	0	0	0	1	0	0	0	0	1	**0.2**	0	0	0	**2.67**

Table B5-10.2c: Pest modeling for foliage aphids and their natural enemies (Centre: Ludhiana)

Date	Plant No.(No. of aphids/tiller)											Collateral host (wheat)			
	P1	P2	P3	P4	P5	P6	P7	P8	P9	P10	Avg.	P1	P2	P3	Avg.
18.01.2019	0	0	0	0	0	0	0	0	0	0	**0**	0	0	0	**0.00**
25.01.2019	0	0	0	0	0	0	0	0	0	0	**0**	0	0	0	**0.00**
01.02.2019	0	0	0	0	0	2	2	0	0	2	**0.6**	0	0	0	**0.00**
08.02.2019	0	0	0	0	0	0	5	4	2	0	**1.1**	0	0	0	**0.00**
15.02.2019	0	4	0	0	4	0	0	5	0	0	**1.3**	0	0	2	**0.67**
22.02.2019	8	0	7	0	4	0	5	0	4	0	**2.8**	4	0	2	**2.00**
01.03.2019	7	5	8	10	4	9	15	10	12	7	**8.7**	8	4	5	**5.67**
08.03.2019	11	15	10	17	9	14	10	8	11	12	**11.7**	4	5	9	**6.00**
15.03.2019	10	18	10	15	9	10	17	15	11	18	**13.3**	7	12	9	**9.33**
22.03.2019	10	7	8	10	8	8	14	10	8	9	**9.2**	8	7	8	**7.67**
29.03.2019	7	2	8	4	0	0	7	4	5	4	**4.1**	4	5	8	**5.67**
05.04.2019	0	0	4	5	4	4	2	5	0	0	**2.4**	0	0	0	**0.00**
Date	**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.**
18.01.2019	0	0	0	0	0	0	0	0	0	0	**0.00**	0	0	0	**0.00**
25.01.2019	0	0	0	0	0	0	0	0	0	0	**0.00**	0	0	0	**0.00**
01.02.2019	0	0	0	0	0	0	0	0	0	0	**0.00**	0	0	0	**0.00**
08.02.2019	0	0	0	0	0	0	0	0	0	0	**0.00**	0	0	0	**0.00**
15.02.2019	0	0	0	0	0	0	0	0	0	0	**0.00**	0	0	0	**0.00**
22.02.2019	0	0	0	0	0	1	0	0	0	0	**0.10**	0	0	0	**0.00**
01.03.2019	0	2	0	0	2	0	0	0	0	0	**0.40**	0	1	1	**0.67**
08.03.2019	1	0	2	0	2	0	0	0	4	0	**0.90**	0	2	2	**1.33**
15.03.2019	2	0	0	1	4	0	0	0	1	2	**1.00**	0	0	0	**0.00**
22.03.2019	2	4	8	2	4	4	0	4	0	7	**3.50**	4	0	2	**2.00**
29.03.2019	0	4	4	5	2	2	8	0	1	1	**2.70**	4	5	4	**4.33**
05.04.2019	0	0	0	0	1	2	0	0	0	1	**0.40**	0	0	0	**0.00**
18.01.2019															

Table B5-10.2d: Population dynamics of wheat aphid during 2018-19 (Centre: Niphad)

Date of observation	MW	Plant No. (No. of aphids/tiller)											Collateral host (barley)				Rain fall (mm)	Temperature (^{0}C)		Humidity (%)	
		P1	P2	P3	P4	P5	P6	P7	P8	P9	P10	Avg.	P1	P2	P3	Avg.		Max	Min	Morn	Even
Nov. 5-11	**45**	0	0	0	0	0	0	0	0	0	0	**0.00**	0	0	0	**0.00**	0	33.1	16.2	74	39
12-18	**46**	0	0	0	0	0	0	0	0	0	0	**0.00**	0	0	0	**0.00**	0	32.4	11.2	76	33
19-25	**47**	0	0	0	0	0	0	0	0	0	0	**0.00**	0	0	0	**0.00**	14.8	32.0	15.8	77	41
26-2	**48**	0	0	0	0	0	0	0	0	0	0	**0.00**	0	0	0	**0.00**	0	29.4	11.0	74	42
Dec. 3-9	**49**	0	0	0	0	0	0	0	0	0	0	**0.00**	0	0	0	**0.00**	0	29.6	12.8	81	39
10-16	**50**	2	0	0	1	0	0	0	2	0	2	**0.50**	0	0	0	**0.00**	0	28.5	10.2	78	39
17-23	**51**	7	9	12	17	15	8	10	9	7	11	**10.50**	0	0	0	**0.00**	0	27.3	7.5	69	39
24-31	**52**	25	27	31	24	32	25	21	27	23	33	**26.80**	0	0	0	**0.00**	0	26.9	6.1	72	32
Jan. 1-7	**01**	72	77	68	57	82	85	79	72	74	80	**74.60**	10	15	13	**12.67**	0	29.0	5.5	71	28
8-14	**02**	125	147	138	172	139	154	118	135	145	152	**142.50**	40	45	39	**41.33**	0	28.3	5.9	73	31
15-21	**03**	149	157	160	135	147	164	192	189	137	154	**158.40**	52	58	44	**51.33**	0	30.7	8.7	73	33
22-28	**04**	135	149	168	165	178	154	125	152	165	147	**153.80**	45	49	39	**44.33**	0	27.2	7.5	75	40
29-4	**05**	100	113	97	85	72	65	68	82	105	97	**88.40**	12	8	11	**10.33**	0	27.2	7.9	74	38
Feb. 5-11	**06**	25	18	15	12	7	9	12	21	14	10	**14.30**	0	0	0	**0.00**	0	27.3	7.6	73	38
12-18	**07**	0	0	0	0	0	0	0	0	0	0	**0.00**	0	0	0	**0.00**	0	31.6	9.6	77	30
19-25	**08**	0	0	0	0	0	0	0	0	0	0	**0.00**	0	0	0	**0.00**	0	34.1	11.9	72	26
26-4	**09**	0	0	0	0	0	0	0	0	0	0	**0.00**	0	0	0	**0.00**	0	33.1	10.4	73	31
Mar. 5-11	**10**	0	0	0	0	0	0	0	0	0	0	**0.00**	0	0	0	**0.00**					
12-18	**11**	0	0	0	0	0	0	0	0	0	0	**0.00**	0	0	0	**0.00**					

Table B5-10.2e: Population dynamics of jassids during 2018-19 (Centre: Niphad)

Date of observation	MW	Plant No. (No. of jassids/tiller)											Collateral host (Wheat)				RF(mm)	Temperature (^{0}C)		Humidity (%)	
		P1	P2	P3	Max	Min	Max	Min	P8	P9	P10	Avg.	P1	P2	P3	Avg.		Max	Min	Morn	Even
Nov. 5-11	**45**	0	0	0	0	0	0	0	0	0	0	**0.00**	0	0	0	**0.00**	0	33.1	16.2	74	39
12-18	**46**	0	0	0	0	0	0	0	0	0	0	**0.00**	0	0	0	**0.00**	0	32.4	11.2	76	33
19-25	**47**	1	0	0	2	1	1	0	0	1	1	**0.70**	0	0	0	**0.00**	14.8	32.0	15.8	77	41
26-2	**48**	3	2	1	4	2	3	2	4	1	4	**2.60**	0	0	0	**0.00**	0	29.4	11.0	74	42
Dec. 3-9	**49**	13	14	12	14	12	14	12	13	14	14	**13.20**	0	0	0	**0.00**	0	29.6	12.8	81	39
10-16	**50**	15	13	13	22	24	21	22	23	24	25	**20.20**	0	0	0	**0.00**	0	28.5	10.2	78	39
17-23	**51**	13	24	24	25	22	22	23	22	22	19	**21.60**	0	0	0	**0.00**	0	27.3	7.5	69	39

24-31	**52**	22	21	21	22	22	11	12	21	12	12	**17.60**	0	0	0	**0.00**	0	26.9	6.1	72	32
Jan. 1-7	**01**	4	2	2	1	2	4	5	3	2	2	**2.70**	0	0	0	**0.00**	0	29.0	5.5	71	28
8-14	**02**	0	0	0	0	0	0	0	0	0	0	**0.00**	0	0	0	**0.00**	0	28.3	5.9	73	31
15-21	**03**	0	0	0	0	0	0	0	0	0	0	**0.00**	0	0	0	**0.00**	0	30.7	8.7	73	33
22-28	**04**	0	0	0	0	0	0	0	0	0	0	**0.00**	0	0	0	**0.00**	0	27.2	7.5	75	40
29-4	**05**	0	0	0	0	0	0	0	0	0	0	**0.00**	0	0	0	**0.00**	0	27.2	7.9	74	38
Feb. 5-11	**06**	0	0	0	0	0	0	0	0	0	0	**0.00**	0	0	0	**0.00**	0	27.3	7.6	73	38
12-18	**07**	0	0	0	0	0	0	0	0	0	0	**0.00**	0	0	0	**0.00**	0	31.6	9.6	77	30
19-25	**08**	0	0	0	0	0	0	0	0	0	0	**0.00**	0	0	0	**0.00**	0	34.1	11.9	72	26
26-4	**09**	0	0	0	0	0	0	0	0	0	0	**0.00**	0	0	0	**0.00**	0	33.1	10.4	73	31
Mar. 5-11	**10**	0	0	0	0	0	0	0	0	0	0	**0.00**	0	0	0	**0.00**					
12-18	**11**	0	0	0	0	0	0	0	0	0	0	**0.00**	0	0	0	**0.00**					

Table B5-10.2f: Population dynamics of *coccinellid* beetle during 2018-19 (Centre: Niphad)

Date of observation	**MW**	**Plant No. (No. of beetle/sq m area)**											**Collateral host**				**Rain fall (mm)**	**Temperature (^{0}C)**		**Humidity (%)**	
		P1	**P2**	**P3**	**P4**	**P5**	**P6**	**P7**	**P8**	**P9**	**P10**	**Avg.**	**P1**	**P2**	**P3**	**Avg.**		**Max**	**Min**	**Morn**	**Even**
Nov. 5-11	**45**	0	0	0	0	0	0	0	0	0	0	**0.00**	0	0	0	**0.00**	0	33.1	16.2	74	39
12-18	**46**	0	0	0	0	0	0	0	0	0	0	**0.00**	0	0	0	**0.00**	0	32.4	11.2	76	33
19-25	**47**	0	0	0	0	0	0	0	0	0	0	**0.00**	0	0	0	**0.00**	14.8	32.0	15.8	77	41
26-2	**48**	0	0	0	0	0	0	0	0	0	0	**0.00**	0	0	0	**0.00**	0	29.4	11.0	74	42
Dec. 3-9	**49**	0	0	0	0	0	0	0	0	0	0	**0.00**	0	0	0	**0.00**	0	29.6	12.8	81	39
10-16	**50**	0	0	0	0	0	0	0	0	0	0	**0.00**	0	0	0	**0.00**	0	28.5	10.2	78	39
17-23	**51**	0	0	0	0	0	0	0	0	0	0	**0.00**	0	0	0	**0.00**	0	27.3	7.5	69	39
24-31	**52**	0	0	0	0	0	0	0	0	0	0	**0.00**	0	0	0	**0.00**	0	26.9	6.1	72	32
Jan. 1-7	**01**	2	0	0	1	1	1	0	2	1	1	**0.90**	0	0	0	**0.00**	0	29.0	5.5	71	28
8-14	**02**	2	3	2	2	4	2	5	3	5	3	**3.10**	0	0	0	**0.00**	0	28.3	5.9	73	31
15-21	**03**	2	3	3	4	5	2	5	7	4	5	**4.00**	0	0	0	**0.00**	0	30.7	8.7	73	33
22-28	**04**	2	2	3	4	2	3	5	4	2	2	**2.90**	0	0	0	**0.00**	0	27.2	7.5	75	40
29-4	**05**	1	2	2	1	2	3	2	1	2	2	**1.80**	0	0	0	**0.00**	0	27.2	7.9	74	38
Feb. 5-11	**06**	0	0	2	0	0	1	1	0	0	2	**0.60**	0	0	0	**0.00**	0	27.3	7.6	73	38
12-18	**07**	0	0	0	0	0	0	0	0	0	0	**0.00**	0	0	0	**0.00**	0	31.6	9.6	77	30
19-25	**08**	0	0	0	0	0	0	0	0	0	0	**0.00**	0	0	0	**0.00**	0	34.1	11.9	72	26
26-4	**09**	0	0	0	0	0	0	0	0	0	0	**0.00**	0	0	0	**0.00**	0	33.1	10.4	73	31
Mar. 5-11	**10**	0	0	0	0	0	0	0	0	0	0	**0.00**	0	0	0	**0.00**					
12-18	**11**	0	0	0	0	0	0	0	0	0	0	**0.00**	0	0	0	**0.00**					

Table B5-10.2g: Population dynamics of wheat aphid and Coccinellid beetle during 2018-19 (Location-Karnal)

Date of observation	Plant No.(No. of aphids/tiller)											Collateral host (Barley)			
	P1	P2	P3	P4	P5	P6	P7	P8	P9	P10	Av.	P1	P2	P3	Av.
17.01.2019	8	5	5	12	10	7	10	8	9	11	8.5	16	27	21	21.3
27.01.2019	15	28	23	15	14	20	18	6	12	17	16.8	31	46	31	36.0
02.02.2019	57	38	58	29	39	26	31	45	46	37	40.6	37	37	45	39.7
09.02.2019	65	45	40	46	57	52	55	51	37	70	51.8	60	79	47	62.0
16.02.2019	87	53	70	41	50	65	47	79	90	83	66.5	90	69	117	92.0
23.02.2019	77	35	74	70	79	61	67	59	51	67	64.0	87	50	46	61.0
02.03.2019	27	41	25	29	29	40	47	30	27	30	32.5	51	37	47	45.0
09.03.2019	35	23	19	26	20	28	37	41	16	14	25.9	37	21	40	32.7
16.03.2019	13	12	10	18	19	13	17	18	21	26	16.7	14	29	14	19.0
Date of observation	Plant No.(Coccinellid beetle/sq m area)											Collateral host (Barley)			
	P1	P2	P3	P4	P5	P6	P7	P8	P9	P10	Av.	P1	P2	P3	Av.
17.01.2019	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.0
27.01.2019	0	0	4	4	0	3	0	0	0	0	1.1	0	4	5	3.0
02.02.2019	2	0	3	4	0	2	2	2	2	1	1.8	2	6	3	3.7
09.02.2019	5	2	1	2	1	3	6	9	2	2	3.3	5	4	1	3.3
16.02.2019	6	5	4	3	5	8	6	1	3	4	4.5	3	8	5	5.3
23.02.2019	24	1	14	8	2	3	7	2	2	6	6.9	5	7	15	9.0
02.03.2019	17	8	15	16	6	15	3	5	6	4	9.5	8	7	14	9.7
09.03.2019	12	5	13	7	2	5	12	13	11	5	8.5	12	17	7	12.0
16.03.2019	4	8	5	9	5	3	13	7	5	2	6.1	5	7	12	8.0

Table B5-10.2h: Population dynamics of barley aphid and Coccinellid beetle during 2018-19 (Location-Karnal)

Date of observation	Plant No.(No. of aphids/tiller)											Collateral host (wheat)			
	P1	P2	P3	P4	P5	P6	P7	P8	P9	P10	Av.	P1	P2	P3	Av.
17.01.2019	12	7	9	7	22	17	27	22	12	12	14.7	10	8	8	8.7
27.01.2019	37	32	47	57	32	62	46	37	32	42	42.4	17	27	32	25.3
02.02.2019	57	67	97	37	77	82	47	72	62	97	69.5	37	52	47	45.3
09.02.2019	77	107	92	112	102	77	122	47	62	79	87.7	47	77	67	63.7
16.02.2019	12	142	107	142	162	177	112	77	167	72	117.0	77	82	112	90.3
23.02.2019	57	72	92	47	42	77	97	42	102	57	68.5	42	57	37	45.3
02.03.2019	27	17	77	47	77	35	27	47	17	32	40.3	24	22	42	29.3
09.03.2019	13	22	42	12	32	12	27	32	22	37	25.1	27	12	17	18.7
16.03.2019	10	8	22	7	11	9	17	27	12	22	14.5	10	12	13	11.7
Date of observation	Plant No.(Coccinellid beetle/sq m area)											Collateral host (wheat)			
	P1	P2	P3	P4	P5	P6	P7	P8	P9	P10	Av.	P1	P2	P3	Av.
17.01.2019	0	0	0	0	0	0	0	0	0	0	0	2	2	2	2.0
27.01.2019	0	0	3	3	0	2	0	0	0	0	0.8	5	5	5	5.0
02.02.2019	1	0	2	3	0	1	1	1	1	0	1	7	5	6	6.0
09.02.2019	4	1	0	1	0	2	5	8	1	1	2.3	11	5	6	7.3
16.02.2019	5	4	3	2	4	7	5	0	2	3	3.5	6	13	5	8.0
23.02.2019	23	0	13	7	1	2	6	1	1	5	5.9	8	9	11	9.3
02.03.2019	16	7	14	15	5	14	2	4	5	3	8.5	10	11	8	9.7
09.03.2019	11	4	12	6	1	4	11	12	10	4	7.5	9	10	12	10.3
16.03.2019	3	7	4	8	4	2	12	6	4	1	5.1	8	2	10	6.7

Table B6-10.2a: Effect of treatments of IPM modules on pests of wheat (Centre: Ludhiana)

Sr..No.	Days after sowing	Treatments	Avg. no. aphids/ shoot	Avg. lady bird beetle /m^2	Avg. termite infestation (%)	Avg. no.of jassids/plant	Avg. no. of mites/10 cm^2	Avg. stem borer infestation (%)
1.	Pre-count	IPM	0	0	0	-	0	0
		FP	0	0	0	-	0	0
		t value	-	-	-	-	-	-
2.	30	IPM	0	0	0.17 (1.45)*	-	-	0.32 (2.48)*
		FP	0	0	2.79 (9.59)*	-	-	1.04 (5.26)*
		t value	-	-	(1.20)	-	-	(1.44)
3.	45	IPM	0	0	0.65 (4.05)*	-	-	0.63 (3.87)*
		FP	0	0	2.76 (9.53)*	-	-	1.78 (7.64)*
		t value	-	-	(1.42)	-	-	(1.31)
4.	60	IPM	0	0	0	-	-	0
		FP	0	0	0	-	-	0
		t value	-	-		-	-	
5.	75	IPM	0	0	0	-	-	0
		FP	0-1	0	0	-	-	0
		t value						
6.	90	IPM	0-1	0	0	-	-	0
		FP	0-1	0	0	-	-	0
		t value						
7.	At earhead stage	IPM	2.00 (1.64)**	0	0	-	-	0
		FP	9.73 (3.26)**	0	0	-	-	0
		t value	(0.27)	-	-	-	-	
8.	Yield (qt/ha)	IPM	2.13 (1.68)**	4.06 (2.16)**	0	-	4.20 (2.26)**	0
		FP	10.33 (3.35)**	2.73 (1.87)**	0	-	11.73 (3.49)**	0
			(0.34)	NS	-	-	(0.42)	-
			58.4 q/ha					
			52.8 q/ha					

IPM = Integrated Pest Management;FP = Farmers Practice* Figures in parentheses are arcsine transformed means

Table B6-10.2b: Effect of treatments of IPM modules on pests of wheat (Centre: Niphad)

SN	Days	Treatments	No. of aphids/ shoot/ plant	No. of jassids /plant	No. of Brown wheat mite 10 cm^2 /leaves	No. of natural enemies/m^2	Termite damage %	Stem borer % infested tillers
1.	Pre count	IPM	0	0	0	0	0	0
		FP	0	0	0	0	0	0
2.	30	IPM	0	0	0	0	0	0
		FP	0	15.6	0	0	0	0
3.	45	IPM	0	0	0	0	0	0
		FP	25.3	23.3	0	0	0	0
4.	60	IPM	0	0	0	0.3	0	0
		FP	103.0	0.7	0	0.7	0	4.1
5.	75	IPM	7.5	0	0	0	0	0
		FP	78.4	0	0	0	0	0
6.	90	IPM	0	0	0	0	0	0
		FP	4.1	0	0	0	0	0
7.	At maturity	IPM	0	0	0	0	0	0
		FP	0	0	0	0	0	0
8.	Yield q/ha	IPM	**68.05**					
		FP	**42.36**					

IPM= Integrated Pest Management FP= Farmers practice (Non IPM)

Table B6-10.2c: Effect of treatments of IPM modules on pests of wheat (Location: Karnal)

SN	Days	Treatments	No. of aphids/ shoot/ plant	No. of jassids /plant	No. of Brown wheat mite 10 cm^2 /leaves	No. of natural enemies/m^2	Termite damage %	Stem borer % infested tillers	Yield q/ha
1.	30	IPM	16	0.00	0.00	0.00	2.56	0.00	
		FP	23	0.00	0.00	0.00	4.40	0.00	
2.	40	IPM	72	0.00	0.00	1.45	5.33	0.00	IPM 56.48
		FP	127	0.00	0.00	2.22	7.14	0.00	
3.	50	IPM	78	0.00	0.00	2.65	3.45	0.00	
		FP	155	0.00	0.00	6.12	7.89	0.00	
4.	60	IPM	68	0.00	0.00	4.41	0.00	5.45	
		FP	85.7	0.00	0.00	12.21	0.00	6.03	FP (Non IPM) 42.56
5.	70	IPM	43.5	0.00	0.00	15.23	0.00	3.73	
		FP	52	0.00	0.00	16.20	0.00	7.63	
6.	80	IPM	13.2	0.00	0.00	08.50	0.00	2.40	
		FP	15.4	0.00	0.00	13.40	0.00	2.47	

IPM= Integrated Pest Management FP= Farmers practice (Non IPM)

Table B6-10.2d: Effect of IPM modules on incidence and infestation of major insect-pests of wheat 2018-19 (Centre- Kharibari)

S.No	Time of observation	Treatments	Mean no. of aphids/ shoot	Mean no. of lady bird beetle/shoot	% termite infestation	Mean no. of Jassids/ shoot	Mean no. of mites/10 cm2 leaf area	% pink stem borer infestation
1	Pre-count	IPM	65.90	4	0	0	0	18
		FP	54.70	2	0	0	0	16
2	30	IPM	48.50	3	0	0	0	8
		FP	35.15	0	0	0	0	2
3	45	IPM	32.95	5	0	0	0	3
		FP	26.10	1	0	0	0	1
4	60	IPM	22.50	5	0	0	0	0
		FP	12.90	2	0	0	0	0
5	75	IPM	12.20	6	0	0	0	0
		FP	5.10	0	0	0	0	0
6	90	IPM	6.75	4	0	0	0	2
		FP	2.50	3	0	0	0	5
7	At maturity	IPM	2.25	6	0	0	0	0
		FP	1.50	3	0	0	0	0
8	Yield (qt/ha)	IPM	18.50	0	0	0	0	18.50
		FP	17.75	0	0	0	0	17.75

Table B6-10.2e: Effect of IPM modules on incidence and infestation of major insect-pests of wheat 2018-19 (Centre-Durgapura)

S.No.	Time of Observation	Treatments	Mean no. of aphids/shoot	Mean no. of lady bird beetle/shoot	% termite infestation	Mean no. of Jassids/shoot	Mean no. of mites/10 cm^2 of leaf area	% pink stem borer infestation
1.	Pre-count	IPM	-	-		-	-	-
		FP	-	-		-	-	-
		t value						
2.	30	IPM	-	-	2.80	-	-	-
		FP	-	-	5.20	-	-	-
		t value						
3.	45	IPM	-	-	3.10	-	-	-
		FP	-	-	6.80	-	-	-
		t value						
4.	60	IPM	-	-	4.30	-	-	-
		FP	-	-	7.20	-	-	-
		t value						
5.	75	IPM	2.66	0.67	5.10	-	-	-
		FP	12.33	1.00	8.45	-	-	-
		t value						
6.	90	IPM	3.33	1.00	6.30	-	6.33	-
		FP	21.66	2.00	14.50	-	15.66	-
		t value						-
7.	At maturity	IPM	2.66	0.33	7.00	-	6.66	-
		FP	10.33	1.33	16.30	-	12.33	
		t value						
8.	Yield (q/ha)	IPM	41.00					
		FP	30.69					
		t value	-					

B7. Eco friendly management of foliar aphid (Centres: Karnal, Ludhiana, Niphad, Kharibari and Pantnagar)

New bio-pesticides and new chemicals at lower doses were evaluated against foliar aphids in wheat. Insect population counts before and after the treatments were recorded along with yield in each treatment.

Treatment details:

SN	Treatments	Dose (ml or g/ha
1.	Imidacloprid 17.8 SL	100 ml
2.	Quinalphos 25 EC	400 ml
3.	Acetamiprid 20SP	100 g
4.	*Azadirachtin* 1500 ppm	3 ml/l
6.	*Beauveria bassiana* ($2x10^8$ cfu)	5 g/l
7.	*Metarhizium anisopliae* ($2x10^8$ cfu)	3 g/l
8.	Untreated check	-

Observations:

Spray of insecticides was initiated just after the average infestation of10 aphids/shoot was observed and repeated at an interval of 15 days. Five shoot from each treatment were selected and tagged randomly for recording observations. Observations were recorded on the basis of average

population of survival aphids. Pre count was taken 24 hours before spray and post count was taken on 1, 2, 7 and 15 days after spray. The average population of aphid survived per shoot was worked out and subjected to the statistical analysis.

Centre: Ludhiana

Aphid population did not differ significantly among all treatments one day before spray (Table B7). When observed one day after spray, thiamethoxam sprayed plots recorded minimum (1.71 aphids/earhead) and was at par quinalphos (1.79 aphids/earhead) and acetamprid (1.85 aphids/earhead) and siginifcantly better than all other insecticidal treatments. Similar trends was observed two, seven and fifteen days after spray. Maximum Grain yield (q/ha) was recorded in plots treated with acetamiprid (57.02) treated plots. However, all the insecticidal treatments recorded higher than grain yield than untreated check (53.77)(Table B7-10.2a).

Centre: Niphad

Data revealed at 1 day after spray, the plots treated with acetamiprid 20 SP @ 100g/ha registered significantly minimum (0.77) number of aphids/shoot/plant as compared to rest of the treatments and it was at par with quinalphos 25 EC @ 400 ml/ha (1.03) and imidacloprid 17.8 SL @ 100 ml/ha (1.27). Among various biopesticides the treatment with *Metarhizium anisopliae* ($2x10^8$ cfu)@ 3g/l water recorded minimum of 18.67 number of aphids/shoot/plant at 2 days after spray. It was followed by *Azadirachtin* 1500 ppm @ 3ml/l (20.90), *Lecannicillium lecanni* ($2x10^8$ cfu) @ 3g/l (21.93) and *Beauveria bassiana* ($2x10^8$ cfu) @ 5g/l (22.97). At 15 days after spray very less increase in aphid population in various insecticidal and biopesticidal treated plots were observed as compare to untreated control. The highest (96.70, 108.33, 112.67 and 124.10) number of aphids/shoot/plant were recorded at 1, 2, 7 and 15 days after spray, respectively in untreated control plot(Table B7-10.2b)

Centre: Karnal

Aphid population did not differ significantly among all treatments one day before spray. When observed one day after spray, acetamiprid recorded minimum (4.33 aphids/earhead) and was at par with all other insecticidal treatments except untreated check (25.33 aphids/earhead) and bio-pestcides treatments. Similar trends were observed two days,seven and fifteen days after spray, , acetamiprid was the best treatment, however these was at par with all other insecticidal treatments and better than untreated check.The performance of *Azadirahctin* 1500 ppm, *Beauveria bassiana and Metarhizium anisopliae* was comparatively lower than chemical insecticides.Out of these three, *Azadirahctin* 1500 ppm was better than *Azadirahctin* 1500 ppm.

Maximum Grain yield (q/ha) was recorded in plots treated with acetamiprid (59.05) treated plots. However, all the insecticidal treatments recorded higher than grain yield than untreated check (44.00) (Table B7-10.2c).

Centre: Kharibari

Aphid population did not differ significantly among all treatments 15 days before spray except seed treated plots where it was significantly lower than all other treatments (Table 7). The reduction in the wheat aphid population build up of *Rhopalosiphum maidis* due to application of Confidor (Imidacloprid 17.8 SL), Flubendamide (Fame 480 SC), Pride (Acetamiprid 20SP), Chlorantranilipride 18.5 SC(Coragen) was found to be 93.70% to 100% , respectively, over untreated control. The other bio-pesticides ***Azadirahctin* 1500 ppm, *Beaveria bassiana* (2 x 108c.f.u), *Metarhizium anisopliae*** was found to be at 78.17% to 93.77% respectively, over untreated control.

Grain yield (q/ha) obtained was maximum from Pride (Acetamiprid 20SP) (24.55)treated plots followed by flubendamide (22.45), Confidor (Imidacloprid 17.8 SL) (23.15), and Chlorantranilipride 18.5 SC(Coragen) (20.54), ***Azadirahctin* 1500 ppm (18.65), *Beaveria bassiana* (2 x 108c.f.u) (16.75)** and ***Metarhizium anisopliae*(15.45)** treated plots. However, all the insecticidal treatments recorded higher than grain yield than untreated check (15.30) (Table B7-10.2d).

Table B7-10.2a: Efficacy of various insecticides and biopesticides against foliar aphid during 2018-19Centre: Ludhiana)

S. No.	Treatments	Dose ml or g / ha	Aphid population per earhead					Grain Yield (q/ha)
			Before spray	After spray				
			1 day	1 day	2 days	7 days	15 days	
1	Actara (thiamethoxam 25 WG)	50 g	11.43	1.71 (1.64)	1.42 (1.55)	1.01 (1.41)	1.50 (1.58)	56.80
2	Ekalux (quinalphos 25EC)	375 ml	11.20	1.79 (1.67)	1.38 (1.54)	1.08 (1.44)	1.52 (1.58)	56.84
3	Pride (Acetamiprid 20SP)	100 gm	11.43	1.85 (1.68)	1.44 (1.56)	1.07 (1.43)	1.59 (1.60)	57.02
4	Azadirachtin 1500 ppm	3.0 ml/l	11.30	8.75 (3.12)	8.20 (3.03)	8.97 (3.15)	9.26 (3.20)	55.15
5	*Verticillium lecanni* (2 x 108 c.f.u)	3.0 g/l	11.66	9.09 (3.17)	8.96 (3.15)	9.17 (3.18)	9.36 (3.31)	54.88
6	*Beauveria bassiana* (2 x 108c.f.u)	5.0 g/l	11.60	9.07 (3.17)	9.21 (3.19)	9.12 (3.18)	9.53 (3.24)	54.84
7	*Metarhizium anisopliae*	3.0 g/l	11.33	9.39 (3.22)	9.12 (3.18)	9.26 (3.20)	9.31 (3.21)	54.62
8	Control	-	11.43	12.08 (3.61)	12.57 (3.68)	12.88 (3.72)	13.08 (3.75)	53.77
CD (p=0.05)			NS	(0.12)	(0.14)	(0.15)	(0.12)	1.33

* Figures within parentheses are transformed means

Date of sowing : 12.11.2018
Date of insecticidal application : 15.03.2019
Date of harvest : 27. 04.2019
Plot size : 7.5 m^2
Variety : PBW 725
Replications : Three

Table B7-10.2b: Efficacy of various insecticides and biopesticides against foliar aphid during 2018-19 (Centre: Niphad)

SN	Treatments	Dose (ml or g/ha	Av. Population of survived foliage feeding wheat aphids per shoot					Yield q/ha	Population of N. enemies/ m^2
			Pre count	1DAS	2DAS	7DAS	15DAS		15DAS
1	Imidacloprid 17.8 SL	100 ml	67.00 (8.24)	1.27 (1.50)	0.00 (1.00)	0.00 (1.00)	9.50 (3.24)	66.25	0.00 (1.00)
2	Quinalphos 25%EC	400ml	68.67 (8.34)	1.03 (1.42)	0.00 (1.00)	0.00 (1.00)	9.80 (3.28)	63.57	0.00 (1.00)
3	Acetamiprid 20SP	100 g	68.80 (8.35)	0.77 (1.33)	0.00 (1.00)	0.00 (1.00)	9.70 (3.27)	62.55	0.00 (1.00)
4	*Azadirachtin* 1500 ppm	3 ml/l	70.67 (8.46)	31.27 (5.68)	20.90 (4.67)	10.43 (3.38)	20.67 (4.65)	54.86	0.05 (1.02)
5	*Lecanicillium lecanni* ($2x10^8$ c.f.u.)	3 g/l	70.37 (8.44)	50.20 (7.15)	21.93 (4.78)	8.63 (3.10)	15.27 (4.03)	56.48	0.07 (1.03)
6	*Beauveria bassiana* ($2x10^8$ c.f.u.)	5 g/l	70.27 (8.44)	52.77 (7.33)	22.97 (4.89)	11.77 (3.57)	18.30 (4.39)	56.62	0.07 (1.03)
7	*Metarhizium anisopliae*	3 g/l	74.60 (8.69)	46.80 (6.91)	18.67 (4.43)	8.13 (3.02)	13.30 (3.78)	58.61	0.07 (1.03)
8	Untreated check	-	73.27 (8.61)	96.70 (9.88)	108.33 (10.45)	112.67 (10.66)	124.10 (11.18)	39.45	0.12 (1.05)
	SE ±		**0.10**	**0.09**	**0.03**	**0.04**	**0.10**	**3.22**	**0.011**
	CD at 5%		**NS**	**0.28**	**0.10**	**0.11**	**0.31**	**9.85**	**0.033**

*DAS- Days after spray, figures in parentheses indicate V_{n+1} transformed value,
Date(s) of Insecticides/biopesticides application: i) 24/12/2018 ii) 08/01/2019

Table B7-10.2c: Efficacy of various insecticides and biopesticides against foliar aphid during 2018-19 (Centre: Karnal)

SN	Treatments	Dose (ml or g/ha	Av. Population of survived foliage feeding wheat aphids per shoot					Yield q/ha	Population of N. enemies/ m^2
			Pre count	1DAS	2DAS	7DAS	15DAS		15DAS
1	Imidacloprid 17.8 SL	100 ml	28.67 (5.43)*	5.40 (2.53)	3.67 (2.16)	2.40 (1.84)	2.53 (1.88)	56.38	0.79 (1.34)
2	Quinalphos 25%EC	400ml	26.67 (5.25)	4.80 (2.41)	3.20 (2.05)	2.00 (1.73)	1.67 (1.63)	57.32	0.99 (1.41)
3	Acetamiprid 20SP	100 g	30.33 (5.59)	4.33 (2.31)	2.80 (1.95)	1.67 (1.62)	1.07 (1.44)	59.05	0.64 (1.28)
4	*Azadirachtin* 1500 ppm	3 ml/l	28.00 (5.38)	4.60 (2.36)	3.07 (2.02)	1.73 (1.65)	1.27 (1.50)	51.22	0.95 (1.40)
5	*Lecanicillium lecanni* ($2x10^8$ c.f.u.)	3 g/l	30.00 (5.57)	5.27 (2.50)	3.47 (2.11)	2.27 (1.80)	2.33 (1.82)	49.21	1.34 (1.53)
6	*Beauveria bassiana* ($2x10^8$ c.f.u.)	5 g/l	28.33 (5.40)	5.00 (2.45)	3.33 (2.08)	2.20 (1.79)	2.00 (1.73)	50.12	0.54 (1.24)
7	*Metarhizium anisopliae*	3 g/l	27.00 (5.29)	5.67 (2.58)	3.87 (2.20)	2.53 (1.88)	2.87 (1.96)	51.07	2.17 (1.78)
8	Untreated check	-	27.33 (5.32)	25.33 (5.13)	22.67 (4.86)	19.33 (4.51)	17.33 (4.28)	44.00	0.62 (1.27)
	SE ±		**0.04**	**0.06**	**0.07**	**0.06**	**0.06**	**0.04**	**0.01**
	CD at 5%		**NS**	**0.17**	**0.13**	**0.15**	**0.22**	**0.17**	**0.19**

*DAS- Days after spray, figures in parentheses indicate V_{n+1} transformed value,
Date(s) of Insecticides/biopesticides application: 14/2/2019

Table B7-10.2d: Efficacy of various insecticides and biopesticides against foliar aphid during 2018-19 (Centre: Kharibari)

Name of Treatment	Dose gm/ml/lt.	Before spray Population	Mean no. population of survived foliage feeding wheat aphids/shoot/plant												Grain Yield (q/ha)
			I st Spray				Av. Aphid population/ shoot after spray	% reduction over control	Before spray Population	II nd Spray				Av. Aphid population/ shoot after spray	
			1 DAT	2 DAT	7 DAT	15 DAT				1 DAT	2 DAT	7 DAT	15 DAT*		
Confidor (Imidacloprid 17.8 SL)	20	75.50 (8.69)	56.75 (7.53)	35.20 (5.93)	12.50 (3.54)	2.15 (1.4)	26.65	97.77	28.65 (5.35)	15.65 (3.96)	8.10 (2.85)	2.50 (1.58)	1.25 (1.12)	6.88	23.15
Fame (Flubendamide 480 SC)	20	77.35 (8.79)	50.45 (7.10)	32.45 (5.70)	15.45 (3.93)	1.65 (1.2)	25.00	98.33	32.45 (5.70)	20.15 (4.49)	9.45 (3.07)	2.65 (1.63)	0.00 (0.71)	8.06	22.45
Pride (Acetamiprid 20SP)	20	82.15 (9.06)	59.75 (7.73)	45.25 (6.73)	22.65 (4.76)	4.20 (2.0)	32.96	96.46	30.15 (5.49)	21.45 (4.63)	12.30 (3.51)	3.45 (1.86)	1.65 (1.28)	9.71	24.65
Coragen (Chlorantranilipride 18.5 SC)	20	77.45 (8.80)	42.50 (6.52)	24.15 (4.91)	10.75 (3.28)	1.95 (1.4)	19.84	98.03	25.95 (5.09)	18.50 (4.30)	8.70 (2.95)	2.95 (1.72)	1.85 (1.36)	8.00	20.54
Azadirachtin 1500 ppm	3.0	72.25 (8.50)	56.75 (7.53)	36.45 (6.04)	22.35 (4.73)	5.75 (2.4)	30.33	93.77	46.50 (6.82)	30.25 (5.50)	19.50 (4.42)	9.85 (3.14)	4.15 (2.04)	15.94	18.65
Beauveria bassiana (2 x 108c.f.u)	5	65.10 (8.07)	50.45 (7.10)	48.50 (6.96)	32.25 (5.68)	15.9 (3.9)	36.79	80.82	65.15 (8.07)	48.30 (6.95)	31.65 (5.63)	22.15 (4.71)	12.35 (3.51)	28.61	16.75
Metarhizium anisopliae	3	67.35 (8.21)	48.10 (6.94)	40.15 (6.34)	30.75 (5.55)	17.8 (4.2)	34.20	79.31	60.10 (7.75)	41.20 (6.42)	32.50 (5.70)	24.50 (4.95)	14.85 (3.85)	28.26	15.45
Untreated check	-	79.92 (8.94)	85.10 (9.22)	92.15 (9.60)	98.20 (9.91)	102.1 (10.1)			115.1 (10.7)	120.2 (10.9)	122.3 (11.06)	124.9 (11.18)	130.3 (11.4)		15.30
SEm±		1.20	1.09	1.14	0.92	0.67			1.023	1.015	0.748	0.715	0.63		
CD at 5%		3.55	3.24	3.38	2.72	1.99			3.02	3.00	2.21	2.11	1.89		

B8. Eco friendly management of termites (Centres: Durgapura, Kanpur, Ludhiana and Vijapur)
Few selected new chemicals along with botanicals as seed treatment were tested against termites. The observations on plant population per meter row length, per cent damaged shoots and effective tillers were taken at different stages of crop.

B8a. Management of termites through seed treatment

Centre:Ludhiana

The data 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 treatments recorded significantly lower per cent damaged effective tillers/ m row than the untreated check. However, the termite damage was significantly more in *Beauveria bassiana and Metarhizium anisopliae* as compared to all other pesticide treatments.

At ear head stage, the per cent damaged effective tillers per meter row (in marked spots) were minimum in the plot treated with thiamethoxam 70 WS (1. 88 per cent) treated plots and it was on par with all the other treatments except untreated check and two other biocontrol treatments. The numbers of damaged effective tillers/ha were lowest in plots treated with thiamethoxam 70 WS @ 1.0 ml/kg of seed (12333). All these insecticide treated plots recorded significantly lower number of damaged tillers/ha as compare to untreated check.

The grain yield (q/ha) obtained was maximum in plot treated with thiamethoxam (49.70 q/ha) and it was at par with all insecticidal seed treatments. The data revealed that all the treatments has significantly higher yield than the untreated check (46.30 q/ha) (Table B8a-10.1a).

Centre: Vijapur

The data further revealed that there was no termite damage observed during 3rd, 4th and 5th weeks after sowing in all treatments including untreated plot. The result of percent damaged effective tillers/m row found significant among the treatments however, the maximum and minimum per cent damaged effective tillers/meter row was observed in untreated check and in treatment of fipronil 5 SC @ 0.3 g a.i./kg seed respectively which was at par with treatments of thiamethoxam 25 WG @ 0.8 g a.i./kg and thiamethoxam 30 FS @ 0.72 g a.i./kg. The result of number of damaged effective tillers/ha revealed that significantly the lowest damage was recorded in treatment of fipronil 5 SC @ 0.3 g a.i./kg seed and other treatments were at par with this as compared to untreated check. There was also significantly low termite damage recorded in bio-pesticide as compared to untreated check. The grain yield in g/m row revealed non-significant difference among the treatments. The maximum grain yield (g/m row) was recorded in the plot treated with fipronil 5 SC @ 0.3 g a.i./kg seed as compared to untreated check. The data on grain yield computed on the basis of q/ha from different treatments showed non-significant differences among all the treatments although the maximum grain yield was obtained from fipronil 5 SC @ 0.3 g a.i./kg seed treated plot followed by treatment thiamethoxam 30 FS @ 0.72 g a.i./kg seed (Table B8a-10.1b).

Centre:Kanpur

The incidence of termite after 3 weeks of sowing was not seen in any of the treatments accept untreated plot i.e. 2.44 per cent. The incidence of termite after 4 weeks of sowing range from 0.44 to 0.74 per cent, while in untreated plot it was 3.32 per cent. The incidence of termite after 5 weeks of sowing range from 1.15 to 1.71 per cent, while in untreated plot it was 3.46 per cent, significantly less damaged shoot were recorded in treated plot with fipronil 5SC and *Beaveria bassiana*, which was at par Thiamethoxam 70WS and imidacloprid 600FS (48%). Minimum damage of effective tiller per meter row was recorded in the treated plots with fipronil 5SC and *Beaveria bassiana*. Which was at par Thiamethoxsam 70WS and imadacloprid 600FS (48%). Manimum damage of effective tiller per meter row was recordrd in the treated plots with fipronil 40 % + imidacloprid 40 WG and Fipronil 5 SC which was at par clothionidin 50 WDG and imidacloprid 600 FS (48%).

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 3100.00 to 4233.33 while it was 73343.33 untreated plots. The minimum damaged

number of effective tillers/ha were recorded in fipronil 5SC and *Beaveria bassiana* followed by Thiamethoxam 70WS and imidacloprid 600FS (48%).

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 fipronil 5SC and *Beaveria bassiana*, followed by Thiamethoxam 70 WS and imidacloprid 600 FS (48%).

The result concluded that insecticide fipornil 5SC @ 6.0ml/kg of seed and *Beaveria bassiana* @ 5.0g/lit were superior to Thiamethoxam 70WS @ 1.0 ml/kg, imidacloprid 600 FS (48%) @ 2.0ml, Clothianidin 50WDG @ 1.5gm, Thiamethoxam 25WG 3.2 gm/kg of seed and *Metarhizium anisopliae* @ 3.0g/lit.(Table B8a-10.2c).

Experiment B8b: Management of termites through broadcast application in standing crop

Centre: Vijapur

An experiment on eco-friendly management of termitethrough broadcast application in standing wheat crop was conducted under irrigated condition at Wheat Research Station, Vijapur. The broadcast application of treatments was made on 16-12-2018 and the results are summarized in table 2. There was no termite damage in all the treatments after 3rd, 4th and 5th weeks of sowing including untreated check. At ear head stage, the percent damaged effective tillers/m row were zero in all the insecticides broadcasted plots. However, all the bio-pesticides recorded significantly less percent damaged effective tiller/m row than untreated check. The number of damaged effective tillers/ha was significantly higher in untreated check whereas among the insecticidal treatments, it was significantly minimum in fipronil 5 SC @ 80 g. a.i./ha which was at par treatment of fipronil 0.3 G @ 60 g a.i./ha and fipronil + imidacloprid 40 % WG (Lacenta). While there were low termite damage reported in bio-pesticides as compared to untreated check. However, there were non-significant difference among the treatments in grain yield in g/m row but the maximum grain yield was obtained in plot treated with fipronil 5 SC @ 80 g. a.i./ha followed by treatment of fipronil 0.3 G @ 60 g a.i./ha and fipronil + imidacloprid 40 % WG (Lacenta). Similarly, there were non-significant results found in grain yield (q/ha). Although, the highest grain yield (q/ha) was recorded in treatment of fipronil 5 SC @ 80 g a.i./ha followed by treatment of fipronil 0.3 G @ 60 g a.i./ha and fipronil + imidacloprid 40 % WG (Lacenta).(Table B8b-10.2a).

Table B8a-10.2a: Eco-friendly management of termitethrough seed treatment (Centre: Ludhiana)

S. No	Treatments	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 (q/ha)
				3 weeks	4 weeks	5 weeks			
1	Thiamethoxam 25WG	3.2 gm	47.06	1.38 (7.88)	1.21 (7.51)	1.33 (7.77)	1.98 (9.05)	12500 (111.75)	49.11
2	Thiamethoxam 70WS	1.0 ml	45.90	1.24 (7.57)	1.08 (7.23)	1.18 (7.43)	1.88 (8.86)	12333 (111.03)	49.70
3	Fipronil 5 SC	6.0 ml	45.70	1.34 (7.80)	1.19 (7.47)	1.37 (7.86)	2.02 (9.12)	13250 (115.08)	49.12
4	Imidacloprid 600FS	2 ml	47.30	1.30 (7.70)	1.08 (7.21)	1.34 (7.79)	1.96 (9.02)	13000 (113.98)	49.40
5	Clothianidin 50 WDG	1.5 gm	46.76	1.34 (7.79)	1.10 (7.26)	1.35 (7.81)	1.91 (8.93)	13250 (115.07)	49.43
6	*Beauveria bassiana*	5 gm/kg seed	47.73	2.31 (9.65)	2.00 (9.09)	1.99 (9.08)	2.39 (9.78)	17500 (132.23)	47.29
7	*Metarhizium anisopliae*	3 gm/kg seed	46.06	2.26 (9.56)	1.95 (9.01)	2.01 (9.12)	2.38 (9.77)	17166 (131.01)	46.23
8	Untreated check	-	46.43	3.73 (11.85)	3.50 (11.53)	3.62 (11.70)	3.91 (12.11)	23333 (152.74)	46.30
CD (p=0.05)			NS	(0.61)	(0.34)	(0.50)	(0.53)	(6.27)	0.84

* Figures in parentheses are transformed means

Date of sowing	:	12-11-2018	Plot size	:	40 m^2
Date of insecticidal application	:	11-11-2018	Variety	:	PBW 660
Date of harvest	:	27-04-2019	Replications	:	Three

Table B8a-10.2b: Eco-friendly management of termitethrough seed treatment during 2018-19 (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 (week)			% Damaged effective tillers/m row	No. of damaged effective tillers/ha	Grain yield q/ha
					3rd	4th	5th			
1.	Thiamethoxam 25 WG	0.8	54	87.33	0.00* (0.00)	0.00* (0.00)	0.00* (0.00)	3.78*ab (0.44)	1594**a (3484)	47.14
2.	Thiamethoxam 30 FS	2.0	59	85.00	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)	3.67ab (0.41)	1459a (2369)	48.86
3.	Fipronil 5 SC	0.3	56	88.00	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)	2.60a (0.21)	1232a (1115)	51.27
4.	Imidacloprid 600 FS	2.4	57	89.00	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)	4.12bc (0.53)	1589a (4181)	47.28
5.	Clothianidin 50 WDG	0.75	60	84.67	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)	4.95bc (0.75)	2001a (4599)	46.18
6.	*Beauveria bassiana* (g/kg seed)	1.2	61	85.00	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)	5.33c (0.87)	2090a (3205)	45.65
7.	*Metarhizium anisopliae* (g/kg seed)	5	58	87.00	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)	5.00bc (0.78)	2090a (5017)	46.00
8.	Untreated Check	3	61	90.00	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)	10.95d (3.69)	3800b (8361)	42.81
	S.Em.±		3.0	4.47	-	-	-	0.49	291	3.35
	C.D. at 5%		NS	NS	-	-	-	1.49	882	NS
	C.V.%		10.10	8.90	-	-	-	16.85	25.41	12.39

* 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 : 26/11/2018 Date of sowing : 27/11/2018

Date of Plant population count : 16 /12/2018 Date of harvesting : 06/04/2019

Design : R.B.D Replications: Three Spacing : 23 cm between row No. of rows / plot: 12

Plot size : Gross : 14.0m x 2.76 m Net: 13.0m x 1.84m Variety: GW 496 Condition : Irrigated

Table B8a-10.2c: Eco-friendly management of termitethrough seed treatment during 2018-19 (Centre: Durgapura)

Treatments	Dose gm/ml/ kg seed	Plant population/m row	Percent damaged shoot/m row	Per cent damaged effective tillers/m row at ear head stage	No. of damaged effective tillers/ ha	Grain yield q/ha
Thiamethoxam 25 WG	3	41.33	0.91 (5.47)*	2.11 (8.34)	8246.33	37.32
Thiamethoxam 75 WS	10	41.66	1.10 (5.9)	2.72 (9.43)	8312.00	37.12
Fipronil 5 SC	4	41.33	0.59 (4.39)	0.96 (5.49)	5986.66	40.86
Imidacloprid 600 FS	1.5	42.33	0.32 (3.21)	0.56 (4.28)	3712.00	42.78
Clothianidin 50 WDG	4	41.66	0.80 (5.12)	1.12 (6.07)	6146.00	39.72
Beauveria bassiana	3.2	41.66	3.32 (10.49)	8.32 (16.76)	24132.00	28.48
Metarhizium anisopliae	3	41.66	2.22 (8.56)	7.00 (15.31)	21512.00	30.18
Control	5	39.66	10.37 (18.76)	21.31 (27.47)	39628.00	17.29
SEm	-	N/A	(1.23)	(1.48)	183.55	1.83
CD @ 5%	-	0.53	(0.40)	(0.48)	59.93	0.59
CV	-	2.28	(9.00)	(7.17)	0.71	3.02

*Figures in parentheses are angular transformed value

Table B8a-10.2d: Eco-friendly management of termitethrough seed treatment during 2018-19 (Centre: Kanpur)

S. No	Treatments	Actual Dose gm/ ml/kg of seed.	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 q/ha
				3 weeks	4 weeks	5 weeks			
1.	Thiamethoxam 25 WG	3.2g	36.16	0	0.70 (4.80)	1.66 (7.27)	1.63 (7.27)	3836.66 (61.86)	23.59
2.	Thiamethoxam 70WS	1.0ml	32.53	0	0.58 (4.37)	1.35 (6.55)	1.51 (7.04)	3375.00 (58.09)	24.96
3.	Fipronil 5 SC (regent)	6.0ml	33.03	0	0.44 (3.80)	1.15 (6.02)	1.37 (6.55)	3100.00 (55.47)	26.60
4.	Imidacloprid 600 FS (48%)	2.0ml	34.43	0	0.61 (4.48)	1.43 (6.80)	1.56 (7.04)	3503.33 (59.08)	24.67
5.	Clothianidin 50 WDG	1.5g	36.06	0	0.63 (4.55)	1.61 (7.27)	1.57 (7.04)	3683.33 (60.58)	24.43
6.	*Beauveria bassiana*	5.0g	36.66	0	0.47 (3.93)	1.26 (6.99)	1.45 (6.80)	3216.66 (56.54)	25.54
7.	*Metarhizium anisopliae*	3.0g	35.70	0	0.74 (4.93)	1.71 (7.49)	1.73 (7.49)	4233.33 (64.78)	23.23
8.	Control		36.73	2.44	3.32 (10.47)	3.46 (10.63)	3.68 (10.94)	73343.33 (131.66)	18.04
	SEm±	-	NS	-	0.227	0.125	0.159	0.975	0.445
	CD at 5%	-	NS	-	0.707	0.391	0.488	3.110	1.361

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

Date of sowing : 11.12.2018
Date of insecticidal application : 20.12.2018
Date of plant population counts : 07.01.2019
Date of harvest : 03.04.2019
Plot size Gross : 4 x 5m = 20 Sqm.
Design : R.B.D. (3 reps.)
Variety : K8027 (Unirrigated)
No. of rows/plot : 23

Table B8b-10.2a: Management of termites through broadcast application in standing crop during 2018-19 (Location: Vijapur)

Sr. No.	Treatment	Dose g a.i./ ha	Per cent damaged shoots/m row after sowing (week)			% Damaged effective tillers/ m row	No. of damaged effective tillers/ha	Grain yield q/ha
			3rd	4th	5th			
1.	Fipronil 5 SC	80	0.00* (0.00)	0.00* (0.00)	0.00* (0.00)	0.00*a (0.00)	851**a (1533)	45.57
2.	Thiamethoxam 30FS	75	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)	0.00a (0.00)	1187c (3205)	44.08
3.	Imidacloprid 600 FS	180	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)	0.00a (0.00)	1090bc (2648)	44.63
4.	Fipronil 0.3 G broadcast at the time of sowing	60	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)	0.00a (0.00)	978ab (2090)	44.83
5.	Fipronil+Imidacloprid 40 % WG (Lacenta)	400	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)	0.00a (0.00)	916ab (1812)	44.73
6.	*Beauveria bassiana* g/ha	500	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)	4.65b (0.66)	1996e (9337)	38.84
7.	*Metarhizium anisopliae* g/ha	500	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)	4.39b (0.59)	1862e (8082)	42.63
8.	*Beauveria bassiana* in furrow at sowing g/ha	500	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)	4.02b (0.52)	1809de (7664)	42.87
9.	*Metarhizium anisopliae* in furrow at sowing g/ha	500	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)	3.79b (0.44)	1629b (6132)	43.52
10.	Untreated Check	-	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)	6.89c (2.24)	2938f (20485)	38.02
	S.Em ± C.D. at 5% C.V.%		-	-	-	0.52 1.56 38.28	68 201 7.70	2.81 NS 11.34

* Figures followed within same column are Arcsin percentage transformation ** Figures followed within same column are square root transformation

Date of sowing : 27/11/2018 Date of insecticide application : 16/12/2018

Date of harvesting : 03/04/2019 Design: R.B D Replications : Three

Spacing : 23 cm between row No. of rows / plot : 12

Plot size: Gross: 14.0m x 2.76m Net: 13.0m x 1.84m Variety: GW 496 Condition : Irrigated

Table B8b-10.2b: Management of termites through broadcast application in standing crop during 2018-19 (Location: Durgapura)

S. No.	Treatments	Dose ml/gm/lit./ha	Plant population/m row	Per cent damaged shoot/m row	Percent damaged effective tillers/m row at ear head stage	No. of damaged effective tillers/ ha	Grain yield q/ha
1.	Thiamethoxam 25 WG	3.2	41.33	0.91 (5.47)*	2.11 (8.34)	8246.33	37.32
2.	Thiamethoxam 75 WS	1.0	41.66	1.10 (5.9)	2.72 (9.43)	8312.00	37.12
3.	Fipronil 5 SC	6.0	41.33	0.59 (4.39)	0.96 (5.49)	5986.66	40.86
4.	Imidacloprid 600 FS	2	42.33	0.32 (3.21)	0.56 (4.28)	3712.00	42.78
5.	Clothianidin 50 WDG	1.5	41.66	0.80 (5.12)	1.12 (6.07)	6146.00	39.72
6.	*Beauveria bassiana*	5.0	41.66	3.32 (10.49)	8.32 (16.76)	24132.00	28.48
7.	*Metarhizium anisopliae*	3.0	41.66	2.22 (8.56)	7.00 (15.31)	21512.00	30.18
8.	Control	-	39.66	10.37 (18.76)	21.31 (27.47)	39628.00	17.29
9.	CD @ 5 %	-	N/A	(1.23)	(1.48)	183.55	1.83
10.	Sem	-	0.53	(0.40)	(0.48)	59.93	0.59
	CV		2.28	(9.00)	(7.17)	0.71	3.02

*Figures in parentheses are angular transformed value

11.3 STORED GRAIN PEST MANAGEMENT

11.3 (i). Studies on the insecticidal treatments on seed viability during storage under ambient condition against store grain pests, *Trogoderma granarium or Rhizopertha dominica* (Centres: Karnal and Niphad)

Plants having toxicity effects on insects will be tested as seed protectant to wheat seed/grains against major stored grain insect pests*; Sitophilus oryzae* or *Rhizopertha dominica*

Observations:

1. One kg of clean and pest free seed of wheat was taken for each treatment with three replications in cloth bags.
2. Five pair of adults of *Sitophilus oryzae* inoculated in each treatment.
3. The 1st census count initiated 45 days after inoculation of insects and continued at 75, 105, 135, 165 and 195 days. At each census the dead insects should be removed.
4. Percent reduction in the insect population
5. Weight of seed grains was taken at the end of each census and the data analyzed statistically.

Centre:Niphad

The data pertaining to effect of various plant material as seed protectant to wheat seed against grain weevil (*Sitophilus oryzae* L.) in wheat seed is depicted in Table 16 & 17. The data indicated significant differences among the treatments.

Population of grain weevil :

The data indicated that the seed treatment with *Vekhand* powder and its combinations with Neem leaves, Jungli Imli and Gulwel powder proved to be significantly effective in controlling the population of grain weevil (*Sitophilus oryzae* L.) as compared to rest of the treatments. The seed treatment with *Vekhand* powder @ 10 g/kg of seed recorded significantly lowest (6.00, 7.00, 0.00, 0.00, 0.00 and 0.00) number of survival grain weevil at 45, 75, 105, 135, 165 and 195 days after inoculation, respectively over untreated control i.e 116.67, 177.00, 950.67, 1204.33, 1302.67 and 1322.33. Survival population of grain weevil were not recorded in treatments *Vekhand* powder @ 10 g/kg seed, *Vekhand* powder + Neem leaves, *Vekhand* powder + Jungli Imli and *Vekhand* powder + Gulwel powder @ 5+5 g/kg of seed at 135, 165 and 195 days after inoculation. This treatment was statistically at par with the treatments of *Vekhand* powder + Neem leaves, *Vekhand* powder + Jungli Imli and *Vekhand* powder + Gulwel powder @ 5+5 g/kg of seed.

Percent reduction of grain weevil over untreated control:

The treatment with *Vekhand* powder @ 10 g / kg seed recorded highest (94.93, 96.04, 100.00, 100.00, 100.00 and 100.00) per cent reduction of grain weevil at 45, 75, 105, 135, 165 and 195 days after inoculation, respectively as against the zero per cent reduction in untreated control, it was at par with *Vekhand* powder + Neem leaves, *Vekhand* powder + Jungli Imli and *Vekhand* powder + Gulwel powder @ 5+5 g/kg of seed at 45, 75, 105, 135, 165 and 195 days after inoculation.

Weight of grains :

The treatment with *Vekhand* powder @ 10 g / kg seed recorded significantly highest (996.67, 996.00, 992.00, 991.00, 990.67 and 988.67 g) grain weight over all the treatments including untreated control at 45, 75, 105, 135, 165 and 195 days after inoculation. It is at par with *Vekhand* powder + Neem leaves, *Vekhand* powder + Jungli Imli and *Vekhand* powder + Gulwel powder @ 5+5 g/kg of seed. The untreated control recorded minimum (910.00, 788.67, 700.00, 643.33, 606.00 and 591.33 g) weight of grains at 45, 75, 105, 135, 165 and 195 days after inoculation. It indicated that the loss in weight of grain was increasing as the days after inoculation increased. Also it indicated that the seed treatment alone of *Vekhand* powder and combination of *Vekhand* powder plus other plant products were found to be effective for the control of grain weevil.

Germination and seedling vigour index :

Germination test of the different treatments were taken at 195 days after storage of seed. Data presented in Table 17 revealed that the maximum germination percentage of 94.00% was found in seed treatment with *Vekhand* powder @ 10 g / kg seed as against lowest in untreated control (31.00%). Seedling vigour index was maximum of 1864.17 in seed treatment with *Vekhand* powder @ 10 g / kg seed as against lowest in untreated control (297.70)(Table C-10.3 a& b).

Centre: Karnal

The seed treatment with *Vekhand* powder @ 10 g/kg of seed recorded significantly lowest (9.3, 10.4,4.1,3.1,4.1&3.6) number of survival grain weevil at 45, 75, 105, 135, 165 and 195 days after inoculation, respectively over untreated control i.e 122.3,177.4,989.8,1229.4,1320.1&1337. The treatment with *Vekhand* powder @ 10 g/kg of seed recorded significantly highest per cent reduction of grain weevil over all the treatments (99.7,94.1,99.6, 99.7,99.7&92.4)at 45, 75, 105, 135, 165 and 195 days after inoculation, respectively) over untreated control(Table C-10.3 c).The maximum germination percentage of 97.97% was found in seed treatment with *Vekhand* powder @ 10 g / kg seed as against lowest in untreated control (35.87%). Seedling vigour index was maximum of 1910.24in seed treatment with *Vekhand* powder @ 10 g / kg seed as against lowest in untreated control (318).

The data indicated that the seed treatment with *Vekhand* powder and its combinations with Neem leaves, Jungli Imli and Gulwel powder proved to be significantly effective in controlling the population of grain weevil (*Sitophilus oryzae* L.) as compared to rest of the treatments (Table C-10.3 c &d).

Co-OPERATORS OF ENTOMOLOGY PROGRAMME

NAME	CENTRE
POONAM JASROTIA, D.P.SINGH SUDHEER KUMAR	**KARNAL (COORDINATING UNIT)**
A.A. PATEL	**VIJAPUR**
BEANT SINGH	**LUDHIANA**
SANAY D. PATIL	**NIPHAD**
J.K. SINGH	**KANPUR**
A.S. BALODA	**DURGAPURA**
MD. WASIM REZA	**KHARIBARI (W.B.)**
K.K. SARMA	**SHILLONGANI**
P.V. PATIL	**DHARWAD**

Table C-10.3a: Effect of plant products as seed protectant on survival population of grain weevil and per cent reduction of grain weevil (Centre: Niphad)

TN	Treatments Details	Dose(g/kg seed)	No. of live grain weevil at						% Reduction of grain weevil over untreated control					
			45 DAI	75 DAI	105 DAI	135 DAI	165 DAI	195 DAI	45 DAI	75 DAI	105 DAI	135 DAI	165 DAI	195 DAI
T1	Neem leaves powder (*Azadirachta indica)*	10	94.00 *(9.74)	168.33 (13.01)	609.33 (24.70)	843.00 (29.05)	872.67 (29.55)	1096.00 (33.12)	19.36 **(26.13)	10.11 (18.53)	32.50 (34.76)	30.67 (33.65)	32.57 (34.82)	19.79 (26.42)
T2	Vekhand powder (*Acorus calamus*)	10	6.00 (2.64)	7.00 (2.82)	0.00 (1.00)	0.00 (1.00)	0.00 (1.00)	0.00 (1.00)	94.93 (76.95)	96.04 (79.86)	100.00 (90.00)	100.00 (90.00)	100.00 (90.00)	100.00 (90.00)
T3	Jangli imli powder (*Phyllanthus niruri*)	10	81.00 (9.05)	102.67 (10.18)	290.00 (17.05)	695.33 (26.38)	753.00 (27.46)	948.00 (30.80)	29.79 (33.09)	44.88 (42.07)	69.49 (56.48)	42.80 (40.86)	42.13 (40.46)	29.11 (32.65)
T4	Giloe (*Tinospora cordifolia*)/Gulvel powder	10	92.67 (9.67)	160.67 (12.71)	458.67 (21.44)	895.33 (29.93)	934.67 (30.58)	1036.00 (32.20)	20.54 (26.92)	14.42 (22.30)	51.73 (45.97)	26.48 (30.98)	28.20 (32.08)	22.25 (28.18)
T5	Vekhand powder + Neem leaves	5+5	5.67 (2.58)	10.00 (3.31)	2.67 (19.15)	0.00 (1.00)	0.00 (1.00)	0.00 (1.00)	95.15 (77.34)	94.62 (76.56)	99.72 (84.47)	100.00 (90.00)	100.00 (90.00)	100.00 (90.00)
T6	Jangli imli + Neem leaves	5+5	92.33 (9.66)	175.33 (13.27)	351.33 (18.77)	426.00 (20.66)	581.00 (24.12)	766.00 (27.69)	20.51 (26.92)	7.03 (15.34)	63.26 (52.71)	65.01 (53.73)	55.41 (48.10)	42.35 (40.63)
T7	Giloe + Neem leaves	5+5	94.67 (9.78)	136.33 (11.71)	561.00 (23.70)	581.67 (24.13)	765.67 (27.68)	892.00 (29.88)	21.51 (27.63)	28.59 (32.33)	51.65 (45.97)	52.42 (46.38)	41.25 (39.99)	32.93 (35.00)
T8	Vekhand powder + Jangli imli	5+5	5.67 (2.58)	5.67 (2.58)	5.33 (2.51)	0.00 (1.00)	0.00 (1.00)	0.00 (1.00)	95.11 (77.21)	96.97 (79.86)	99.46 (84.41)	100.00 (90.00)	100.00 (90.00)	100.00 (90.00)
T9	Vekhand powder + Giloe	5+5	8.67 (3.10)	10.00 (3.31)	3.67 (2.16)	0.00 (1.00)	0.00 (1.00)	0.00 (1.00)	92.53 (74.11)	94.67 (76.69)	99.62 (84.44)	100.00 (90.00)	100.00 (90.00)	100.00 (90.00)
T10	Jangli imli + Giloe	5+5	81.00 (9.05)	138.00 (11.78)	381.67 (19.56)	792.00 (28.16)	927.33 (30.46)	973.67 (31.22)	30.65 (33.65)	27.33 (31.44)	59.57 (50.53)	35.06 (36.27)	28.55 (32.33)	26.83 (31.18)
T11	Untreated control	--	116.67 (10.84)	177.00 (13.34)	950.67 (30.85)	1204.33 (34.71)	1302.67 (36.10)	1332.33 (36.51)	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)
	SE ±		**0.29**	**0.56**	**0.70**	**0.51**	**0.63**	**0.74**	**3.15**	**3.14**	**2.12**	**1.23**	**1.71**	**2.09**
	CD at (5%)		**0.86**	**1.68**	**2.08**	**1.52**	**1.88**	**2.20**	**9.36**	**9.33**	**6.28**	**3.66**	**5.09**	**6.22**

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

Table C-10.3b: Effect of plant products as seed protectant on grain weight, germination and seedling vigour (Centre: Niphad)

TN	Treatments Details	Dose(g/kg seed)	Weight of grains at						% Germination at 195 DAI	Seedling vigour index
			45 DAI	75 DAI	105 DAI	135 DAI	165 DAI	195 DAI		
T1	Neem leaves powder (*Azadirachta indica)*	10	926.67	883.33	786.00	738.33	716.67	698.33	56.33 (48.62)	711.53
2	Vekhand powder (*Acorus calamus*)	10	996.67	996.00	992.00	991.00	990.67	988.67	94.00 (75.82)	1864.17
T3	Jangli imli powder (*Phyllanthus niruri*)	10	940.00	922.33	830.00	805.33	781.67	761.67	52.00 (46.15)	571.77
T4	Giloe (*Tinospora cordifolia*) / Gulvel powder	10	943.33	894.00	783.33	784.67	744.67	720.67	58.00 (49.60)	637.23
T5	Vekhand powder + Neem leaves	5+5	993.33	993.33	990.00	988.67	989.33	987.67	92.00 (73.57)	1604.17
T6	Jangli imli + Neem leaves	5+5	940.00	902.00	800.00	772.67	716.00	694.67	54.67 (47.70)	701.97
T7	Giloe + Neem leaves	5+5	946.67	901.33	803.33	769.33	717.00	691.67	53.67 (47.12)	688.70
T8	Vekhand powder + Jangli imli	5+5	996.67	991.33	984.67	987.33	983.33	982.67	91.33 (72.84)	1673.80
T9	Vekhand powder + Giloe	5+5	970.00	960.00	955.00	953.33	953.33	959.33	91.33 (72.54)	1519.77
T10	Jangli imli + Giloe	5+5	946.67	913.33	810.33	772.00	728.67	700.00	54.00 (47.29)	594.30
T11	Untreated control	--	910.00	788.67	700.00	643.33	606.00	591.33	31.00 (33.83)	297.70
	SE ±		**7.40**	**5.33**	**4.84**	**4.73**	**6.88**	**41.73**	**0.84**	**50.13**
	CD at (5%)		**21.98**	**15.85**	**14.37**	**14.05**	**20.44**	**129.96**	**2.50**	**148.93**

Table C-10.3c: Effect of plant products as seed protectant on survival population of grain weevil and per cent reduction of grain weevil (Centre: Karnal)

TN	Treatments Details	Dose(g/kg seed)	No. of live grain weevil at						% Reduction of grain weevil over untreated control					
			45 DAI	75 DAI	105 DAI	135 DAI	165 DAI	195 DAI	45 DAI	75 DAI	105 DAI	135 DAI	165 DAI	195 DAI
T1	Neem leaves powder (*Azadirachta indica)*	10	100.6 (10.1)	170.4 (13.1)	600.4 (24.5)	869.8 (29.5)	936.8 (30.6)	1072.9 (32.8)	17.7 (24.9)	3.9 (11.50	39.3 (38.8)	29.3 (32.7)	29.0 (32.6)	19.8 (26.4)
T2	Vekhand powder (*Acorus calamus*)	10	9.3 (3.2)	10.4 (3.4)	4.1 (2.3)	3.1 (2.0)	4.1 (2.3)	3.6 (2.1)	92.4 (74.0)	94.1 (76.0)	99.6 (86.3)	99.7 (87.1)	99.7 (86.8)	99.7 (87.0)
T3	Jangli imli powder (*Phyllanthus niruri*)	10	85.9 (9.3)	108.1 (10.4)	300.8 (17.4)	699.4 (26.5)	765.4 (27.7)	936.3 (30.6)	29.8 (33.1)	39.1 (38.7)	69.6 (56.5)	43.1 (41.0)	42.0 (40.4)	30.0 (33.2)
T4	Giloe (*Tinospora cordifolia*)/Gulvel powder	10	100.3 (10.1)	165.1 (12.9)	479.8 (21.9)	914.1 (30.3)	969.8 (31.2)	1011.3 (31.8)	18.0 (25.1)	6.9 (15.3)	51.5 (45.9)	25.6 (30.4)	26.5 (31.0)	24.4 (29.6)
T5	Vekhand powder + Neem leaves	5+5	9.9 (3.3)	13.4 (3.8)	6.4 (2.7)	3.1 (2.0)	4.1 (2.3)	3.6 (2.1)	91.9 (73.5)	92.4 (74.0)	99.4 (85.4)	99.7 (87.1)	99.7 (86.8)	99.7 (87.0)
T6	Jangli imli + Neem leaves	5+5	93.9 (9.7)	157.1 (13.4)	362.1 (19.1)	449.8 (21.2)	603.4 (24.6)	743.3 (27.3)	23.2 (28.8)	11.4 (19.8)	63.4 (52.8)	63.4 (52.8)	54.3 (47.5)	44.4 (41.8)
T7	Giloe + Neem leaves	5+5	93.9 (9.7)	138.4 (11.8)	563.4 (23.8)	603.8 (24.6)	773.8 (27.8)	847.9 (29.1)	23.2 (28.8)	22.0 (28.0)	43.1 (41.0)	50.9 (45.5)	41.4 (40.0)	36.6 (37.2)
T8	Vekhand powder + Jangli imli	5+5	10.3 (3.4)	10.8 (3.4)	9.1 (3.2)	3.1 (2.0)	4.1 (2.3)	3.6 (2.1)	91.6 (73.1)	93.9 (75.7)	99.1 (84.5)	99.7 (87.1)	99.7 (86.8)	99.7 (87.0)
T9	Vekhand powder + Giloe	5+5	12.9 (3.7)	13.1 (3.8)	7.1 (2.8)	3.1 (2.0)	4.1 (2.3)	3.6 (2.1)	89.5 (71.0)	92.6 (74.2)	99.3 (85.1)	99.7 (87.1)	99.7 (86.8)	99.7 (87.0)
T10	Jangli imli + Giloe	5+5	83.6 (9.2)	145.4 (12.1)	378.8 (19.5)	760.1 (27.6)	902.1 (30.1)	973.3 (31.2)	31.6 (34.2)	18.0 (25.1)	61.7 (51.8)	38.2 (38.2)	31.7 (34.2)	27.3 (31.5)
T11	Untreated control	--	122.3 (11.1)	177.4 (13.4)	989.8 (31.5)	1229.4 (35.1)	1320.1 (36.3)	1337.9 (36.6)	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)
	SE ±		**0.22**	**0.45**	**0.62**	**0.42**	**0.45**	**0.50**	**2.73**	**5.45**	**1.79**	**1.27**	**1.23**	**1.85**
	CD at (5%)		**0.81**	**1.13**	**1.54**	**0.74**	**1.47**	**1.47**	**8.34**	**16.23**	**5.10**	**3.67**	**3.42**	**5.00**

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

Table C-10.3d: Effect of plant products as seed protectant on grain weight, germination and seedling vigour (Centre: Karnal)

TN	Treatments Details	Dose (g/kg seed)	Weight of grains at							% Germination at 195 DAI	Seedling vigour index
			45 DAI	75 DAI	105 DAI	135 DAI	165 DAI	195 DAI	Average		
T1	Neem leaves powder (*Azadirachta indica)*	10	937.56	892.68	793.76	742.41	728	705.92	800.56	71.76	968.19
T2	Vekhand powder (*Acorus calamus*)	10	997.56	991.02	984.76	983.74	985	950.25	982.56	97.97	1910.24
T3	Jangli imli powder (*Phyllanthus niruri*)	10	937.56	916.68	839.1	817.08	790	770.25	845.61	56.97	620.5
T4	Giloe (*Tinospora cordifolia*) / Gulvel powder	10	940.9	901.35	797.43	789.74	756.33	732.25	820.17	61.64	686.84
T5	Vekhand powder + Neem leaves	5+5	1000.9	998.35	993.1	991.08	989.67	983.58	993.28	96.3	1692.1
T6	Jangli imli + Neem leaves	5+5	944.23	899.68	810.1	780.08	726.67	705.58	811.56	60.64	754.17
T7	Giloe + Neem leaves	5+5	947.56	897.02	812.43	776.41	725.33	697.58	809.89	60.31	724.24
T8	Vekhand powder + Jangli imli	5+5	1000.9	995.68	990.43	985.08	985	982.58	990.45	95.64	1715.07
T9	Vekhand powder + Giloe	5+5	997.56	990.35	986.43	985.08	985	980.92	988.06	97.31	1662
T10	Jangli imli + Giloe	5+5	940.9	908.35	822.1	779.74	738	704.58	816.11	59.97	651.67
T11	Untreated control	--	920.9	790.35	709.76	647.08	616.33	597.58	714.17	35.97	318
	SE ±		6.46	5.99	5.97	5.77	9.54	14.79	7.88	6.51	33.21
	CD at (5%)		15.72	12.58	8.88	14.32	17.23	34.59	19.12	12.19	94.6

PROGRAMME 11: NEMATOLOGY

11.1 Crop Health Survey

Rajasthan

Survey was conducted in the different cultivator's fields of three districts of Rajasthan for the incidence and intensity of Cereal Cyst Nematode (CCN) by the scientist from Durgapura center. Diseased fields were randomly selected on the basis of above ground symptoms of the crops. Symptoms of stunting, yellowing, patchy and poor growth were recorded during survey of each field. Roots samples were collected from the rhizospere of wheat and barley crops looking above ground symptoms along with composite soil sample. Root & soil sample were processed with standard technique of nematode identification. Presence of cereal cyst nematode was further confirmed by seeing the bushy roots with white cyst on it. Cereal cyst nematode infestation was recorded in all three districts e.i. Dausa, Jaipur and Sikar districts. A large number of infested fields were observed in Amer, Bassi, Chomu, Jamwa Ramgarh, Kotputli, Sahapura, Sanganer and Viratnagar tehsil of Jaipur district. Post harvest survey was also conducted to observe the infestation of Ear Cockle Nematode (ECN) disease in various grain market of Jaipur district. This year, ECN was not found in collected grain sample of wheat.

Hisar

Crop health monitoring survey for plant parasitic nematodes was done in Bhiwani and Sirsa districts. Cereal cyst nematode was reported in 26.6 % (12/45) samples. Number of cysts ranged from 1-24 per 200 cc soil. Other plant parasitic nematodes present in 200 cc soil samples were *Pratylenchus* sp., *Tylenchorhynchus* sp., *Hoplolaimus* sp., *Helicotylenchus* sp., *Hirschmaniella* sp. and *Criconematids* sp. Wheat seed gall nematode (*Anguina tritici*) was not recorded from the samples.

Ludhiana

A total of 2250 wheat grain samples were collected from 150 different grain markets of the Punjab State in the months of April, 2019 and were analyzed for ear cockle nematode (ECN). None of the samples showed incidence of ear cockle nematode.

One hundred and eight soil and root samples were collected from thirty localities for the analysis of plant parasitic nematode infestation on wheat crop in the Punjab (Table 11.1). *Heterodera avenae* cyst, species of *Meloidogyne, Tylenchorhynchus, Hirschmanniella, Helicotylenchus* and *Hoploloaimus* were recorded. CCN cysts were recorded from Ariayan (Jalandhar District), Baghapurana (Moga district), Wara Daraka, Kotakapura (Faridkot), Malout (Muktasar) and Abohar (Fazilka). The number of cysts recorded were 1-3 cysts/250cc soil. Root knot nematode was also recorded up to 110 larvae/250cc soil and *Tylenchorhynchus* was recorded from all the collected with the highest of 430 larvae/250cc soil.

Table 11.1. Plant parasitic nematodes associated with wheat crop in Punjab (2018-2019)

S. No.	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***
1	Kawarala	4	0	60-110 (50.00)	130-320 (100.00)	40-110 (50.00)	40 (25.00)	20 (25.00)
2	Jadla	3	0	40-80 (50.00)	90-220 (100.00)	30-90 (50.00)	30 (25.00)	-
3	Ghanauli	3	0	30-50 (50.00)	100-330 (100.00)	20-80 (50.00)	60 (25.00)	-
4	Nurpur Bedi	3	0	40-60 (50.00)	160-450 (100.00)	60-110 (50.00)	20-60 (75.00)	-
5	Balachaur	3	0	30-50 (50.00)	140-260 (100.00)	60-120 (50.00)	30-60 (50.00)	-

6	Nagar	3	0	40-60 (50.00)	150-310 (100.00)	40-80 (50.00)	-	10 (25.00)
7	Baddi	3	0	50-90 (50.00)	100-320 (100.00)	30-100 (50.00)	-	
8	Rahon	3	0	20-80 (50.00)	40-250 (100.00)	60-130 (75.00)	20 (25.00)	-
9	Anandpur Sahib	3	0	40-60 (50.00)	110-260 (100.00)	20-60 (50.00)	20-40 (50.00)	-
10	Chakadana	3	0	30-50 (50.00)	100-240 (100.00)	-	20-70 (50.00)	-
11	Thopia	3	0	40-60 (50.00)	120-270 (100.00)	40-90 (50.00)	30 (25.00)	-
12	Mehindipur	3	0	30-60 (50.00)	130-220 (100.00)	60-130 (50.00)	30-50 (50.00)	20-40 (50.00)
13	Ariyan	4	2-3 (50.00)	20-40 (50.00)	160-300 (100.00)	60-120 (50.00)	-	20 (25.00)
14	Apra	4	0	30-60 (50.00)	100-210 (100.00)	-	-	
15	Aur	3	0	40-60 (50.00)	90-220 (100.00)	30-80 (50.00)	-	-
16	Mahal khurd	3	0	30-60 (50.00)	140-350 (100.00)	60-120 (75.00)	40 (25.00)	20 (25.00)
17	Sehbaj pur	4	0	20-50 (50.00)	280-320 (100.00)	20-90 (50.00)	20-60 (50.00)	5-10 (50.00)
18	Majara	4	0	60-110 (75.00)	140-260 (100.00)	50-140 (100.00)	-	30 (25.00)
19	Singham wala	4	0	-	180-360 (100.00)	20-80 (50.00)	20-40 (25.00)	20-40 (50.00)
20	Gill	4	0	40-80 (50.00)	180-410 (100.00)	20-90 (50.00)	30 (25.00)	-
21	Baghapurana	4	2-3 (50.00)	-	130-430 (100.00)	40-130 (75.00)	20-40 (50.00)	-
22	Kotkapura	4	1-3 (50.00)	-	160-340 (100.00)	50-150 (100.00)	-	20-50 (50.00)
23	Wara Daraka	4	1-3 (50.00)	40-70 (50.00)	160-330 (100.00)	50-140 (50.00)	-	20 (25.00)
24	Sarai Naga	5	0	40-60 (50.00)	30-240 (100.00)	-	-	20-50 (50.00)
25	Muktsar	4	0	40-80 (50.00)	140-330 (100.00)	20-70 (50.00)	40 (25.00)	30 (25.00)
26	Rupana	4	0	20-40 (50.00)	110-240 (100.00)	30-60 (50.00)	20-50 (50.00)	-
27	Malout	4	1-2 (50.00)	40-70 (50.00)	140-270 (100.00)	20-70 (50.00)	20-70 (50.00)	30 (25.00)
28	Goriya	4	0	30-40 (50.00)	130-170 (100.00)	30-50 (50.00)	30-60 (50.00)	30 (25.00)
29	Mehatina	4	0	20-60 (50.00)	120-150 (100.00)	40-60 (60.00)	20-40 (50.00)	20 (25.00)
30	Abohar	4	1-2 (50.00)	40-60 (50.00)	110-160 (100.00)	40-70 (50.00)	30-50 (50.00)	45 (25.00)
	Total	**108**	**1-3**	**20-110**	**30-430**	**20-150**	**20-70**	**10-50**

11.2. Studies of Pathotypes of *Heterodera avenae*:

The pathotypes studies of cereal cyst nematode were carried out during the crop season 20018-19 against Jaipur population of cereal cyst nematode, *Heterodera avenae*. Out of 26 International differentials of wheat, barley and oat, twelve showed resistant reaction i.e. AUS-15854, AUS-7869,

AUS-15895, Psathia, KVL-191, Harlan, Dalmitsche, Morocco, P-313221, Martin, Siri, La-estanzuella while rest showed susceptible reaction. Reaction on various test assortment revealed that Jaipur population of CCN is Pathotype Ha 21 (Table 11.2).

Table 11.2. Reaction of *Heterodera avenae* of Jaipur population on International differentials

S. No.	International Differentials	Reactions	S. No.	International Differentials	Reactions
1	AUS-15854	R	14	Ogrlitsche	S
2	AUS-15807	S	15	Dalmitsche	R
3	AUS-7869	R	16	Harta	S
4	AUS-15895	R	17	Emir	S
5	AUS-4930	S	18	Morocco	R
6	AUS-498	S	19	Gelliune	S
7	Loros	S	20	P-313221	R
8	IK2 Light	S	21	Martin	R
9	Psathia	R	22	Varda	S
10	Capa	S	23	Siri	R
11	Ortalan	S	24	La-estanzuella	R
12	KVL-191	R	26	L-62	S
13	Harlan	R	26	Nidar-2	S
Pathotype: Ha 21, Rating scale: 0 -5%= resistant; 6 -100% = susceptible					

11.3 Host resistance

Resistance against *Heterodera avenae*

Ludhiana Centre

One hundred fifty eight entries of AVT were screened for resistance against *H. avenae* (CCN) under sick plot conditions. PBW 550 and HD 2967 were used as susceptible checks. Out of these none of the entry was found resistant. Only six entries namely HS673, DPW621-50 (C), K0307 (C), PBW 822^{B}, DDW 47(d)*Q and HW1098 (C) have shown moderately resistant reaction. Rest of the entries was either susceptible or highly susceptible to CCN (Table 11.3).

Durgapura Centre

One hundred forty fifty eight wheat germplasms (AVT) were screened in naturally sick field against cereal cyst nematode, *Heterodera avenae* (Pathotypes Ha 21) of RARI, Durgapura, Jaipur. The inoculums level was 4.8 L/gm of soil. Out of 158 germplasm, three had been found resistant [HI 1628*, NIAW 3170* and K8027 (C)], whereas, four germplasm showed moderately resistant reaction *viz.*, HS652, HD2967 (C), HI 8812 (d) and HI8807(d). Rest was found susceptible (Table 11.3).

Hisar centre

Out of 158 germplasm, none was found resistant and moderately resistant all were fall in susceptible or highly susceptible (Table 11.3).

Table 11.3 Screening of AVT entries CCN during 2018-19 at different locations.

S. No.	Entries	Durgapura	Ludhiana	Hisar	HS
I. Northern Hill Zone					
1	HPW349 (C)	S	S	S	S
2	VL907 (C)	S	S	S	S
3	HS507 (C)	S	S	HS	HS
4	HS652	MR	S	S	S
5	HS562 (C)	S	S	S	S
6	VL892 (C)	S	S	HS	HS
7	HS490 (C)	S	S	S	S

8	HPW468	S	S	S	S
9	HS673	S	MR	S	S
10	VL3020	S	S	S	S
11	UP3041	S	S	S	S
12	HPW467	S	S	S	S
13	HS674	S	S	S	S
14	VL3019	S	S	HS	HS
15	VL3021	S	S	HS	HS
II. North Western Plain Zone					
16	WH1105 (C)	S	S	S	S
17	HD3226(I) (C)	S	S	S	S
18	HD3086 (C)	S	S	HS	HS
19	PBW820[M]	S	S	S	S
20	DBW 221*	S	S	HS	HS
21	DBW 222*	S	S	HS	HS
22	PBW550 (C)	S	S	S	S
23	PBW821[M]	S	S	S	S
24	HD2967 (C)	MR	S	S	S
25	NW 7049	S	S	S	S
26	DPW621-50 (C)	S	MR	S	S
27	DBW88 (C)	S	S	S	S
28	PBW752(I) (C)	S	S	S	S
29	DBW173 (C)	S	S	S	S
30	WH1021 (C)	S	S	HS	HS
31	HD3059 (C)	S	S	S	S
32	WH1124 (C)	S	S	S	S
33	PBW 771*	S	S	S	S
34	HI1620(I) (C)	S	S	S	S
35	PBW 796	S	S	S	S
36	HI 1628*	R	S	S	S
37	WH1142 (C)	S	S	S	S
38	HD3043 (C)	S	S	S	S
39	PBW644 (C)	S	S	S	S
40	HD3237(I) (C)	S	S	S	S
41	BRW 3806*[#]	S	S	S	S
42	NIAW 3170*	R	S	S	S
43	WH1080 (C)	S	S	HS	HS
III. North Eastern Plain Zone					
44	HD3249*[#Q]	S	S	HS	HS
45	HD2733 (C)	S	S	S	S
46	PBW 781	S	S	S	S
47	DBW 257	S	S	S	S
48	DBW39 (C)	S	S	S	S
49	HD 3277	S	S	S	S
50	RAJ 4529	S	S	S	S
51	DBW187(I) (C)	S	S	S	S
52	WH 1239	S	S	S	S
53	K0307 (C)	S	MR	S	S
54	HD2967 (C)	S	S	S	S
55	K1317 (C)	S	S	HS	S
56	HI1612 (C)	S	S	S	S
57	HD 3293	S	S	S	S
58	HD3171 (C)	S	S	S	S

59	HD2888 (C)	S	S	S	S
60	DBW 252*[#]	S	S	S	S
61	K8027 (C)	R	S	S	S
62	DBW 273	S	S	S	S
IV. Central Zone					
63	HI8713(d) (C)	S	S	S	S
64	NIDW 1158 (d)	S	S	HS	HS
65	HI 8811 (d)	S	S	S	S
66	HD3343[M]	S	S	S	S
67	GW322 (C)	S	S	S	S
68	HI1544 (C)	S	S	S	S
69	HI8737(d) (C)	S	S	S	S
70	HI 8812 (d)	MR	S	S	S
71	GW 1348 (d)	S	S	S	S
72	DDW 49 (d)	S	S	S	S
73	PBW 822[B]	S	MR	S	S
74	HD 3345[B]	S	S	S	S
75	DDW 48 (d)	S	S	S	S
76	HI8627(d) (C)	S	S	S	S
77	DBW110 (C)	S	S	S	S
78	UAS 466(d)*	S	S	S	S
79	MP3288 (C)	S	S	S	S
80	DBW 277	S	S	S	S
81	DDW 47(d)*[Q]	S	MR	S	S
82	HD2932 (C)	S	S	HS	HS
83	HD2864 (C)	S	S	S	S
84	MP3336 (C)	S	S	S	S
85	MP4010 (C)	S	S	S	S
86	CG1029	S	S	S	S
87	UAS3002	S	S	S	S
88	HI1633	S	S	S	S
89	HI1634	S	S	S	S
90	HI8808 (d)	S	S	S	S
91	HI8807 (d)	S	S	S	S
V. Peninsular Zone					
92	PBW 823[B]	S	S	S	S
93	UAS428 (d) (C)	S	S	S	S
94	DDW 49 (d)	S	S	HS	HS
95	UAS 3001	S	S	S	S
96	MACS3949 (d) (C)	S	S	S	S
97	MACS6222 (C)	S	S	S	S
98	GW 322 (C)	S	S	S	S
99	DDW 48 (d)	S	S	HS	HS
100	MACS6478 (C)	S	S	S	S
101	HD3343[M]	S	S	S	S
102	WHD 963 (d)	S	S	HS	HS
103	HI8807(d)	MR	S	S	S
104	HI1633	S	S	S	S
105	UAS 3002	S	S	S	S
106	Raj4083 (C)	S	S	S	S
107	HD2932 (C)	S	S	S	S
108	GW509	S	S	S	S
109	HD3090 (C)	S	S	S	S

110	NIAW 3170*	S	S	HS	HS
111	GW 1346(d)*	S	S	HS	HS
112	MACS 4058(d)*	S	S	S	S
113	DBW93 (C)	S	S	HS	HS
114	HI 8805(d)*	S	S	S	S
115	AKDW2997-16(d) (C)	S	S	S	S
116	MACS 6695*	S	S	S	S
117	UAS446(d) (C)	S	S	S	S
118	HI1605 (C)	S	S	S	S
119	MACS 6696*	S	S	S	S
120	NIDW 1149(d)	S	S	S	S
121	HI 8802(d)*	S	S	S	S
VI. Special Trial (Dicoccum)					
122	DDK1029 (C)	S	S	S	S
123	MACS5052	S	S	S	S
124	MACS6222 (aest.) (C)	S	S	S	S
125	DDK1056	S	S	HS	HS
126	HW1098 (C)	S	MR	S	S
127	MACS5053	S	S	S	S
128	DDK1057	S	S	S	S
VII. Special Trial- SPL-HYPT					
129	HD3317	S	S	S	S
130	WH1254	S	S	S	S
131	DBW301	S	S	S	S
132	WH1270	S	S	S	S
133	HD2967 (C)	S	S	S	S
134	PBW824	S	S	S	S
135	UP3043	S	S	S	S
136	DBW187	S	S	S	S
137	HD3086 (C)	S	S	S	S
138	DBW303	S	S	S	S
139	DBW304	S	S	HS	HS
140	UP3042	S	S	S	S
141	DBW302	S	S	S	S
142	PBW825	S	S	HS	HS
143	HD3347	S	S	S	S
VIII. Special Trial (SPL-AST)					
144	WH1223	S	S	S	S
145	KRL19 (C)	S	S	S	S
146	Kharchia65 (C)	S	S	HS	HS
147	NW 7060	S	S	S	S
148	KRL210 (C)	S	S	S	S
149	WH 1228	S	S	S	S
150	NW 7062	S	S	S	S
IX. Special Trial (SPL-VLS)					
151	PBW757 (C)	S	S	HS	HS
152	WR544 (C)	S	S	S	S
153	HD3298	S	S	S	S
154	HD3271	S	S	S	S
155	DBW14 (C)	S	S	S	S
156	DBW71 (C)	S	S	HS	HS
157	HI1621	S	S	S	S
158	PBW 797	S	S	HS	HS

Resistance against rice root nematode (*Meloidogyne graminicola*)

Hisar centre
A total 158 AVT entries were screened against rice root-knot nematode *Meloidogyne graminicola* in infested field area of department of Nematology, CCSHAU, Hisar. The observation for gall index was recorded on 1-5 scale. All entries appeared to be resistant or highly resistant.

11.4 Multiple Disease/Pest Screening Nurseris (MDSN)

Hisar
Thirty eight entries were evaluated for resistance to cereal cyst nematode, *H. avenae* and none were found resistant except one entry namely DDK1052 (dic.) which gave moderately resistant reaction.

Durgapura
Thirty eight entries of MDSN were planted in sick field condition and screened against cereal cyst nematode, *Heterodera avenae* at RARI, Durgapura, Jaipur. The inoculums level was 6.5 L/gm of soil. Out of 38 germplasm, none was found resistant, whereas, five showed moderately resistant (tolerant) reaction viz. (TL3014 (T), TL3015 (T), VL3014, MACS6677, HI1612), rest were found susceptible.

Ludhiana
Thirty eight wheat entries were evaluated for resistance to root knot nematode, *Meloidogyne graminicola* and none was found resistant. All the entries showed susceptible to highly susceptible reaction.

11.5 Integrated CCN Management

Durgapura
An experiment was conducted at Rajasthan Agricultural Research Institute, Durgapura, Jaipur in earthen pot. Two formulation of Chalcone was tried for nematicidal properties (Table 11.4). Chalcone are precursor compound for flavonids biosynthesis in plants and they can also be synthesized in laboratory. Chalcone is posses, a broad spectrum of biological activities including antioxidative, antibacterial, antiviral, insecticide and nematicides. Inoculum level was kept 5 cysts of cereal cyst nematode per pot. The experiment consisted of fourteen treatments *viz* Chalcone C1 @10 ppm conc., Chalcone C1 @20 ppm conc., Chalcone C1 @40 ppm conc., Chalcone C2 @10 ppm conc., Chalcone C2 @20 ppm conc., Chalcone 2 @40 ppm conc., Chalcone C1 @10 ppm conc. +half dose of Carbofuran, Chalcone C1 @20 ppm conc. +half dose of Carbofuran, Chalcone C1 @40 ppm conc. +half dose of Carbofuran, Chalcone C2 @10 ppm conc. +half dose of Carbofuran, Chalcone C2 @20 ppm conc. +half dose of Carbofuran, Chalcone C2 @40 ppm conc. +half dose of Carbofuran along with treated check (Carbofuran@ 2.0 kg ai/ha) and untreated check (Raj 3765) in a completely randomized block design and replicated thrice. The crop after attaining the age of 75-90 days was examined for count the white cyst/plant in each treatment. The grain yield was taken at the time of maturity of the crop in each treatment separately.

The results revealed that all the treatments gave significantly higher grain yield with reduced number of cysts/plant over control. The maximum reduction of population was observed in Chalcone C1 @40 ppm conc. +half dose of Carbofuran (60 %) with high grain yield. Half dose of carbofuran with Chalcone C1 @40 ppm conc. showed its overall superiority by keeping larvae entry away from root and better plant growth. Chalcone ($C_{15}H_{12}0$) and their derivative demonstrate a wide range of biological activities including nematicidal. Chalcone is an aromatic ketone and an enone that forms the central core for variety of important biological compound.

Hisar

Crop health monitoring survey for plant parasitic nematodes was done in Bhiwani and Sirsa districts. Cereal cyst nematode was reported in 26.6 % (12/45) samples. Number of cysts ranged from 1-24 per 200 cc soil. Other plant parasitic nematodes present in 200 cc soil samples were *Pratylenchus* sp., *Tylenchorhynchus* sp., *Hoplolaimus* sp., *Helicotylenchus* sp., *Hirschmaniella* sp. and *Criconematids* sp. (Table 11.4). Wheat seed gall nematode (*Anguina tritici*) was not recorded from the samples.

Table 11.4. Management of cereal cyst nematode, *Heterodera avenae* by organic amendments in wheat at Durgapura center.

S. No.	Treatments	Durgapura				Hisar
		No of cysts		Population reduction (%)		No of cysts
		Pi	Pf			
T1	Untreated Check	5	14	9 (+)	180	37
T2	Treated check(Carbofuran 2 kg a.i. per hac)	5	1	4 (-)	80	09
T3	Chalcone C1 @10 ppm conc.	5	9	4 (+)	80	06
T4	Chalcone C1 @20 ppm conc.	5	7	2 (+)	40	23
T5	Chalcone C1 @40 ppm conc.	5	4	1(-)	20	26
T6	Chalcone C2 @10 ppm conc.	5	10	5 (+)	100	10
T7	Chalcone C2 @20 ppm conc.	5	8	3 (+)	60	13
T8	Chalcone C2 @40 ppm conc.	5	4	1 (-)	20	11
T9	Chalcone C1 @10 ppm conc. +half dose of Carbofuran	5	3	2 (-)	40	10
T10	Chalcone C1 @20 ppm conc. +half dose of Carbofuran	5	3	2 (-)	40	08
T11	Chalcone C1 @40 ppm conc. +half dose of Carbofuran	5	2	3 (-)	60	15
T12	Chalcone C2 @10 ppm conc. +half dose of Carbofuran	5	4	1 (-)	20	13
T13	Chalcone C2 @20 ppm conc. +half dose of Carbofuran	5	3	2 (-)	40	13
T14	Chalcone C2 @40 ppm conc. +half dose of Carbofuran	5	3	2 (-)	40	17
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); (+) = Population increase; (-) = Population decrease						

Cooperators:

Name	Center
Priyanka Duggal	Hisar
S. P. Bisnoi	Durgapura
Ramanna Koulagi	Ludhiana
Sudheer Kumar, D.P. Singh, PL Kashyap	Karnal (Coordinating unit)

Annexure 1: Seedling response of AVT against the pathotypes of *Puccinia graminis tritici* (wheat black rust) during 2018-19 at ICAR-IIWBR, RS, Shimla

S. No.	Variety/Line	PATHOTYPE																										Resistance/ *Sr* genes
		11	**11A**	**14**	**15-1**	**21**	**21-1**	**21A-2**	**24A**	**34-1**	**40**	**40A**	**40-1**	**40-2**	**40-3**	**42B**	**117**	**117A**	**117A-1**	**117-1**	**117-2**	**117-3**	**117-4**	**117-5**	**117-6**	**122**	**184**	**295**	
		1	2	3	4	5	6	7	8	9	10	11	12	13	14	16	17	18	19	20	21	22	23	24	25	26	27	28	
1	HPW349 (C)	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	R	*Sr7b+2+*
2	VL907 (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	R	R	R	*Sr31+2+*
3	HS507 (C)	R	R	NG	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	*Sr31+*
4	HS652	R	R	R	R	R	R	R	R	R	R	MR	R	R	MS	R	R	R	R	R	R	R	R	R	R	R	R	R	*Sr2+*
5	HS562 (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	R	R	R	*Sr8a+9b+2+*
6	VL892 (C)	R	R	R	R	R	R	R	R	R	R	R	R	R	MR	R	R	R	R	R	R	R	R	R	R	R	R	R	*Sr30+11+*
7	HS490 (C)	S	MS	R	R	R	R	R	R	R	R	R	R	MS	R	R	R	R	R	R	MR	R	R	R	R	R	R	R	*Sr28+9b+*
8	HPW468	S	R	R	R	R	R	R	R	R	R	R	R	R	S	R	R	R	R	MS	R	R	R	R	MS	R	R	S	*Sr9b+11+*
9	HS673	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	R	*Sr31+*
10	VL3020	R	R	R	R	R	R	R	R	NG	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	*Sr31+*
11	UP3041	S	R	NG	R	R	R	R	R	NG	R	R	NG	R	R	NG	R	R	R	R	R	R	MS	R	R	R	R	R	*Sr9b+11+*
12	HPW467	R	R	R	R	R	R	R	R	R	NG	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	-
13	HS674	S	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	*Sr30+*
14	VL3019	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	R	*Sr31+*
15	VL3021	R	R	R	R	R	R	R	MS	R	NG	R	R	R	R	R	R	R	R	R	R	R	MS	R	MS	R	R	R	*Sr13+11+2+*
16	WH1105 (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	R	R	R	R*
17	HD3226 (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	R	R	R	R	*Sr2+*
18	HD 3086 (C)	S	R	NG	S	R	R	R	S	R	R	R	R	R	MR	R	R	R	R	MS	R	R	MR	R	MR	S	R	S	*Sr7b+2+*
19	PBW820	R	R	R	R	R	R	R	R	R	R	R	R	R	MR	R	R	R	R	R	R	R	R	R	R	R	R	R	*Sr31+2+*
20	DBW221	R	R	R	S	S	S	S	MS	R	R	S	R	S	S	R	R	MS	R	MR	MS	S	S	MS	S	R	R	S	*Sr7b+2+*
21	DBW222	S	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	*Sr31+*
22	PBW550 (C)	R	R	NG	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	*Sr31+2+*
23	PBW821	R	R	R	R	R	R	R	R	NG	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R
24	HD2967 (C)	R	R	R	S	R	R	R	R	R	R	R	R	R	MS	R	R	R	R	R	R	R	R	R	R	R	R	R	*Sr8a+11+2+*
25	NW7049	R	R	R	R	R	R	R	R	R	R	R	R	R	MR	R	R	R	R	R	R	R	R	R	R	R	R	R	*Sr2+*
26	DDW621-50 (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	NG	R	R	*Sr2+*
27	DBW88 (C)	S	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	*Sr11+2+*
28	PBW752 (I)(C)	S	R	R	R	R	R	R	R	R	R	R	R	R	MR	R	R	R	R	R	R	R	R	R	R	R	R	R	-
29	DBW173 (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	R	R	R	*Sr31+5+*
30	WH1021 (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	R	R	R	*Sr31+2+*
31	HD 3059 (C)	R	R	R	R	R	R	R	R	R	R	R	R	R	MR	R	R	R	R	R	R	MS	R	R	S	R	R	S	*Sr11+2+*
32	WH1124 (C)	S	S	R	MS	R	R	R	R	R	R	MS	R	S	MS	R	R	R	R	MS	R	R	MS	MR	R	R	R	S	*Sr7b+2+*
33	PBW771	R	R	R	R	R	R	R	R	R	R	R	NG	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	*Sr31+*
34	HI1620 (I) (C)	S	R	R	R	R	R	R	M	R	R	R	R	R	M	R	R	R	R	R	R	MS	R	R	S	R	R	R	*Sr11+7b+*
35	PBW796	S	R	R	R	R	R	R	R	NG	R	R	R	R	R	R	R	R	MR	R	R	R	R	R	R	R	R	S	*Sr9b+11+2+*
36	HI1628	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	R	*Sr2+*
37	WH1142	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	R	*Sr31+2+*
38	HD3043(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	R	R	R	*Sr31+2+*
39	PBW644 (C)	R	R	R	R	R	R	R	R	R	R	MS	R	R	MS	R	R	R	R	R	R	R	R	R	R	R	R	R	*Sr11+2+*
40	HD3237 (C)(I)	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	R	*Sr5+*

41	BRW 3806	R	R	R	R	R	R	R	R	R	R	R	R	R	MR	R	R	R	R	R	R	R	R	R	R	R	R	*Sr28+5+*
42	NIAW3170	R	R	R	MR	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	*Sr2+*
43	WH1080 (C)	R	R	R	R	R	R	R	R	R	R	MS	R	MR	S	R	R	R	R	R	R	R	R	R	R	R	R	*Sr9e+2+*
44	HD3249(C)	R	R	R	R	R	R	R	R	R	R	R	R	R	MS	MS	R	R	R	R	R	MS	R	R	R	R	R	*Sr11+2+*
45	HD2733 (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	MR	R	*Sr31+2+*
46	PBW781	R	R	R	R	R	R	R	R	R	R	R	R	R	S	R	MR	R	R	R	R	R	R	R	R	R	R	*Sr11+*
47	DBW257	R	R	R	S	MR	R	R	R	R	R	R	R	S	S	R	R	R	R	R	R	R	R	R	R	R	R	*Sr28+5+*
48	DBW39 (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	R	R	*Sr31+2+*
49	HD3277	R	R	R	NG	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R
50	RAJ4529	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	R
51	DBW187 (I) (C)	R	R	R	R	R	R	R	R	R	R	R	R	R	S	R	R	R	MR	R	R	MR	R	R	R	R	R	*Sr5+11*
52	WH1239	S	S	R	S	R	R	R	R	R	R	S	R	S	MS	R	R	R	R	R	R	R	R	R	R	S	R	S	*Sr7b+*
53	K0307 (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	R	R	*Sr2+*
54	HD2967 (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	R	R	*Sr8a+11+2+*
55	K1317 (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	R	R	*Sr31+2+*
56	HI1612 (C)	S	R	R	R	R	R	R	R	NG	S	R	R	S	S	R	MR	R	R	MR	R	R	R	R	R	R	R	*Sr7b+2+*
57	HD3293	MS	S	R	R	R	R	R	R	R	R	R	R	R	MS	R	R	R	R	R	R	MR	R	R	R	R	R	*Sr13+*
58	HD3171 (C)	S	R	R	R	R	R	R	R	R	R	R	R	R	R	R	MS	R	R	R	R	MS	R	R	R	R	MS	R	*Sr11+7b+2+*
59	HD2888 (C)	R	R	R	R	R	R	R	R	R	NG	R	MR	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	*Sr24+2+*
60	DBW252	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	R	*Sr8a+5+11+2+*
61	K8027 (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	R	R	R	-
62	DBW 273	R	R	R	R	R	R	R	R	R	R	R	R	S	S	R	R	R	R	R	R	R	R	R	R	S	R	R	*Sr9e+*
63	HI8713 (d) (C)	R	R	R	R	R	R	R	R	R	R	R	NG	R	R	R	R	S	MR	MR	S	MR	R	R	MR	R	S	R	*Sr9e+2+*
64	NIDW1158(d)	R	R	R	R	R	R	NG	R	R	R	MR	R	R	R	MS	R	S	R	MS	S	R	R	R	S	R	S	S	*Sr7b+2+*
65	HI8811 (d)	R	R	R	R	R	R	R	MS	R	R	R	R	R	M	MR	MR	S	R	MS	S	MR	R	R	S	R	S	S	*Sr11+2+*
66	HD3343	S	R	R	R	R	R	R	R	R	R	R	R	R	S	R	R	R	R	R	R	MR	MS	R	R	R	R	S	*Sr13+2+*
67	GW322 (C)	S	R	R	R	R	R	R	R	R	R	R	R	R	MR	R	R	R	R	R	R	MS	R	MS	R	R	R	MR	*Sr11+2+*
68	HI1544 (C)	R	NG	R	R	R	R	R	R	R	R	R	MR	R	R	R	R	R	R	R	R	R	R	R	S	R	R	R	*Sr24+2+*
69	HI8737 (C)(d)	R	R	R	S	R	R	R	S	R	R	R	R	R	S	R	S	S	MR	MS	S	S	MS	MR	S	R	MR	S	*Sr9e+2+*
70	HI8812 (d)	R	R	R	R	R	R	R	S	R	R	MR	R	R	R	R	R	R	MR	R	R	R	R	R	S	R	MR	R	*Sr7b+2+*
71	GW1348 (d)	R	R	R	MS	R	R	R	MS	R	R	S	R	R	R	R	R	S	R	S	S	S	S	S	S	R	S	R	*Sr7b+*
72	DDW49 (d)	R	R	R	S	R	R	R	S	S	MR	S	S	S	S	R	R	S	MR	S	S	MS	S	S	S	R	S	R	*Sr7b+*
73	PBW822	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	NG	R	R	R	R	R	R	R	R	R
74	HD3345	R	R	R	R	R	R	R	R	R	NG	R	R	R	MS	R	R	R	R	R	R	R	R	R	R	R	R	R	*Sr30+8a+2+*
75	DDW48(d)	R	R	R	R	R	R	R	S	R	MS	R	R	R	R	R	MS	S	S	S	S	S	R	R	S	R	R	S	*Sr7b+2+*
76	HI8627 (d) (C)	R	R	R	R	R	R	R	R	R	R	S	R	R	R	R	R	S	R	R	S	S	NG	R	S	R	S	R	*Sr9e+2+*
77	DBW110(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	R	R	R	R
78	UAS466 (d)	R	R	R	R	R	R	R	S	R	R	S	R	R	R	R	R	S	R	S	S	S	R	MS	S	R	R	R	*Sr11+2+*
79	MP3288 (C)	R	R	R	R	R	R	R	R	R	R	R	MR	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	*Sr24+2+*
80	DBW277	R	R	R	R	R	R	R	R	R	R	R	R	S	S	R	R	R	R	R	R	R	R	R	R	R	R	R	*Sr5+8a+*
81	DDW47 (d)	R	R	R	MS	R	R	R	S	R	R	R	R	R	MS	R	R	S	MR	R	MS	S	R	R	R	R	MS	R	*Sr11+7b+2+*
82	HD2932 (C)	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	R	*Sr11+*
83	HD2864 (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	R	R	R	R
84	MP3336 (C)	MS	R	R	R	R	R	R	R	NG	R	MR	R	R	R	R	R	R	R	R	R	S	R	MS	R	R	R	R	*Sr11+2+*
85	MP4010 (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	R	R	R	*Sr24+2+*
86	CG1029	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	R	R
87	UAS3002	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	R	*Sr31+5+*
88	HI1633	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	R	*Sr31+*
89	HI1634	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	R	*Sr31+*

90	HI8808 (d)	R	R	R	R	R	R	R	S	R	R	R	R	R	R	S	S	R	MR	MS	S	R	R	R	S	R	S	MS	*Sr7b+2+*
91	HI8807 (d)	R	R	R	R	R	R	R	S	R	R	R	R	R	R	R	R	R	MS	MR	R	R	R	R	S	R	MS	R	*Sr11+2+*
92	PBW823	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	R	*Sr2+*
93	UAS 428 (d) (C)	R	R	NG	MS	R	R	R	R	R	R	MS	R	R	MR	R	NG	S	R	S	S	S	S	S	S	R	S	R	*Sr7b+*
94	DDW49 (d)	R	R	R	S	M	R	R	S	R	MS	S	R	S	S	R	R	S	MR	S	S	S	R	R	S	R	S	R	*Sr7b+2+*
95	UAS3001	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	R	*Sr31+*
96	MACS3949(d)(C)	R	R	R	R	R	R	R	R	R	R	MR	R	R	R	R	R	S	MR	S	S	S	R	R	S	R	S	R	*Sr7b+2+*
97	MACS 6222 (C)	R	R	R	R	R	R	R	R	NG	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R
98	GW322 (C)	S	R	R	R	R	R	R	R	R	R	R	R	R	S	R	R	R	R	R	R	S	R	R	R	R	R	R	*Sr11+2+*
99	DDW48 (d)	R	R	R	S	R	R	R	S	R	S	S	R	S	MS	R	R	S	MS	S	S	S	R	R	S	R	S	R	*Sr7b+2+*
100	Macs6478	R	S	R	R	R	R	R	R	NG	R	R	R	R	S	R	R	R	R	R	R	MR	R	R	R	R	R	R	*Sr28++*
101	HD3343	R	R	R	R	R	R	R	R	R	R	MR	R	R	S	R	R	S	R	R	R	MR	R	R	R	R	R	S	*Sr13+2+*
102	WHD 963 (d)	R	R	R	MR	R	R	R	S	R	R	R	R	R	R	R	R	S	R	S	MS	S	S	R	S	R	MS	R	*Sr7b+2+*
103	HI8807(d)	R	R	R	M	R	R	R	S	R	R	R	R	R	R	R	R	R	MR	R	S	R	MX	R	S	R	S	R	*Sr11+2+*
104	HI 1633	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	R	*Sr31+*
105	UAS3002	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	R	*Sr31+5+*
106	Raj4083(d)	R	R	R	R	R	R	R	R	R	R	R	R	R	MS	R	R	R	R	R	R	R	S	R	R	R	R	R	*Sr11+2+*
107	HD2932 (C)	R	R	R	R	R	R	R	R	R	R	S	R	R	MS	R	R	R	R	R	R	R	S	R	R	R	R	R	*Sr11+*
108	GW509	R	R	R	R	R	R	R	R	R	R	R	S	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	*Sr24+2+*
109	HD3090 (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	R	R	R	*Sr31+2+*
110	NIAW3170	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	R	*Sr2+*
111	GW1346(d)	R	MR	R	R	R	R	R	S	R	R	R	R	R	R	S	MR	R	R	R	S	R	R	R	MS	R	MR	MR	*Sr7b+2+*
112	MACS 4058(d)	R	R	R	R	R	R	R	S	R	R	MS	R	R	R	MR	R	S	MR	S	R	MR	R	R	S	R	MS	MR	*Sr11+*
113	DBW93 (C)	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	S	R	R	R	*Sr31+2+*
114	HI8805 (d)	R	NG	R	R	R	R	R	S	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	S	R	R	R	*Sr13+11+2+*
115	AKDW2997-16 (d) (C)	S	S	R	S	S	R	R	S	R	R	R	R	MS	R	R	R	S	R	S	S	MS	S	R	S	R	MS	S	*Sr7b+2+*
116	Macs6695	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	R	*
117	UAS446 (d)(C)	R	R	R	MS	R	R	R	S	R	R	R	R	R	R	R	R	S	R	MS	MR	R	M	R	S	R	MS	R	*Sr11+2+*
118	HI1605 (C)	S	R	R	R	R	R	R	R	R	R	S	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	*Sr5+11+*
119	Macs 6696	R	R	R	R	R	R	R	R	R	R	MS	R	R	MS	R	R	R	R	R	R	R	R	R	R	R	R	R	*Sr9e+*
120	NIDW1149 (d)	R	R	NG	R	R	R	R	R	R	R	MR	R	R	R	MR	R	S	R	R	R	R	R	R	R	R	S	MS	*Sr11+2+*
121	HI8802 (d)	R	R	R	MS	R	R	R	S	R	R	R	R	R	MR	R	R	S	MR	MR	R	MS	R	R	S	R	R	R	*Sr13+2+*
122	DDK1029 (C)	R	MR	R	R	R	R	R	R	R	R	R	R	R	R	MS	R	R	R	R	MR	R	R	R	R	R	S	MR	*Sr11+*
123	MACS5052	R	S	R	MR	R	R	R	S	R	R	R	R	R	S	S	R	R	MR	R	R	MR	R	R	S	R	S	MS	-
124	MACS6222 (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	R	R	R	R
125	DDK1056	R	MS	R	S	S	R	R	S	R	R	R	R	R	MS	S	R	R	MR	R	S	MS	R	R	S	R	S	MS	*Sr7b+2+*
126	HW1098(C)	R	R	R	R	R	R	R	S	NG	R	R	R	R	MR	S	MR	R	NG	R	MS	R	R	NG	S	R	S	S	*Sr11+2+*
127	Macs 5053	R	R	R	R	R	R	R	S	R	R	R	R	R	R	R	R	R	MR	R	R	R	R	MR	S	R	S	S	*Sr11+*
128	DDK1057	R	R	R	R	R	R	R	S	R	R	R	R	R	R	MS	R	R	NG	R	S	R	MS	R	S	R	NG	R	*Sr13+*
129	HD3317	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	R	*Sr31+*
130	WH1254	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	R	*Sr25+*
131	DBW301	R	R	R	R	R	R	R	R	R	R	MS	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	*Sr11+*
132	WH1270	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	MR	R	MR	R	R	R	R	R	R	R	*Sr13+*
133	HD2967	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	NG	R	R	R	R	R	R	R	R	R	R	R	*Sr8a+11+2+*
134	PBW824	R	MR	R	R	R	R	R	R	NG	R	MR	R	R	MS	R	R	R	R	R	R	R	R	R	R	R	R	R	*Sr28+2+*
135	UP3043	S	R	R	R	R	R	R	S	R	R	MR	R	R	S	R	R	R	MR	R	R	R	R	R	S	R	R	R	*Sr2+*
136	DBW187	MS	R	R	R	R	R	R	R	R	R	R	R	R	MR	R	R	R	R	R	R	MR	R	R	R	R	R	R	*Sr5+11+*
137	PBW825	S	S	R	R	R	R	R	MS	R	R	MS	R	S	R	R	R	R	R	R	MS	R	MR	R	S	R	R	S	*Sr2+*

138	DBW303	R	NG	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R
139	DBW304	MS	R	R	R	R	R	R	R	R	R	R	R	R	MR	R	R	R	R	R	R	R	R	R	R	R	R	*Sr30+5+2+*
140	UP3042	S	R	R	R	R	R	R	R	R	NG	S	R	R	R	R	R	NG	R	R	R	R	R	NG	R	R	R	*Sr30+5+2+*
141	DBW302	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	*Sr31+2+*
142	PBW825	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	MR	R*
143	HD3347	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	MS	*Sr11+7b+2+*
144	WH1223	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	R*
145	KRL 19 (C)	R	R	R	R	R	R	R	R	R	R	MS	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	*Sr8b+9b+11+2+*
146	Kharchia 65	S	R	R	R	S	MS	R	S	S	R	S	S	S	S	S	MR	R	MS	S	S	S	R	MS	S	S	S	*Sr7b+*
147	NW7060	S	R	R	R	R	R	R	R	R	R	MS	R	R	S	R	R	R	R	R	R	R	R	R	R	R	R	*Sr30+5+*
148	KRL 210(C)	S	R	R	S	R	R	R	MR	R	R	S	R	S	R	R	R	R	R	R	R	R	R	R	S	MS	R	MS	*Sr7b+2+*
149	WH1228	S	R	R	R	R	R	R	R	R	R	R	R	S	MR	R	R	R	R	R	R	R	R	R	R	R	R	R	*Sr28+2+*
150	NW7062	R	R	R	R	R	R	NG	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	*Sr31+5+2+*
151	PBW 757 (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	R	R	R	*Sr2+**
152	WR544 (C)	R	R	R	R	R	R	R	R	R	R	S	R	R	S	R	R	R	R	R	R	R	R	R	R	R	R	R	*Sr28+8a+2+*
153	HD3298	R	R	R	R	R	R	R	R	NG	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R*
154	HD3271	S	R	R	R	R	R	R	MR	R	R	MS	R	S	R	MR	MS	S	S	MS	R	R	R	R	MS	MS	MR	S	*Sr11+2+*
155	DBW 14 (C)	MS	R	R	R	R	R	R	R	R	R	S	R	R	MR	R	R	R	R	R	R	R	R	R	R	R	R	R	*Sr28+11+2+*
156	DBW71 (C)	R	R	R	S	R	R	R	MS	R	R	S	R	R	S	MR	R	R	R	R	R	R	R	R	S	R	R	R	*
157	HI1621	R	R	R	MS	R	R	R	R	R	R	R	R	MS	R	R	R	R	R	R	R	R	R	R	R	R	R	R	*Sr28+*
158	PBW 797	S	R	R	R	R	R	R	R	R	R	MS	R	R	R	R	R	R	R	R	R	MR	R	R	R	R	R	S	*Sr11+7b+2+*

Annexure 2: Seedling response of AVT against the pathotypes of *Puccinia triticina* (wheat brown rust) during 2018-19 at ICAR-IIWBR, RS, Shimla

S. No.	Variety/Line	PATHOTYPE																				Resistance/ *Lr* genes
		11	12-2	12-5	12-7	12-8	16-1	77	77-2	77-5	77-7	77-8	77-9	77-10	77A-1	104-2	104-3	104-4	107-1	162-1	162A	162-3	
		3	4	5	6	22	2	8	9	10	11	1	12	13	14	15	16	17	18	19	20	23	
1	HPW349 (C)	R	S	MS	S	M	R	R	S	S	R	R	S	S	R	R	S	S	R	MS	R	R	*Lr13*+10+
2	VL907 (C)	R	R	R	S	R	R	R	R	S	S	R	S	S	R	S	MS	S	R	R	R	R	*Lr26*+
3	HS507 (C)	R	NG	R	R	R	R	R	NG	S	R	R	S	MS	R	R	R	S	R	R	R	NG	*Lr26*+1+
4	HS652	R	R	R	S	R	R	R	R	S	R	R	MS	S	R	MS	S	S	R	R	R	R	*Lr23*+10+
5	HS562 (C)	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R Seed*
6	VL892 (C)	R	R	R	R	R	R	R	S	S	R	R	S	S	R	S	S	S	R	R	R	NG	*Lr13*+10+
7	HS490 (C)	R	M	R	MS	R	R	R	S	R	NG	R	S	S	R	M	S	S	R	R	R	R	*Lr23*+
8	HPW468	R	S	R	S	R	R	R	S	S	R	R	S	S	R	S	S	S	R	R	R	R	*Lr23*+10+
9	HS673	R	R	R	R	R	R	R	MX	MX	R	R	MX	R	R	S	R	R	R	R	R	R	*Lr26*+
10	VL3020	R	R	R	R	R	R	NG	R	S	R	NG	S	R	R	R	R	S	R	R	R	R	*Lr26*+23+1+
11	UP3041	R	S	R	S	NG	NG	R	S	S	S	R	S	NG	R	S	S	R	R	R	MX	NG	*Lr23*+10+
12	HPW467	R	S	S	R	S	R	S	S	S	R	NG	S	NG	S	S	S	R	R	S	S	MS	*Lr13*+
13	HS674	R	S	R	S	R	R	R	S	S	R	R	S	S	R	S	S	S	R	R	R	R	*Lr23*+10+
14	VL3019	R	R	R	S	MX	R	R	R	S	R	R	R	S	R	MS	S	S	MS	MX	R	R	*Lr26+10+*
15	VL3021	R	S	S	S	R	R	R	S	S	R	R	S	S	R	S	S	S	R	R	R	R	*Lr23*+13+
16	WH1105 (C)	R	R	R	R	R	R	S	S	S	R	S	S	S	S	R	R	R	R	R	R	R	*Lr13*+
17	HD3226 (I)(C)	R	S	R	S	R	R	R	S	S	R	R	S	S	R	S	S	S	R	S	R	R	*Lr23*+10+
18	HD 3086 (C)	R	S	R	S	R	R	NG	S	S	R	R	S	S	R	S	S	R	R	S	MS	NG	*Lr13+10+*
19	PBW820	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	*Lr26+R*
20	DBW221	R	S	S	S	R	R	S	S	S	MS	R	S	S	MS	S	S	R	R	R	R	R	*Lr13*+
21	DBW222	R	R	R	R	R	R	R	R	MS	R	R	MS	S	R	R	R	R	R	R	R	NG	*Lr26+23+*
22	PBW550 (C)	R	R	R	R	R	R	NG	R	R	R	R	R	R	R	R	R	R	R	R	R	R	*Lr26+R*
23	PBW821	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	NG	R
24	HD2967 (C)	R	R	R	MX	R	R	MX	R	S	R	R	S	S	R	R	R	R	R	R	R	R	*Lr23*+
25	NW7049	R	R	R	S	R	R	R	S	S	R	R	S	R	R	R	R	R	R	R	R	R	*Lr23+10+*
26	DDW621-50 (C)	R	R	R	S	R	R	R	S	S	S	NG	S	S	R	R	R	R	R	S	R	R	*Lr13+10+*
27	DBW88 (C)	R	R	R	MX	R	R	R	S	S	S	S	S	S	R	R	R	M	R	R	R	R	*Lr13+10+3+*
28	PBW752 (I)(C)	R	R	R	S	R	R	R	S	S	S	S	S	S	R	S	R	MX	R	MS	R	R	*Lr13+10+*
29	DBW173 (C)	R	R	R	R	R	R	R	R	MS	MS	R	S	MX	R	R	R	R	R	R	R	MX	*Lr26+10+3*
30	WH1021 (C)	R	R	R	R	R	R	R	R	R	S	R	S	R	R	R	R	M	R	R	R	S	*Lr26+1+*
31	HD 3059 (C)	R	R	R	S	R	R	R	S	S	S	MS	S	S	R	R	R	R	R	S	R	R	*Lr13*+
32	WH1124 (C)	R	S	R	S	R	R	R	S	S	MS	R	S	S	R	S	S	R	R	S	R	R	*Lr13+10+*
33	PBW771	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	S	R	R	R	R	*Lr26*+23+1+
34	HI1620 (I) (C)	R	R	R	R	R	R	R	R	S	R	R	S	R	R	R	R	MS	R	R	R	R	*Lr13+10+3+*
35	PBW796	R	S	R	S	R	R	R	S	S	R	R	S	S	R	R	R	S	R	R	R	R	*Lr23+10+*
36	HI1628	R	S	R	S	R	R	S	S	S	R	R	S	S	S	MX	R	S	R	R	R	R	*Lr13+10+*
37	WH1142	R	R	R	S	R	R	R	R	S	MS	R	R	R	R	S	S	R	R	MS	R	R	*Lr26+23+10+*
38	HD3043(C)	R	R	R	R	R	R	R	R	S	MS	R	S	S	R	S	S	S	R	R	R	R	*Lr26+23+*
39	PBW644 (C)	R	R	R	R	R	R	R	S	S	R	R	S	S	R	S	S	S	R	R	R	R	*Lr13+1+*
40	HD3237 (C)(I)	R	S	S	S	R	R	S	S	S	R	S	S	S	S	S	M	R	S	R	MX	R	*Lr13+3+*
41	BRW 3806	R	R	R	R	R	R	R	S	R	S	S	S	S	S	S	R	S	R	R	R	R	*Lr10*+
42	NIAW3170	R	MX	R	M	R	R	R	S	S	R	R	S	S	R	R	R	M	R	R	R	R	*Lr13+10+*

43	WH1080 (C)	R	S	S	S	R	R	S	S	S	R	R	S	S	MS	S	S	R	R	S	R	S	*Lr13+*
44	HD3249(C)	R	R	R	MX	R	R	R	S	S	R	R	S	S	R	R	R	R	MX	R	R	R	*Lr13+10+*
45	HD2733 (C)	R	R	S	S	R	R	R	R	S	R	R	S	S	R	S	S	S	R	MX	R	R	*Lr26+34+*
46	PBW781	R	R	R	S	R	R	R	MS	S	S	S	MX	S	MX	R	R	MX	R	R	R	R	*Lr23+10+*
47	DBW257	R	S	R	S	R	R	R	S	S	R	R	S	S	R	S	S	R	R	R	R	R	*Lr23+10+*
48	DBW39 (C)	R	R	R	M	R	R	R	S	S	R	MX	S	R	MX	MS	MX	R	R	R	S	R	*Lr26+23+10+*
49	HD3277	R	S	R	R	R	R	R	S	S	R	R	R	R	R	S	S	S	R	R	R	R	*Lr23+10+*
50	RAJ4529	R	S	S	S	R	MS	S	S	S	S	R	S	S	S	S	S	S	R	S	R	S	*Lr13+*
51	DBW187 (I) (C)	R	R	R	M	R	R	R	R	R	R	R	S	R	R	R	R	R	R	R	R	R	*Lr23+10+*
52	WH1239	R	S	R	S	R	R	S	S	S	MS	M	S	S	S	S	S	S	R	S	R	R	*Lr13+10+*
53	K0307 (C)	R	R	R	R	R	R	R	S	S	MS	R	S	S	R	S	S	S	R	R	R	R	*Lr23+1+*
54	HD2967 (C)	R	R	R	M	R	R	R	MS	S	R	R	S	S	R	R	R	S	R	R	R	R	*Lr23+*
55	K1317 (C)	R	R	R	R	R	R	S	S	R	R	R	S	S	R	S	S	S	R	R	R	R	*Lr26+1+*
56	HI1612 (C)	R	S	S	S	R	R	R	R	S	R	R	S	R	R	S	S	S	R	R	R	R	*Lr23+*
57	HD3293	R	R	R	S	R	R	R	R	S	R	R	S	S	R	S	R	S	R	R	R	R	*Lr13+10+*
58	HD3171 (C)	R	R	R	S	R	R	R	S	S	MS	R	S	S	R	S	S	S	R	S	R	R	*Lr23+13+10+*
59	HD2888 (C)	R	R	R	R	NG	R	R	R	R	R	R	R	R	R	R	R	R	NG	R	R	NG	*Lr24+R*
60	DBW252	R	R	R	R	R	R	R	S	S	R	R	S	S	R	R	R	MS	R	R	R	R	*Lr13+10+*
61	K8027 (C)	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R Seed*
62	DBW 273	R	R	R	R	R	R	R	S	R	R	R	S	R	R	R	R	MX	R	R	R	R	*Lr23+10+*
63	HI8713 (d) (C)	S	R	MS	S	S	S	R	R	S	S	R	S	S	R	S	S	S	R	S	S	R	*Lr13+*
64	NIDW1158(d)	R	R	R	MS	R	S	R	R	R	R	R	R	R	R	R	R	R	R	R	R	S	*Lr23+*
65	HI8811 (d)	S	S	S	S	S	S	R	R	S	S	R	S	S	R	S	S	S	R	S	S	R	*Lr13+*
66	HD3343	R	S	R	S	NG	R	MX	S	S	S	R	S	S	R	MX	M	S	R	R	R	R	*Lr23+10+*
67	GW322 (C)	R	S	R	M	R	R	MS	S	MX	S	R	S	S	MS	R	R	S	R	R	R	R	*Lr13+1+*
68	HI1544 (C)	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	*Lr24+R*
69	HI8737 (C)(d)	R	R	R	S	MX	S	R	R	S	MS	R	R	R	R	R	R	R	R	R	R	MX	*Lr24+R*
70	HI8812 (d)	S	S	R	S	R	S	R	R	S	S	R	S	R	R	S	S	S	R	R	R	R	*Lr13+*
71	GW1348 (d)	R	S	MS	R	R	R	R	R	S	R	R	S	S	R	S	MS	MS	R	R	R	R	*Lr13+*
72	DDW49 (d)	R	S	S	S	R	R	R	R	S	R	R	S	S	R	S	S	S	R	R	R	R	*Lr18+*
73	PBW822	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R
74	HD3345	R	R	R	R	R	R	S	MS	S	R	MS	S	S	MX	R	R	R	R	R	R	R	*Lr13+*
75	DDW48(d)	R	MX	R	R	NG	R	R	R	R	R	R	MS	MX	R	R	MX	MX	R	R	R	R	-
76	HI8627 (d) (C)	S	MS	S	S	S	R	R	R	S	R	NG	R	S	R	S	S	NG	R	S	R	R	*Lr13+*
77	DBW110(C)	R	S	R	M	R	R	S	S	S	MX	R	S	S	S	S	R	S	R	R	R	R	*Lr13+*
78	UAS466 (d)	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	*Lr13+*
79	MP3288 (C)	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	*Lr24+R*
80	DBW277	R	R	S	MX	R	R	R	MX	S	R	R	S	S	R	R	R	R	R	MS	R	R	-
81	DDW47 (d)	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R
82	HD2932 (C)	R	S	S	S	S	S	S	S	S	MX	S	S	S	S	S	S	S	S	S	S	R	*Lr13+*
83	HD2864 (C)	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R
84	MP3336 (C)	R	S	S	MX	R	R	S	S	S	S	R	S	S	R	S	S	S	R	R	R	R	*Lr13+*
85	MP4010 (C)	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	*Lr24+R*
86	CG1029	R	R	R	R	R	R	R	R	R	R	R	R	NG	R	R	R	R	R	R	R	R	R
87	UAS3002	R	MX	R	S	R	R	R	R	MS	R	R	S	S	R	MX	MX	S	R	R	R	R	*Lr26+10+*
88	HI1633	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	*Lr26+*
89	HI1634	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	*Lr26+R*
90	HI8808 (d)	S	S	S	S	R	S	R	R	S	R	R	S	M	R	S	S	MX	R	R	R	R	-
91	HI8807 (d)	R	R	R	MX	R	S	R	R	MS	R	R	R	R	R	R	R	R	R	R	R	R	*Lr23+*
92	PBW823	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R
93	UAS 428 (d) (C)	R	R	S	R	R	NG	NG	R	S	R	R	R	NG	NG	MX	S	NG	R	R	R	R	-

94	DDW49 (d)	R	S	S	S	R	R	R	R	S	R	R	S	S	R	S	S	S	R	R	R	MS	*Lr18+*
95	UAS3001	R	R	R	M	R	R	R	R	S	R	R	S	S	R	R	R	S	M	R	R	R	*Lr26+*
96	Macs3949(d)(C)	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R
97	Macs 6222 (C)	R	R	R	R	R	R	NG	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R
98	GW322 (C)	R	R	R	M	R	R	S	S	S	S	R	S	S	MX	R	MX	R	R	R	R	R	*Lr13+1+*
99	DDW48 (d)	M	R	R	R	R	MX	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R
100	Macs6478	R	R	R	R	R	R	R	S	S	R	MS	S	S	R	R	R	R	R	R	R	R	*Lr23+1+*
101	HD3343	R	R	R	MX	R	R	R	S	M	R	R	S	S	R	R	R	MX	R	R	R	MX	*Lr23+10+*
102	WHD 963 (d)	R	NG	S	S	R	S	R	R	S	R	R	MX	S	R	S	S	R	R	R	R	R	*Lr23+*
103	HI8807(d)	R	R	R	MS	R	S	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	-
104	HI 1633	R	R	R	S	R	R	R	R	R	R	R	R	R	R	R	R	S	R	R	R	R	*Lr26+*
105	UAS3002	R	R	R	MS	R	R	R	R	MS	R	R	S	S	R	R	R	MX	M	R	R	R	*Lr26+10+*
106	Raj4083(d)	R	S	S	MX	R	NG	S	S	S	S	R	S	S	R	S	S	MX	R	R	NG	R	*Lr13+*
107	HD2932 (C)	R	S	S	S	S	S	S	S	S	R	S	S	S	S	S	S	S	S	S	S	S	*Lr13+*
108	GW509	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	*Lr24+R*
109	HD3090 (C)	R	R	R	R	R	NG	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	*Lr26+*
110	NIAW3170	R	MS	R	S	R	R	R	S	S	R	R	S	S	R	R	R	S	R	R	R	R	*Lr13+10+*
111	GW1346(d)	S	R	R	R	R	R	R	R	R	R	R	S	MS	R	S	R	R	R	R	R	R	*Lr13+*
112	Macs 4058(d)	R	R	MS	S	R	S	R	R	MS	R	R	R	R	R	R	R	R	R	R	R	R	*Lr23+*
113	DBW93 (C)	R	R	R	S	R	R	R	MX	R	R	R	S	S	R	R	R	M	R	R	R	R	*Lr26+*
114	HI8805 (d)	MX	S	MX	MX	R	S	R	R	S	R	R	R	S	R	S	S	MS	R	R	R	R	*Lr23+*
115	AKDW2997-16 (d) (C)	R	R	R	S	R	S	R	R	S	R	R	R	R	R	R	R	R	R	R	R	MS	*Lr23+*
116	Macs6695	R	S	S	S	S	R	S	S	S	S	MX	S	S	S	S	S	S	S	S	S	S	*Lr13+*
117	UAS446 (d)(C)	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R
118	HI1605 (C)	R	NG	S	S	S	NG	R	MX	S	R	R	S	S	R	S	R	S	MS	MS	R	R	*Lr13+*
119	Macs 6696	R	S	S	S	S	S	S	S	S	S	MX	S	S	S	S	S	S	MS	S	S	S	*Lr13+*
120	NIDW1149 (d)	R	S	MS	S	MS	S	R	R	S	R	R	R	S	NG	R	R	MX	R	R	R	R	*Lr23+*
121	HI8802 (d)	R	R	MS	S	R	S	R	R	R	R	R	R	R	R	R	MS	R	R	R	R	NG	*Lr23+*
122	DDK1029 (C)	S	R	MS	R	R	S	R	R	S	R	R	R	R	R	S	MS	R	R	R	R	R	*Lr13+*
123	Macs5052	S	R	R	R	R	R	R	R	R	R	R	MS	R	R	MS	R	R	R	R	R	R	-
124	Macs6222 (C)	R	R	R	R	R	R	NG	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R
125	DDK1056	S	NG	R	R	R	MX	NG	R	MS	R	R	R	R	R	S	R	R	R	R	R	R	-
126	HW1098(C)	S	NG	R	R	R	R	R	R	S	R	R	R	R	R	S	S	R	R	R	R	R	*Lr18+*
127	Macs 5053	S	R	R	R	R	R	R	R	S	R	R	R	R	R	R	R	R	R	R	R	R	-
128	DDK1057	R	R	R	R	R	NG	R	R	R	R	NG	NG	R	R	NG	R	NG	R	R	R	R	R
129	HD3317	R	R	R	S	R	R	R	R	S	R	R	S	S	R	S	S	S	R	R	R	R	*Lr26+*
130	WH1254	R	R	R	R	R	R	R	R	R	R	S	R	R	R	R	R	R	R	R	R	R	*Lr19+*
131	DBW301	R	S	S	S	R	R	R	R	S	R	R	S	S	R	S	S	S	R	R	R	R	*Lr23+*
132	WH1270	R	S	S	S	R	R	R	S	S	R	R	S	S	R	S	S	S	R	R	R	R	*Lr23+*
133	HD2967	R	R	R	R	R	R	R	R	S	S	R	S	S	R	M	R	MX	R	R	R	R	*Lr23+*
134	PBW824	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R
135	UP3043	R	R	R	R	R	R	S	R	R	R	R	MS	S	R	R	R	R	R	R	R	R	*Lr13+*
136	DBW187	R	R	R	R	R	R	R	MS	MS	MX	R	S	S	R	R	R	R	R	R	R	R	*Lr23+1+*
137	PBW825	R	S	R	S	R	R	R	S	S	R	R	S	S	R	S	S	R	R	R	R	R	*Lr23+*
138	DBW303	R	R	R	S	R	R	MS	R	S	R	R	S	S	R	R	R	R	S	R	R	MS	*Lr13+*
139	DBW304	R	R	R	R	R	R	R	S	S	R	R	S	S	R	R	R	R	R	R	R	R	*Lr23+*
140	UP3042	R	R	R	R	R	R	R	R	S	R	R	R	R	R	R	R	R	R	R	NG	R	*Lr23+2a+*
141	DBW302	R	R	MX	MX	R	R	R	MX	S	R	R	R	R	R	MX	S	S	R	R	R	R	*Lr26+23+2a+*
142	PBW825	R	R	R	R	R	R	R	R	R	R	R	S	S	R	R	R	R	R	R	R	R	*Lr23+*
143	HD3347	R	S	R	S	R	R	R	S	S	R	R	S	S	R	S	S	R	R	S	MS	R	*Lr23+*

144	WH1223	R	S	R	S	R	R	S	R	R	R	R	S	S	R	R	R	R	R	R	R	R	*Lr13+*
145	KRL 19 (C)	R	R	MS	S	R	R	S	S	S	R	R	S	S	M	S	S	S	R	R	R	R	*Lr13+*
146	Kharchia 65	S	S	S	S	S	S	S	S	S	R	S	S	S	S	S	S	S	S	S	S	S	-
147	NW7060	R	R	R	R	R	R	NG	S	S	R	R	S	S	R	R	R	R	R	R	R	R	*Lr23+1+*
148	KRL 210(C)	R	MS	R	S	R	R	R	S	S	R	R	S	S	R	S	S	R	R	S	R	NG	*Lr23+*
149	WH1228	R	S	R	S	R	R	MX	S	R	R	R	S	S	R	MX	R	MS	R	R	R	R	*Lr13+*
150	NW7062	R	MX	R	R	R	R	R	R	MX	S	R	S	MS	R	MX	R	R	R	R	R	R	*Lr26+*
151	PBW 757 (C)	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R
152	WR544 (C)	R	S	R	S	R	R	S	S	S	S	R	S	S	R	R	R	R	R	R	R	R	*Lr13+1+*
153	HD3298	R	S	R	S	R	R	R	R	S	R	R	MX	R	R	MX	R	S	R	R	R	NG	*Lr23+*
154	HD3271	R	R	R	S	R	R	R	R	S	R	R	R	R	R	S	S	R	R	MS	R	R	*Lr23+*
155	DBW 14 (C)	R	S	R	S	R	R	R	S	S	R	R	S	S	R	S	R	S	R	R	R	R	*Lr23+*
156	DBW71 (C)	R	S	S	S	S	R	R	S	S	R	R	S	R	R	S	S	S	R	MX	R	R	- Seed
157	HI1621	R	S	R	S	R	R	S	S	R	R	R	S	S	S	R	R	R	R	R	R	R	*Lr13+*
158	PBW 797	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R

Annexure 3: Seedling response of AVT against the pathotypes of *Puccinia striiformis tritici* (wheat yellow rust) during 2018-19 at ICAR-IIWBR, RS, Shimla

S. No.	Variety/Line	PATHOTYPE																		Resistance/ *Yr* genes
		46S19	110S119	238S119	110S247	78S84	110S84	T	P	79S68	111S68	79S4	6S0	7S0	K	I	L	20A	N	
		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	
1	HPW349 (C)	S	S	S	S	R	S	S	S	R	R	R	R	R	S	R	S	R	R	*Yr2+*
2	VL907 (C)	S	S	S	S	R	R	R	R	R	R	R	R	R	R	R	R	R	R	*Yr9+*
3	HS507 (C)	R	S	S	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	*Yr9+*
4	HS652	S	S	S	S	MS	S	S	S	R	R	R	S	MS	S	R	S	R	R	-
5	HS562 (C)	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	seed
6	VL892 (C)	R	S	S	S	R	MS	MS	R	R	R	R	R	R	R	MS	S	R	R	*YrA+*
7	HS490 (C)	S	S	S	MS	R	R	MS	R	R	R	R	R	R	MS	R	R	R	R	*YrA+*
8	HPW468	S	S	S	S	R	S	S	S	R	S	R	R	R	S	R	S	R	R	*Yr2+*
9	HS673	S	S	S	S	R	S	R	R	R	R	R	R	R	R	R	R	R	R	*Yr9+*
10	VL3020	S	S	R	S	R	S	R	R	R	R	R	S	R	R	R	R	R	R	*Yr9+*
11	UP3041	S	S	S	R	S	S	S	S	R	S	S	S	R	R	R	S	S	R	-
12	HPW467	MS	S	MS	MS	R	R	MS	R	R	R	R	R	R	MR	R	R	R	R	*YrA+*
13	HS674	S	S	S	MS	R	R	R	R	R	R	R	R	R	R	R	R	R	R	*YrA+*
14	VL3019	MS	S	S	MR	R	MS	R	R	R	R	R	R	R	R	R	R	R	R	*Yr9+*
15	VL3021	S	S	S	R	R	S	S	S	R	R	R	R	R	S	R	S	R	R	*Yr2+*
16	WH1105 (C)	R	S	S	R	R	R	R	R	R	R	R	R	R	MS	R	R	R	R	*Yr2+*
17	HD3226 (I)(C)	S	S	R	S	R	MS	MS	S	R	R	R	R	R	S	R	S	R	R	*Yr2+*
18	HD 3086 (C)	S	S	MR	S	R	S	S	S	R	R	R	R	R	S	R	S	R	R	*Yr2+*
19	PBW820	R	MS	S	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	*Yr9+*
20	DBW221	S	S	S	S	S	S	S	S	MR	S	S	R	R	S	S	S	R	S	*Yr2+*
21	DBW222	R	S	S	R	R	S	R	R	R	R	MR	R	R	R	R	R	R	R	*Yr9+*
22	PBW550 (C)	S	S	S	S	S	S	R	R	R	R	R	R	R	R	R	R	R	R	*Yr9+*
23	PBW821	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	Resistant
24	HD2967 (C)	S	S	S	S	R	R	S	S	R	R	R	R	R	S	MS	S	R	R	*Yr2+*
25	NW7049	S	S	S	S	R	MS	S	MS	R	R	R	R	R	S	R	S	R	R	*Yr2+*
26	DDW621-50 (C)	S	S	S	S	R	MS	R	R	R	MS	R	R	R	R	R	R	R	R	-
27	DBW88 (C)	S	S	S	S	R	MS	R	R	R	R	R	R	R	R	R	R	R	R	*YrA+*
28	PBW752 (I)(C)	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	Resistant
29	DBW173 (C)	S	S	S	S	R	MR	R	R	R	R	R	R	R	R	R	R	R	R	*Yr9+A+*
30	WH1021 (C)	S	S	S	R	S	S	R	R	R	R	R	R	R	R	R	R	R	R	*Yr9+*
31	HD 3059 (C)	S	S	S	MS	MR	S	R	R	R	S	R	R	R	R	R	R	R	R	*Yr2+*
32	WH1124 (C)	S	S	S	S	R	MS	S	S	R	R	R	R	R	S	R	S	R	R	*Yr2+*
33	PBW771	MS	MR	R	S	S	R	R	R	R	R	R	R	R	R	R	R	R	R	*Yr9+*
34	HI1620 (I) (C)	S	S	S	S	R	R	S	MS	R	R	R	R	R	S	R	S	R	R	*YrA+*
35	PBW796	S	S	S	S	S	S	S	S	S	S	S	S	MR	S	R	S	MS	R	-
36	HI1628	S	S	S	S	S	S	S	S	S	R	R	R	R	S	R	S	R	R	*Yr2+*
37	WH1142	S	S	S	S	S	MS	R	R	R	R	R	R	R	R	R	R	R	R	*Yr9+*
38	HD3043(C)	R	S	MS	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	*Yr9+A+*
39	PBW644 (C)	R	S	S	S	MS	S	R	R	R	R	MS	R	R	MR	R	R	S	S	*Yr2+*
40	HD3237 (C)(I)	S	S	S	S	S	S	S	S	R	S	R	MR	R	S	R	S	R	S	*Yr2+*
41	BRW 3806	R	S	S	MS	R	R	S	S	R	R	R	R	R	MS	R	MS	R	R	*Yr2+*

42	NIAW3170	S	S	S	S	S	S	S	S	S	S	R	MX	MS	S	MS	S	R	S	-
43	WH1080 (C)	S	S	S	S	S	MS	S	S	S	S	R	R	S	S	R	S	R	S	-
44	HD3249(C)	MS	S	S	S	R	S	S	S	R	MS	R	R	R	MS	R	S	R	R	*Yr2+*
45	HD2733 (C)	S	S	S	S	R	S	R	R	R	R	R	R	R	R	R	R	R	R	*Yr9+18+*
46	PBW781	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	Resistant
47	DBW257	S	S	MS	S	R	S	S	S	R	R	R	R	R	S	R	S	R	R	*Yr2+*
48	DBW39 (C)	MS	S	S	S	MS	R	R	R	R	R	R	R	R	R	R	R	R	R	*Yr9+*
49	HD3277	S	S	MS	S	R	MS	S	S	MX	R	R	R	R	S	R	S	R	R	*Yr2+*
50	RAJ4529	S	S	S	S	S	S	S	S	S	MS	S	S	MS	S	MS	S	MS	S	-
51	DBW187 (I) (C)	S	S	S	S	S	R	S	S	R	R	R	R	R	S	R	S	R	R	*Yr2+*
52	WH1239	S	S	S	S	R	R	S	S	R	R	R	R	R	S	R	S	R	R	*YrA+*
53	K0307 (C)	MS	S	S	S	S	S	S	S	S	S	R	S	S	S	R	S	R	S	*Yr2+*
54	HD2967 (C)	S	S	S	S	R	R	S	S	R	R	R	R	R	S	R	S	S	R	*Yr2+*
55	K1317 (C)	MS	S	S	S	R	R	MR	R	R	R	R	R	R	MX	R	MS	R	R	*Yr9+A+*
56	HI1612 (C)	S	S	S	S	MS	MS	MS	S	MR	MS	R	S	R	MR	R	S	R	MS	*Yr2+*
57	HD3293	S	S	S	S	R	R	MS	S	R	R	R	R	R	MS	R	S	R	R	*Yr2+*
58	HD3171 (C)	MR	MS	R	MS	R	R	R	R	R	R	R	R	R	R	R	R	R	R	*Yr2+*
59	HD2888 (C)	S	MS	S	S	R	R	S	MS	MR	R	R	R	R	MR	MS	S	R	R	*Yr2+*
60	DBW252	MR	S	S	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	*YrA+*
61	K8027 (C)	MS	S	S	MS	R	MR	S	MS	R	R	R	R	R	MS	R	S	R	R	*Yr2+*
62	DBW 273	S	S	S	S	MS	S	S	S	MS	S	S	R	R	S	R	S	MS	S	*Yr2+*
63	HI8713 (d) (C)	MR	S	S	S	S	MS	S	S	MS	S	R	S	S	MS	S	MS	S	R	-
64	NIDW1158(d)	R	R	R	R	R	MR	R	R	R	R	R	R	R	R	R	R	R	R	Resistant
65	HI8811 (d)	MS	S	S	MS	S	MS	MS	S	R	R	R	S	MS	MR	MS	MR	R	R	-
66	HD3343	S	S	S	S	MS	S	S	S	MS	S	R	R	R	MS	R	S	MR	R	*Yr2+*
67	GW322 (C)	S	S	S	S	MS	S	S	S	MR	S	R	S	MS	S	MS	S	R	R	*Yr2+*
68	HI1544 (C)	S	S	S	S	MS	S	S	MS	S	S	S	MS	R	MS	MS	S	S	S	*Yr2+*
69	HI8737 (C)(d)	MS	MS	S	S	MS	MR	S	S	R	R	R	S	S	MS	MS	S	S	R	*Yr2+*
70	HI8812 (d)	MS	S	S	S	S	S	MS	S	S	MS	R	R	R	S	R	R	MS	R	*Yr2+*
71	GW1348 (d)	MS	S	S	S	S	S	S	S	MS	R	R	R	R	MS	R	S	MS	MR	*Yr2+*
72	DDW49 (d)	MS	S	S	S	S	MS	S	S	R	MS	R	S	MS	MS	S	MS	MR	MR	-
73	PBW822	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	Resistant
74	HD3345	MS	S	MS	MS	R	R	R	MR	R	R	R	R	R	R	R	MR	R	R	-
75	DDW48(d)	MS	S	S	S	S	MR	S	S	R	MS	MS	R	R	MS	R	MS	R	R	-
76	HI8627 (d) (C)	S	S	S	MS	S	S	S	S	R	R	R	MS	R	MR	R	R	MS	R	*Yr2+*
77	DBW110(C)	S	S	S	S	S	S	S	S	R	S	MS	R	MR	S	R	S	R	MS	*Yr2+*
78	UAS466 (d)	R	S	S	MS	R	MS	MS	S	R	R	R	MS	MS	MR	R	MS	MS	R	-
79	MP3288 (C)	S	S	S	MS	R	R	S	S	R	S	R	MR	MR	MS	R	S	R	R	*Yr2+*
80	DBW277	S	S	S	S	R	R	S	S	R	R	R	R	R	S	R	S	R	R	*Yr2+*
81	DDW47 (d)	MS	S	MS	R	R	S	S	R	R	R	R	MS	MS	R	R	R	R	R	-
82	HD2932 (C)	S	S	S	MS	S	S	S	S	MR	S	R	R	MR	S	R	S	R	R	-
83	HD2864 (C)	S	S	S	S	S	S	MS	MS	MR	MS	R	R	MS	MS	R	S	S	R	*Yr2+*
84	MP3336 (C)	S	S	S	S	MS	S	MS	S	MS	S	MS	MS	R	MS	R	S	MS	MS	-
85	MP4010 (C)	S	S	S	S	S	S	S	S	S	S	MS	R	R	S	R	S	MS	MS	*Yr2+*
86	CG1029	S	S	S	S	S	S	S	MS	R	S	R	R	MS	S	R	S	MR	R	-
87	UAS3002	S	S	S	S	R	S	R	R	R	R	R	R	R	R	R	R	R	R	*Yr9+*
88	HI1633	S	S	S	S	S	S	R	R	R	R	R	R	R	R	R	R	R	R	*Yr9+*
89	HI1634	MS	S	S	S	S	S	R	R	R	R	R	R	R	R	R	R	R	R	*Yr9+*
90	HI8808 (d)	S	S	S	S	S	S	S	S	R	R	R	S	S	MR	MS	S	R	MR	-
91	HI8807 (d)	S	MS	MS	MS	R	MR	MR	R	R	MS	MR	MS	MS	R	MR	MR	R	R	-
92	PBW823	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	Resistant

93	UAS 428 (d) (C)	S	S	S	S	S	S	S	S	MS	S	MS	S	MR	S	R	S	S	S	-
94	DDW49 (d)	S	S	S	S	S	MS	S	S	R	S	R	S	MS	MS	MS	MR	R	R	-
95	UAS3001	R	S	S	S	R	R	R	R	R	S	R	R	R	R	R	R	R	R	*Yr9+*
96	MACS3949(d)(C)	R	MS	S	MS	R	R	S	S	R	R	R	S	MR	R	R	R	R	R	*Yr2+*
97	MACS6222 (C)	R	S	S	MS	S	S	R	R	MR	MR	R	R	MR	R	R	MS	R	R	-
98	GW322 (C)	S	S	S	S	MS	S	S	S	R	S	R	MR	MR	S	R	S	R	R	*Yr2+*
99	DDW48 (d)	S	S	S	S	S	S	S	S	MS	S	S	S	S	S	R	S	S	S	-
100	MACS6478	MS	S	S	S	R	R	R	R	R	S	R	MR	R	R	R	MR	R	R	*Yr2+*
101	HD3343	S	S	S	S	S	MS	S	S	MR	S	R	R	R	S	MR	S	MS	R	*Yr2+*
102	WHD 963 (d)	R	S	MS	MR	R	R	R	R	R	S	R	R	R	R	R	R	R	R	-
103	HI8807(d)	MS	S	MS	S	MR	MS	R	MX	R	R	R	S	MR	R	R	R	R	R	-
104	HI 1633	R	S	S	S	S	S	R	R	R	R	R	R	R	R	R	R	R	R	*Yr9+*
105	UAS3002	R	S	S	S	R	R	R	R	R	R	R	R	R	R	R	R	R	R	*Yr9+*
106	RAJ4083(d)	S	S	S	MS	S	MS	MS	S	R	S	R	R	R	MS	R	S	MS	MR	*Yr2+*
107	HD2932 (C)	S	S	S	S	S	S	S	S	R	S	R	R	MS	S	MR	S	MX	R	-
108	GW509	S	S	S	S	MS	S	S	S	R	S	R	R	MS	S	S	S	MR	R	-
109	HD3090 (C)	S	S	S	S	S	S	R	R	R	R	R	R	R	R	R	R	R	R	*Yr9+*
110	NIAW3170	S	S	S	S	S	S	S	S	R	R	S	S	R	S	MS	S	R	R	-
111	GW1346(d)	S	S	S	S	S	S	S	S	MS	S	MS	S	S	S	MS	S	S	S	-
112	Macs 4058(d)	S	S	S	S	S	S	S	S	S	S	S	S	MS	S	MS	S	S	S	-
113	DBW93 (C)	S	S	S	S	S	S	R	R	R	R	R	R	R	R	R	R	R	R	*Yr9+*
114	HI8805 (d)	S	S	S	S	S	MR	MS	S	MS	R	R	S	S	R	R	R	R	R	-
115	AKDW2997-16 (d) (C)	S	S	S	S	S	S	S	S	MS	MS	MS	R	S	S	S	S	S	S	-
116	Macs6695	S	S	S	S	MS	S	S	MS	MR	S	R	MR	S	S	MR	S	R	MS	-
117	UAS446 (d)(C)	S	S	S	S	R	MR	S	MS	R	R	R	R	S	R	MS	MR	MR	R	-
118	HI1605 (C)	R	S	S	S	R	R	R	R	R	R	R	R	R	R	R	R	R	R	*Yr2+*
119	Macs 6696	S	S	S	S	S	S	S	S	S	S	MS	MS	MS	S	MR	S	R	R	-
120	NIDW1149 (d)	R	S	R	S	MS	R	S	MS	R	R	MS	R	R	S	MS	R	S	R	-
121	HI8802 (d)	R	MR	MX	MS	MS	R	R	R	R	R	R	R	R	R	R	R	R	R	-
122	DDK1029 (C)	MS	S	S	MS	MS	MS	MX	S	MS	MS	MS	MS	MS	MS	MS	MS	S	MS	-
123	Macs5052	MS	S	S	MS	MS	MS	S	MS	MR	MS	MS	R	R	MS	R	MS	MR	MR	-
124	Macs6222 (C)	S	S	S	MS	R	S	R	R	R	R	R	R	R	R	R	S	R	R	-
125	DDK1056	MS	S	S	MS	R	MS	S	MS	R	MS	R	R	MR	MS	R	MS	MR	R	*Yr2+*
126	HW1098(C)	MS	S	S	MS	R	MS	MS	R	MR	R	R	R	R	R	R	R	R	R	*Yr2+*
127	MACS5053	MS	S	S	MS	MS	MS	MS	S	R	MS	MR	R	R	MS	R	MS	MR	MR	*Yr2+*
128	DDK1057	S	S	S	S	S	S	S	S	NG	NG	S	S	S	R	S	S	S	S	-
129	HD3317	S	S	S	S	S	S	R	R	R	R	R	R	S	R	R	R	R	R	*Yr9+*
130	WH1254	S	S	S	S	R	S	S	S	R	R	R	R	R	S	R	S	R	S	*Yr2+*
131	DBW301	R	R	R	R	S	R	R	R	R	R	R	R	R	S	R	R	R	R	-
132	WH1270	MS	S	S	S	R	MS	S	S	R	R	R	R	R	S	R	S	R	R	*Yr2+*
133	HD2967	S	S	S	S	R	R	S	S	R	R	R	R	R	S	R	S	R	R	*Yr2+*
134	PBW824	MS	S	S	S	S	S	S	S	R	R	R	R	R	MS	R	MS	R	R	*Yr2+*
135	UP3043	MS	S	S	S	R	MS	S	S	S	MS	S	R	R	S	R	S	R	R	-
136	DBW187	MS	S	S	S	R	MR	S	S	R	S	R	R	R	S	R	S	R	R	*Yr2+*
137	PBW825	S	S	S	S	R	S	S	S	R	R	R	R	R	S	R	S	R	R	*Yr2+*
138	DBW303	MS	S	S	MS	R	MR	MR	MS	R	R	R	R	R	MS	R	MS	R	R	*YrA+*
139	DBW304	S	S	S	S	R	MR	S	S	R	S	R	R	R	S	R	S	R	R	*Yr2+*
140	UP3042	MS	S	S	R	R	R	R	MS	S	S	R	R	R	MR	R	R	R	R	*Yr2+*
141	DBW302	S	S	S	R	R	S	R	R	R	R	R	R	R	R	R	R	R	R	*Yr9+*
142	PBW825	S	S	S	S	R	R	MS	R	R	MR	R	R	R	MS	R	R	R	R	*Yr2+*
143	HD3347	S	S	S	S	MS	S	S	S	R	MR	R	S	R	S	R	S	MS	R	-

144	WH1223	S	S	S	S	MS	S	S	S	MS	MS	R	MR	R	S	R	S	MR	R	*Yr2+*
145	KRL 19 (C)	MS	R	S	S	S	R	S	R	R	S	S	R	S	MS	MS	R	R	R	-
146	Kharchia 65	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	-
147	NW7060	S	S	S	S	MS	R	S	S	R	S	R	R	R	MS	S	S	R	R	*Yr2+*
148	KRL 210(C)	S	S	S	S	R	MS	S	S	S	MS	R	R	R	MS	R	S	R	R	*Yr2+*
149	WH1228	S	S	S	S	MS	MS	S	S	R	S	R	R	R	S	R	S	R	R	*Yr2+*
150	NW7062	S	S	S	S	MR	S	R	R	R	R	R	R	R	R	R	R	R	R	*Yr9+*
151	PBW 757 (C)	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	Resistant
152	WR544 (C)	S	S	S	S	S	S	S	S	R	MS	R	MS	MS	S	R	S	MR	R	-
153	HD3298	S	S	S	S	MS	MR	MS	S	R	R	R	R	R	S	R	R	MS	R	*Yr2+*
154	HD3271	R	R	R	S	R	R	R	MR	R	R	R	R	R	R	R	R	R	R	-
155	DBW14 (C)	MS	S	S	S	MR	MS	MR	MR	MS	S	R	MR	R	R	R	R	MS	MS	*Yr2+*
156	DBW71 (C)	S	S	R	S	S	S	R	S	R	MR	R	R	R	R	MS	S	R	R	-
157	HI1621	S	S	S	S	S	S	S	S	R	S	MS	R	R	S	R	S	S	MS	-
158	PBW 797	R	S	S	S	R	R	R	R	R	MS	R	R	R	R	R	R	R	R	-

Annexure 4: Reaction of AVT wheat genotypes at seedling stage against pathotypes of stem rust during 2018-19 at Mahabaleshwar

S. No.	Entries	Reaction against Stem rust pathotypes											
		Pt 11	Pt 24A	Pt 40	Pt 40A	Pt 42	Pt 42B	Pt 117A	Pt 117-2	Pt 117-3	Pt 117-6	Pt 122	Pt 295
CZ													
1	HI8713(d) (C)	R	R	R	R	S	S	R	R	R	R	R	R
2	NIDW 1158 (d)	R	R	R	R	R	R	R	R	R	R	R	R
3	HI 8811 (d)	R	R	R	R	R	R	R	R	R	R	R	R
4	HD3343[M]	S	S	S	S	R	R	R	S	R	R	R	S
5	GW322 (C)	S	S	R	S	S	S	R	R	R	R	R	R
6	HI1544 (C)	R	R	R	R	R	R	R	R	R	NG	R	R
7	HI8737(d) (C)	R	R	R	S	S	S	R	R	R	R	R	R
8	HI 8812 (d)	R	R	R	R	R	R	S	R	R	S	R	R
9	GW 1348 (d)	R	R	R	R	R	R	S	R	NG	R	R	R
10	DDW 49 (d)	R	S	S	S	R	R	R	R	R	NG	R	R
11	PBW 822[B]	R	R	R	R	R	R	R	R	R	R	R	R
12	HD 3345[B]	S	R	R	S	S	S	R	R	R	S	S	R
13	DDW 48 (d)	R	R	R	R	R	R	R	R	R	R	R	R
14	HI8627(d) (C)	R	R	R	S	R	R	R	R	R	R	R	R
15	DBW110 (C)	R	R	R	R	R	R	R	R	R	R	R	R
16	UAS 466(d)*	R	R	R	R	R	R	R	R	R	R	R	R
17	MP3288 (C)	R	R	R	R	R	R	R	R	R	R	R	R
18	DBW 277	R	R	R	R	S	S	R	S	R	S	R	R
19	DDW 47(d)*[Q]	R	R	R	R	R	R	R	R	R	R	R	R
20	HD2932 (C)	R	R	R	S	S	S	S	R	R	NG	R	R
21	HD2864 (C)	R	R	R	R	R	R	NG	R	R	R	R	R
22	MP3336 (C)	S	R	R	S	R	R	R	S	R	R	R	R
23	MP4010 (C)	R	R	R	R	R	R	S	R	R	R	R	R
24	CG1029	R	R	R	R	R	R	S	R	NG	R	R	R
25	UAS3002	R	R	R	R	R	R	R	R	R	R	R	R
26	HI1633	R	R	R	R	R	R	R	R	R	R	R	R
27	HI1634	R	R	R	R	R	R	R	R	R	R	R	R
28	HI8808 (d)	R	R	R	R	S	S	R	R	R	R	R	R
29	HI8807 (d)	R	R	R	R	R	R	R	R	R	R	S	R
PZ													
30	PBW 823[B]	R	R	R	R	R	R	R	R	R	R	S	R
31	UAS428 (d) (C)	R	R	R	R	R	R	NG	R	R	R	R	R
32	DDW 49 (d)	R	R	S	S	S	S	R	S	R	S	R	S

33	UAS 3001	R	R	R	R	R	R	R	R	R	R	R	R
34	MACS3949 (d) (C)	R	R	R	R	S	S	R	R	NG	R	R	R
35	MACS6222 (C)	R	R	R	R	NG	NG	R	R	R	R	R	R
36	GW 322 (C)	S	R	R	R	S	S	R	S	R	S	R	R
37	DDW 48 (d)	R	R	R	S	R	R	R	R	R	R	R	S
38	MACS6478 (C)	S	R	R	R	S	S	R	R	S	R	R	R
39	HD3343^{M}	R	R	R	R	R	R	R	R	S	R	R	R
40	WHD 963 (d)	R	R	R	R	R	R	R	R	R	NG	R	R
41	HI8807(d)	R	R	R	R	R	R	R	R	NG	R	S	R
42	HI1633	R	R	R	R	R	R	R	R	NG	R	R	R
43	UAS 3002	R	R	R	R	R	R	R	R	R	R	R	R
44	Raj4083 (C)	S	R	R	S	S	S	R	R	R	R	R	S
45	HD2932 (C)	R	R	R	S	S	S	R	S	R	S	R	R
46	GW509	R	R	R	R	R	R	R	R	R	R	R	R
47	HD3090 (C)	R	R	R	R	R	R	R	R	R	R	R	R
48	NIAW 3170*	R	R	R	R	R	R	R	R	R	R	R	R
49	GW 1346(d)*	R	R	R	R	R	R	R	R	R	R	R	R
50	MACS 4058(d)*	R	R	R	R	R	R	R	R	R	S	R	R
51	DBW93 (C)	R	R	S	R	R	R	R	R	R	R	R	R
52	HI 8805(d)*	R	R	R	R	R	R	S	R	R	R	R	R
53	AKDW2997-16(d) (C)	S	R	R	S	S	S	R	S	R	S	S	R
54	MACS 6695*	R	R	R	R	R	R	R	R	R	R	S	R
55	UAS446(d) (C)	R	R	R	R	S	S	S	R	R	R	R	R
56	HI1605 (C)	R	R	R	R	R	R	R	S	R	R	R	R
57	MACS 6696*	R	R	R	S	S	S	R	R	R	S	R	R
58	NIDW 1149(d)	R	R	R	R	R	R	S	R	R	NG	R	R
59	HI 8802(d)*	R	R	R	R	R	R	R	R	R	R	R	R

Annexure 5: Reaction of AVT wheat genotypes at seedling stage against pathotypes of leaf rust during 2018-19 at Mahabaleshwar

S. No.	Entries	Reaction against leaf rust pathotypes									
		Pt 12-2	Pt 12-4	Pt 12-5	Pt 17	Pt 77-4	Pt 77-9	Pt 104	Pt 104B	Pt 104-1	Pt 104-2
CZ											
1	HI8713(d) (C)	R	S	S	R	R	R	R	R	R	R
2	NIDW 1158 (d)	R	S	S	R	R	R	S	R	R	R
3	HI 8811 (d)	S	S	S	R	S	R	R	R	R	S
4	HD3343[M]	R	R	S	R	R	S	R	R	R	R
5	GW322 (C)	R	S	R	R	R	R	R	R	R	R
6	HI1544 (C)	R	S	R	R	R	R	R	R	R	R
7	HI8737(d) (C)	R	S	S	R	R	R	R	R	R	R
8	HI 8812 (d)	R	R	R	R	R	R	R	R	R	R
9	GW 1348 (d)	R	S	S	R	R	R	R	R	R	R
10	DDW 49 (d)	R	R	S	R	R	R	NG	R	R	R
11	PBW 822[B]	R	R	R	R	R	R	R	R	R	R
12	HD 3345[B]	R	S	S	S	R	R	R	R	R	R
13	DDW 48 (d)	R	S	R	R	R	R	R	R	R	R
14	HI8627(d) (C)	R	S	R	R	R	R	R	R	R	R
15	DBW110 (C)	R	S	R	S	R	S	S	R	R	R
16	UAS 466(d)*	R	S	S	R	R	R	R	R	R	R
17	MP3288 (C)	R	S	R	R	R	R	R	R	R	R
18	DBW 277	R	S	S	R	R	R	R	R	R	R
19	DDW 47(d)*[Q]	R	R	S	R	R	R	R	R	R	R
20	HD2932 (C)	R	S	S	S	R	R	S	S	R	S
21	HD2864 (C)	R	R	R	R	R	R	R	R	R	R
22	MP3336 (C)	R	S	R	R	R	R	R	R	R	R
23	MP4010 (C)	R	S	R	R	R	R	R	R	R	R
24	CG1029	NG	R	R	R	R	R	R	R	R	R
25	UAS3002	R	R	R	R	R	R	R	R	R	R
26	HI1633	R	R	R	S	R	R	R	R	R	R
27	HI1634	R	R	R	R	R	R	R	R	R	R
28	HI8808 (d)	R	R	S	R	R	R	R	R	R	R
29	HI8807 (d)	R	R	S	R	R	R	R	R	R	R
PZ											
30	PBW 823[B]	R	R	R	R	R	R	S	R	R	R
31	UAS428 (d) (C)	NG	S	R	NG	R	R	R	R	R	R
32	DDW 49 (d)	R	S	S	S	S	R	S	S	R	S

33	UAS 3001	R	S	R	R	R	R	R	R	R	R
34	MACS3949 (d) (C)	R	R	S	R	R	R	R	R	R	R
35	MACS6222 (C)	R	R	R	R	R	R	R	R	R	R
36	GW 322 (C)	S	S	R	S	R	R	R	R	S	R
37	DDW 48 (d)	R	S	R	R	R	R	R	R	R	R
38	MACS6478 (C)	R	R	R	R	R	R	R	R	S	R
39	HD3343^{M}	R	S	R	S	R	R	R	R	S	R
40	WHD 963 (d)	R	S	S	R	R	R	R	R	R	R
41	HI8807(d)	R	R	R	R	R	NG	R	R	R	R
42	HI1633	R	R	R	R	R	R	R	R	R	R
43	UAS 3002	R	S	S	S	R	R	R	R	R	R
44	Raj4083 (C)	S	S	S	R	R	R	R	R	S	R
45	HD2932 (C)	S	S	S	S	S	S	S	S	S	S
46	GW509	R	R	R	R	R	R	R	R	R	R
47	HD3090 (C)	R	R	R	R	R	R	R	R	R	R
48	NIAW 3170*	R	S	R	R	R	R	R	R	R	R
49	GW 1346(d)*	S	NG	S	R	R	R	R	R	S	R
50	MACS 4058(d)*	S	S	R	R	R	R	R	R	R	R
51	DBW93 (C)	R	R	S	R	R	R	R	R	R	R
52	HI 8805(d)*	S	R	R	R	R	S	S	R	R	S
53	AKDW2997-16(d) (C)	R	S	S	R	R	R	S	R	R	R
54	MACS 6695*	S	S	S	S	S	R	S	R	R	S
55	UAS446(d) (C)	S	S	S	R	R	R	NG	R	S	R
56	HI1605 (C)	R	S	R	R	S	R	S	S	S	R
57	MACS 6696*	R	S	S	S	S	R	NG	S	S	S
58	NIDW 1149(d)	R	S	S	R	R	R	R	R	S	S
59	HI 8802(d)*	R	S	S	R	R	R	NG	R	R	R

Annexure 6: Reaction of NIVT wheat genotypes at seedling stage against pathotypes of stem rust during 2018-19 at Mahabaleshwar

S. No.	Entries	Reaction against Stem rust pathotypes											
		Pt 11	Pt 24A	Pt 40	Pt 40A	Pt 42	Pt 42B	Pt 117A	Pt 117-2	Pt 117-3	Pt 117-6	Pt 122	Pt 295
NIVT-4													
1	UAS470	R	S	R	S	S	S	R	S	S	R	S	S
2	GW1351	R	R	R	R	R	R	R	R	R	R	R	R
3	HI8737 (C)	R	R	S	R	R	R	S	R	R	R	R	R
4	MPO1364	R	NG	R	S	R	R	S	R	R	R	S	R
5	DDW51	R	R	R	S	R	R	R	S	R	R	S	R
6	GW1352	R	NG	R	R	R	R	R	R	R	S	R	R
7	HI8822	R	R	R	S	R	R	R	R	R	R	R	R
8	UAS471	R	R	R	R	S	R	S	R	R	R	S	R
9	PDW356	R	R	S	R	R	R	S	S	R	S	R	R
10	DDW50	R	R	R	S	R	S	R	S	R	S	S	R
11	MPO1366	R	R	R	R	R	R	R	R	R	R	R	NG
12	HI8820	R	R	R	R	R	R	R	R	R	R	R	R
13	NIDW1316	R	R	R	R	S	R	S	R	R	R	R	R
14	WHD964	R	S	NG	S	R	S	S	S	S	R	S	S
15	MACS4091	R	R	R	R	R	R	S	R	R	R	S	R
16	MACS3949 (C)	R	R	R	S	R	R	R	R	R	R	R	R
17	HI8819	R	R	R	S	R	R	R	R	R	R	R	R
18	HI8713 (C)	R	R	R	R	R	R	S	R	R	R	R	R
19	NIDW1302	R	R	R	R	R	R	R	R	R	R	R	R
20	HI8821	R	R	R	R	R	R	R	R	R	S	R	R
21	RKD339	S	R	R	R	R	R	NG	S	R	NG	R	NG
22	NIDW1293	R	R	R	R	R	R	R	R	R	R	R	R
23	MACS4090	R	R	R	R	R	R	R	R	R	R	R	R
24	MPO1365	R	R	R	NG	NG	R	R	R	NG	R	R	R
25	HI8818	R	NG	R	R	R	R	S	R	R	R	R	R
NIVT- 5B													
26	MACS6736	R	R	R	R	S	S	S	S	R	R	S	R
27	MACS4087(d)	R	R	R	R	R	R	R	R	R	R	S	R
28	MPO1357(d)	R	R	R	S	R	R	S	R	R	S	R	R
29	GW520	R	R	R	R	R	R	R	R	R	R	R	NG
30	GW1353(d)	R	R	R	R	R	S	R	R	S	S	R	NG
31	UAS472(d)	R	R	R	R	S	R	R	R	R	R	R	R
32	HI1605 (C)	S	R	R	R	R	R	R	R	R	R	R	R

33	HI8627(d) (C)	R	R	R	R	R	R	R	R	R	S	S	R
34	HI1645	R	R	R	R	R	R	R	R	R	R	R	R
35	UAS446(d) (C)	R	R	R	R	R	R	R	R	R	R	R	R
36	UAS3009	S	R	R	R	R	R	S	R	R	S	S	R
37	UAS3010	R	R	R	S	R	S	S	R	R	S	S	S
38	DBW110 (C)	R	R	R	R	R	R	R	R	R	R	R	NG
39	CG1033	R	R	S	S	R	R	S	R	R	S	S	R
40	HI1643	R	R	R	R	R	R	R	R	R	R	R	R
41	HI1644	R	R	R	R	R	R	R	R	R	R	R	R
42	NIAW3643	S	R	R	S	R	R	R	R	R	S	S	R
43	NIAW3624	R	NG	R	R	R	R	R	R	R	R	R	R
44	HI8823(d)	R	R	R	R	R	R	R	R	R	R	R	R
45	HI8824(d)	R	R	R	R	R	R	S	R	R	R	R	R
46	DBW300	R	R	R	S	R	R	R	R	R	R	R	R
47	DDW52(d)	R	R	R	R	R	R	R	R	R	S	R	R
48	MP3512	S	R	R	R	R	S	R	S	R	S	R	R
49	MP1356	S	S	R	R	R	R	R	R	R	S	R	R
50	MP1358	R	R	R	R	R	R	R	R	R	S	R	NG

Annexure 7: Reaction of NIVT wheat genotypes at seedling stage against pathotypes of leaf rust during 2018-19 at Mahabaleshwar

S. No.	Entries	Reaction against leaf rust pathotypes									
		Pt 12-2	Pt 12-4	Pt 12-5	Pt 17	Pt 77-4	Pt 77-9	Pt 104	Pt 104B	Pt 104-1	Pt 104-2
NIVT-4											
1	UAS470	R	S	R	R	R	R	R	R	R	R
2	GW1351	R	S	R	R	R	R	R	R	R	R
3	HI8737 (C)	R	R	S	R	R	R	R	R	R	R
4	MPO1364	R	S	S	R	S	R	R	S	R	R
5	DDW51	R	S	R	R	R	R	R	S	R	R
6	GW1352	R	S	S	R	R	R	R	S	R	R
7	HI8822	R	R	R	R	R	R	R	R	R	R
8	UAS471	S	S	S	R	R	R	S	R	R	S
9	PDW356	R	S	R	R	R	R	R	S	R	R
10	DDW50	R	R	S	R	R	R	R	R	R	R
11	MPO1366	R	S	S	R	R	R	R	R	R	R
12	HI8820	R	S	R	R	R	S	R	R	R	R
13	NIDW1316	R	S	S	R	R	R	R	R	R	R
14	WHD964	R	R	S	R	R	R	R	R	S	R
15	MACS4091	R	S	S	R	R	R	NG	S	R	R
16	MACS3949 (C)	R	R	S	NG	R	R	R	R	R	R
17	HI8819	R	S	S	R	R	R	R	R	S	R
18	HI8713 (C)	S	S	S	R	R	R	R	R	R	R
19	NIDW1302	S	R	S	R	R	R	R	R	R	R
20	HI8821	S	S	S	R	R	R	R	R	S	S
21	RKD339	R	S	S	R	S	R	R	R	R	R
22	NIDW1293	R	S	S	R	R	R	S	S	R	R
23	MACS4090	R	S	R	R	R	R	NG	S	R	R
24	MPO1365	R	S	S	R	R	R	R	R	R	R
25	HI8818	S	S	S	R	R	R	R	R	R	R
NIVT- 5B											
26	MACS6736	S	S	S	S	S	S	R	S	S	S
27	MACS4087(d)	R	S	R	R	R	S	R	R	R	R
28	MPO1357(d)	S	S	S	R	R	R	R	R	S	R
29	GW520	R	S	R	R	R	R	R	R	R	R
30	GW1353(d)	R	NG	R	R	R	R	R	R	R	R
31	UAS472(d)	R	S	S	R	R	R	R	R	R	R
32	HI1605 (C)	R	S	S	R	R	R	S	S	R	R

33	HI8627(d) (C)	R	S	S	R	R	R	S	R	R	R
34	HI1645	R	R	R	R	R	R	R	R	R	R
35	UAS446(d) (C)	R	S	S	R	R	R	R	R	R	R
36	UAS3009	R	S	R	R	R	S	R	R	S	R
37	UAS3010	S	S	S	S	R	R	R	S	S	R
38	DBW110 (C)	R	S	S	S	R	S	S	S	S	R
39	CG1033	R	R	S	R	R	R	R	R	R	R
40	HI1643	R	R	R	R	R	R	R	R	R	R
41	HI1644	R	S	R	R	R	R	R	R	R	R
42	NIAW3643	R	S	S	R	R	R	R	R	R	R
43	NIAW3624	R	S	R	R	R	R	R	R	R	R
44	HI8823(d)	R	S	S	R	R	S	R	S	S	S
45	HI8824(d)	S	S	S	R	R	R	R	R	R	R
46	DBW300	R	S	R	R	R	R	R	R	R	R
47	DDW52(d)	R	S	R	R	R	R	R	R	R	R
48	MP3512	S	S	R	S	S	S	S	S	S	S
49	MP1356	R	R	R	S	R	S	R	R	S	R
50	MP1358	R	S	R	S	R	R	S	R	S	R

Annexure 8: Incidence of rusts in SAARC Wheat Disease Monitoring Nursery in India during 2018-19.

S. No.	Varieties	Yellow rust													Brown rust												Black
		ABO	ALM	DEL	DKN	DUR	GUR	JAM	KAT	LAN	LUD	PAN	RAJ	ROP	ALM	DEL	DUR	FAZ	GUR	JAM	KAT	LAN	LUD	PAN	PUS	RAJ	WEL	WEL
1	Annapurna-1	TS	40S	0	40S	0	40S	60S	60S	40S	60S	50S	40S	40S	10S	0	0	10S	0	40S	20S	0	0	90S	0S	5S	10M	0
2	WL1562	5S	10S	0	20S	0	20S	60S	20S	20S	60S	30S	20S	20S	10S	5S	0	0	TS	10MS	20S	TS	5S	60S	10S	0	10M	0
3	HD2204	TS	80S	0	40S	0	5S	40S	10MS	5S	60S	60S	20S	5S	10S	0	0	10S	TS	10MS	5MS	TS	20S	80S	20S	0	10MS	10MS
4	PBW343	10S	80S	40S	60S	20S	60S	60S	60S	60S	80S	0	40S	80S	0	0	0	10S	10S	5S	5MS	5s	0	40S	40S	0	10MS	0
5	HD2687	5S	80S	10S	60S	0	10S	20S	60S	10S	60S	20S	5S	10S	0	0	0	10S	0	0	0	0	0	60S	5S	0	10M	0
6	HD2189	TS	0	0	20S	0	40S	40S	20MS	40S	10S	10S	10S	40S	60S	0	0	0	TS	0	5S	TS	10S	60S	0	0	5M	0
7	HP1633	10S	60S	0	40S	0	40S	60S	60S	40S	60S	30S	20S	40S	TS	0	0	0	0	5MS	0	0	0	0	0	0	0	10MS
8	RAJ3765	20S	60S	0	60S	0	60S	60S	40S	60S	80S	20S	10S	60S	10S	0	0	10S	0	0	0	0	0	40S	30s	TMS	5MR	0
9	PBW660	0	0	0	20S	0	5S	10MS	5MR	5S	10S	0	0	TS	TS	0	0	0	0	TMS	TMS	0	0	20S	0	0	5MR	0
10	PAK81	5S	60S	0	40S	0	60S	40S	80S	60S	60S	TR	20S	60S	10S	0	0	10S	0	40S	20S	0	0	90S	0	10S	10MS	0
11	Punjab85	20S	10S	0	20S	0	40S	20MS	20S	40S	10S	0	10S	40S	20S	0	0	TS	5S	5MS	0	5S	10S	30S	0	0	10MS	0
12	Chakwal86	5S	5S	0	20S	0	20S	5MS	10S	20S	60S	0	TMS	20S	10S	0	0	TS	0	0	0	0	0	TR	0	0	5MS	0
13	Faisalabad85	TS	60S	0	60S	TS	80S	40S	40S	80S	60S	30S	20S	60S	20S	0	0	10S	10S	40S	20S	10S	0	60S	30S	10S	10M	0
14	Inquilab91	5S	40S	0	60S	0	60S	40S	40S	60S	60S	0	20S	60S	60S	0	0	60S	5S	40S	40S	5S	20S	90S	20S	20S	0	0
15	Faisalabad83	5S	20S	0	40S	0	60S	40S	40S	60S	40S	TR	20S	60S	40S	0	0	10S	0	0	0	0	0	30S	10S	0	5MS	0
16	Rawal87	TS	5S	0	40S	0	40S	40S	20S	40S	20S	0	5S	40S	40S	0	0	30S	20S	10MS	TMS	40S	10S	50S	0	0	40MSS	0
17	Kohsar	TS	20S	5S	40S	0	40S	40S	40S	40S	40S	0	10S	40S	10S	0	0	30S	0	0	5S	0	0	50S	5S	0	5MS	0
18	Bakhtawar94	5S	10S	0	20S	0	40S	40S	20S	40S	40S	0	20S	40S	10S	0	0	30S	5S	0	TMS	5S	20S	90S	0	0	5MR	0
19	Gourab	5S	20S	0	60S	5S	80S	40S	20MS	80S	60S	20S	0	80S	10S	0	0	TS	0	TMS	0	0	0	40S	0	0	0	0
20	Susceptible check	40S	40S	80S	60S	20S	80S	60S	60S	80S	80S	40S	40S	80S	20S	40S	5S	80S	0	40S	40S	0	0	80S	10S	20S	0	0
Date of first Appearance		-	12.03.19	25.02.19	08.02.19	-	-	27.01.19	21.01.19	-	10.02.19	-	16.02.19	-	15.04.19	18.03.19	07.03.19	10.03.19	-	10.03.19	28.02.19	-	15.03.19	-	-	15.04.19	-	-

* ABO=Abohar, ALM= Almora, DEL=New Delhi, DKN=Dhaulakuan, DUR=Durgapura, GUR=Gurdaspur, JAM=Jammu, KAT=Kathua, LAN=Langroya, LUD=Ludhiana, PAN=Pantnagar, RAJ=Rajauri, ROP=Ropar, FAZ= Faizabad, PUS= Pusa, WEL=Wellington

150 YEARS OF CELEBRATING THE MAHATMA

भाकृअनुप ICAR

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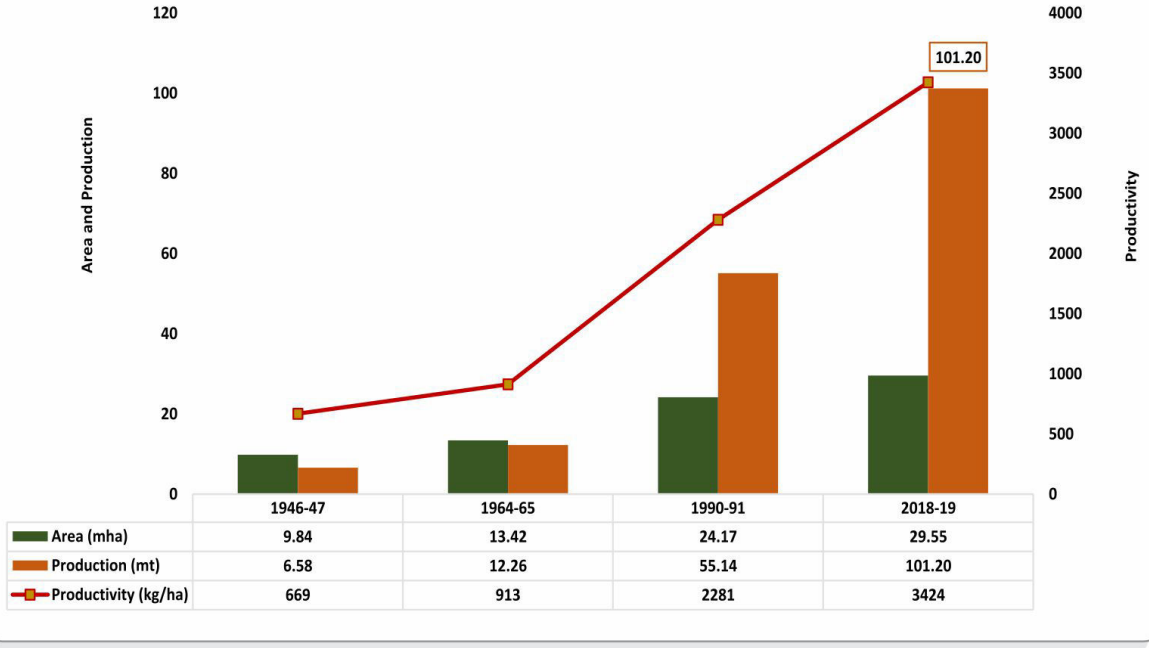
भारतीय कृषि अनुसंधान परिषद
Agrisearch with a human touch

स्वच्छ भारत
एक कदम स्वच्छता की ओर

LAND MARK PRODUCTION DURING 2018-19 (>100 MT)



	1946-47	1964-65	1990-91	2018-19
Area (mha)	9.84	13.42	24.17	29.55
Production (mt)	6.58	12.26	55.14	101.20
Productivity (kg/ha)	669	913	2281	3424

58वीं अखिल भारतीय गेहूँ एवं जौ अनुसंधान कार्यशाला
भा.कृ.अनु.प. - भारतीय कृषि अनुसंधान संस्थान,
क्षेत्रीय केन्द्र, इन्दौर में आयोजित गोष्ठी के दौरान जारी किया गया