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OVER VIEW

Arid Zone (Thal region) is contributing 88% chickpea, 84% mungbean, 95% guar and 14% wheat production of the Punjab. Total area of Thal region is about 3.5 mha, in the districts of Khushab, Mianwali, Jhang (Partly), Bhakkar, Layyah and Muzaffargarh. Arid zone area is characterized with harsh climatic conditions, poor sandy soil and erratic rainfall. Gram is primarily grown in rainfed agriculture system on marginal lands where other crops cannot be grown profitably while mungbean is mainly grown in irrigated agriculture. The major supply of pulses depends upon the production of chickpea and mungbean and failure of these crops results the pulses debacle in the country. Sowing of chickpea crop in Thal mainly depends on availability of moisture at the time of planting. Mandate of Arid Zone Research Institute, Bhakkar is to develop high yielding, temperature and drought tolerant varieties, integrated pest and disease management and provision of quality seed to farmers and other seed stake holders. A new high yielding and disease resistant wheat variety Fakhar-e- Bhakkar was developed and got approved for general cultivation from Punjab Seed Council. Similarly a new high yielding, disease & heat tolerant mungbean variety AZRI-MUNG-2018 was also got approved from Punjab Seed Council for general cultivation.

CROP BREEDING

PULSES:

A. CHICKPEA:

Hybridization

Hybridization program was carried out for the development of desirable recombinants and their evaluation in filial generations. Ten crosses were attempted. Seed of ten successful crosses was reserved to raise F_1 generation during next crop season. Filial generations (F_1 to F_7) comprising 203populations were studied and 231 single plant progenies were selected on the basis of visual observations to good agronomic traits, disease and insect pest resistance. Thirty three uniform lines were selected from F_7 for further evaluation in preliminary yield trials.

Field view of gram hybridization

Preliminary Yield Trial

Twenty entries were evaluated in preliminary yield trials against standard check varieties Bittal-2016 & Bhakar-2011 in RCBD under irrigated and rainfed conditions. The plot size was maintained as 4 x 1.2m. Data regarding germination %age, days to 50% flowering, number of pods per plant, 100 grain weight, days to maturity, disease incidence (Root rot & wilt) and grain yield were recorded. Fourteen lines surpassed check varieties. The strain TG1715 gave the highest average yield (1795 kg/ha), followed by TG1716 with the yield of 1732 kg/ha. However, check varieties Bhakkar-2011& Bittal-2016 gave the yield of 1249 and 1210 kg/ha, respectively. Whereas 12 entries of Kabuli chickpea were tested in preliminary trial and none of test entry could cross check Noor-2009. However, three entries surpass Noor-2013 with yield of 1051(TGK1766), 950 (TGK1770) and 858 (TGK1765) kg/ha.

Supplement irrigation with rain gun to gram during prolong drought spell

Regular Yield Trial (Desi)

Fourteen test entries were studied in regular yield trials (Desi) against the standard check varieties Bhakkar 2011 and Bittal-2016. The plot size maintained as 4 x 1.2m. Data regarding yield and other yield components were recorded. Ten lines out yielded the check entriesBhakkar-2011& Bittal-2016. In brown chickpea trial. GenotypeTG1620 gave the highest yield (2156 kg/ha) followed by TG1613 and TG1622 with yield of 1948 and 1928 kg/ha, respectively. Two check varieties Bhakkar-2011 and Bittal-2016 gave the yield of1710and 1639 kg/ha, respectively.

Field view of gram replicated trials

Micro Yield Trial (Desi& Kabuli)

Ten test entries and two checks were evaluated in micro yield trial at four locations. The plot size was maintained 5 x 1.2m. The data regarding yield and other yield traits were recorded. Test entry TG1501 gave the highest yield 2035 kg /ha in comparison with the check variety Bhakkar-2011 having grain yield 1827 kg/ha. While in Kabuli trial, eight entries surpassed the check with maximum average yield 1776 kg/ha (TGK1504) and Noor-2013 gave average grain yield 1298kg/ha.

Cooperative Yield Trial (Desi & Kabuli)

Arid Zone contributed five chickpea Desi lines (TG1305, TGX220, TG1410, TG1415 and TG1218) and one line (TG12K01). Chickpea cooperative yield trial Desi&(Kabuli) consisting of 24 &18 entries was laid out in RCBD at AZRI Bhakkar. The entry coded as "P" gave the maximum average (irrigated and rainfed) yield of1917 kg/ha while in Kabuli trial, entry coded as Coop-14 gave maximum yield of 1653kg/ha.

National Uniform Yield Trial (Desi& Kabuli)

Chickpea trial consisting of 25 entries (Desi) and 12 entries of Kabuli was laid out in RCBD. Eight advance lines TGX228,TG1415, TG1305, TG1410, TG1424, TG1221, TG1218 and TGX-220 were incorporated by this institute in NUYT (Desi& Kabuli) 2017-18. Coded entry as CH18-D-130 gave the maximum yield 1344 kg/ha followed by CH18-D-132 with yield 1220kg/ha. One advance lineTG12K01was contributed by this institute in NUYT-2017-18(Kabuli). Entry CH18-K-101 gave the maximum yield of1514 kg/ha followed by CH18-K-110 with yield of1434kg/ha.

B. MUNGBEAN:

Hybridization

Hybridization program was carried out to create genetic variability for evaluation of recombinants by testing in filial generations. Six crosses were attempted. F_0 seed of successful crosses was reserved to raise F1 generations in next cropping season. Mungbean segregating generations comprising 162 populations were evaluated in

hot irrigated dry climate. 128single plants progenies were selected from F_3- F_6generations on the basis of plant structure, pods per plant, 100 grain weight, insect and disease incidence. Ten uniform lines were selected from F_7 for further evaluation in preliminary yield trials.

Preliminary Yield Trials

Two trials (A-1& A-2) each comprising of 16entries including two check varieties NM-2016 and AZRI Mung-2006 were conducted according to RCBD. Sixteen test entries performed better than check varieties.The strain TM1714 gave the highest yield 1472 kg/ha, followed by TM1710 with yield of1422kg/ha.Two check varieties AZRIMung-2006 and NM-2016gave the yield of931 and 778 kg/ha, respectively.StrainTM-1726gave the highest yield of944 kg / ha, followed by TM1723with yield of822kg/ha in trial A-2. However, check varieties NM-2016 and AZRI-Mung-2006gave the yield of600 and 594 kg/ha, respectively.

Regular Yield Trials

Regular yield trial comprising 16test entries and two checks NM-2016 and AZRI-Mung-2006 was conducted according to RCBD. Strain TM1603gave the highest yield of1252 kg/ha, followed by TM1605 with yield of1179kg/ha. However, check varieties NM-2016 and AZRI-Mung-2006 gave the yield of909 and 986kg/ha, respectively.

Field view of mungbean replicated trials

Micro Yield Trial

Micro yield trial consisting of 12 entries was laid out in two different sets.TM1513gave the highest yield of1445 kg/ha, followed by TM1515with yield 1402kg/ha. However, check varieties AZRI Mung-2006 and NM-2011 gave the yield of1120 and 1048 kg/ha, respectively.

National Uniform Yield Trial

National uniform yield trial comprising16 entries was laid out in RCBD. Four mungbean advance lines13TM-04, 13TM-14, TM-1418 and TM-1426 were contributed by AZRI Bhakkar. Test entries of Arid Zone Research Institute gave best performance at 12 locations and 13TM-04, 13TM-14, TM-1418 and TM-1426 gave 6.6, 12.6, 11.8 and

5.8% higher yield over check (NM-2011-994kg/ha).

Mungbean experts gathering for Spot Examination

C- WHEAT:

Hybridization& Segregating WHEAT:

Variety development

A high yielding, disease and early heat stress tolerant wheat advance line TW11510 was got approved as commercial variety in the name of FAKHER-E-BHAKKAR for irrigated farming system from Punjab Seed Council in its 49th meeting held on 25-10 2017.

Field view of new wheat Variety Fakhar-e-Bhakkar

Hybridization

Hybridization programme was carried out by crossing different genotypes. One hundred and fifty cross combinations were attempted and F_0 seed amongst of 120 successful crosses was collected. Sixty three bulk populations were selected from F1 generations in natural rusts epidemic condition on the basis of plant height, desirable plant type, spikes shape, disease tolerance coupled with attributes of attractive bold grains and tolerance against elements of heat, frost and drought. In F_2 generations, fifty three desirable populations out of 75 entries were selected and 250 ears per entry were bulked for further studies. In F_3 generations, 24 segregating populations were selected. However, from F_4, F_5, F_6 & F_7 generations 550 desirable single plants were selected for further evaluation. Thirty five uniform lines were selected from F_6 for yield testing in preliminary yield trials.

Preliminary Yield Trials

Three preliminary yield trials comprising each 18 test entries and two check varieties (Annaj, FSD-08 & Jouhar-16) were laid out according to randomized complete block design with three replications and plot size 5m x 1.2m during third week of November 2017. Data pertaining to plant height, days to 50% heading, desirable plant type,

and disease resistance, tolerance to heat, frost and drought were recorded at proper growth stages. Four top yielder genotypes viz. TW1714 (4583kg/ha), TW1701 (4333kg/ha), TW1706 (4150kg/ha), and TW1711 (3783 kg/ha) were selected from A1 trial for further studies in regular yield trials. Similarly four top yielder genotypes viz. TWS17042 (4166 kg/ha), TWS17032 (3850 kg/ha), TWS17049 (3550 kg/ha) and TWS17041 (3516 kg/ha) were also selected from A2 & A3 trials for further studies in regular wheat yield trials.

Regular Yield Trial

Three regular yield trials comprising each 18 test entries and two check varieties (Fakhar-e-Bhakkar & Jouhar-16) were laid out according to randomized complete block design with three replications during third week of November with plot size 5m x 1.2m. The observations pertaining to plant height, days to 50% heading, desirable plant type, compact spikes, disease resistance, tolerance to heat, frost and drought were recorded at proper growth stages. Similarly eight top yielder genotypes viz. TWS16285 (5166kg/ha) TWS16274 (4650kg/ha) TWS16279 (4500kg/ha) TWS16278 (4333kg/ha), TWS16263 (4700kg/ha) TWS16261 (4433kg/ha) TWS16323 (4266kg/ha) and TWS16324 (4200kg/ha) were selected from regular trials for further studies in regular wheat yield trials.

Wheat Adaptation Trial

Wheat adaptation yield trial comprising fourteen test entries and two check varieties (Gold-16) and (Fakhar-e-Bhakkar) were laid out according to RCBD with three replications having plot size 5m x 1.2m at three sowing times as early, timely and late planting starting from 5-11-2017 to 5-12-2018 with 15 days interval at AZRI Bhakkar. Five advance lines (TW15139, TWS15117, TWS15129, TWS15145 and TWS15167) were selected for further studies in Punjab uniform wheat yield trial. The entry TWS15145 was top yielder having av. grain yield 5179 kg/ha followed by TWS15129 with grain yield 5147 kg/ha. The check varieties Fakhar-e-Bhakkar and Gold -2016 expressed av. grain yield 4333 and 3683 kg/ha respectively.

Punjab Uniform Wheat Yield Trial

A Punjab uniform wheat yield trial comprising fifty entries and two replications was conducted during

crop season 2017-18 as a joint venture with WRI FSD. Trial was laid out according to aphla lattice design with two replications. The net plot size was kept 5.0m x 1.20m. All the cultural practices were carried out as and when required. The trial was harvested and threshed during the month of May 2018. Four advance lines viz TWS1578, TWS1579, TWS1581 and TWS1432 of AZRI Bhakkar were got tested in Punjab uniform wheat yield trial. Advance lines. Coded as 7, 23 37 and 38 were top yielder with grain yield of 4550, 4466, 4500 4495 kg/ha

Wheat Yield Demonstration

National Uniform Wheat Yield Trial

A national uniform wheat yield trial comprising sixty entries was laid out according to alpha lattice design with two replications. Gross plot size was kept 5.0m x1.8m while net plot size was reduced to 5.0m x 1.20m. Grain yield and other requisite data were recorded. Four advance lines of AZRI, Bhakkar viz TWS12245, TWS12464, TWS1334 and TWS1335 were tested in NUWYT 2017-18. Advance lines. coded as 17, 25 37 and 38 were top yielder with grain yield of 4250, 4362, 4502 4385 kg/ha respectively.

Figure: 1 new wheat variety Fakhar-e- Bhakkar and advance line TWS12245

Seed production

Breeder nucleus and pre-basic seed of 60 advance lines and approved varieties of gram, mungbean and wheat was also produced in various quantities for provision to private and public seed sector to ensure quality seed production..

2- ENTOMOLOGY

Screening of germplasm of gram against *Helicoverpa*

Experiment was conducted to find the most resistant lines of gram against *Helicoverpa* with plot size of 4.0-1.2 m^2. Data was recorded on weekly basis initially at vegetative later at pod formation stage. TG-1419, TG-1424 and TG-1429 were

relatively resistant with mean larval population 0.1, 0.21 and 0.25/plant, respectively against *Helicoverpa*.

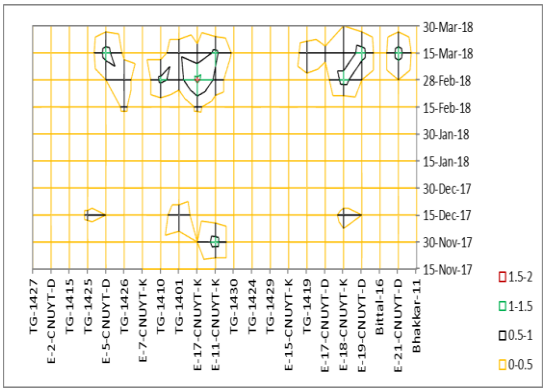

Fig. *Helicoverpa* larvae/plant

Evaluation of new insecticides against ABW on gram

A replicated trial following RCBD with plot size 5 x 9 m^2 was conducted. Larval population/plant was recorded before spray and 3, 7, 10 days of post treatment. Results showed that Emmamectin Benzoate 1.9 EC and Chlorentraniliprol 200 SC were proved highly effective with >90 % control as given here under.

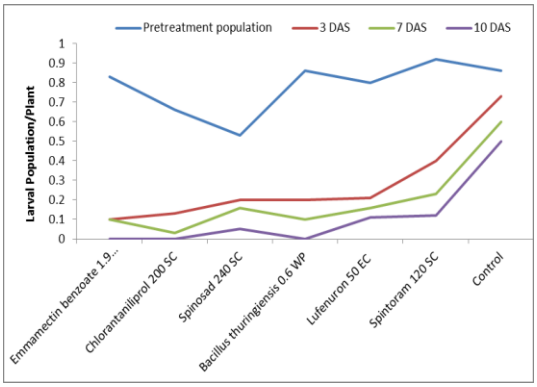

Fig. Insecticides Efficacy against pod borer

Aphid population studies using Yellow Moericke Trays in wheat

Weekly aphid population of wheat aphid was assessed by using yellow Moericke trays @ 6/acre in the wheat field in comparison with meteorological factors. Results depicted that peak population captures during the 2nd week of March as shown in Fig.

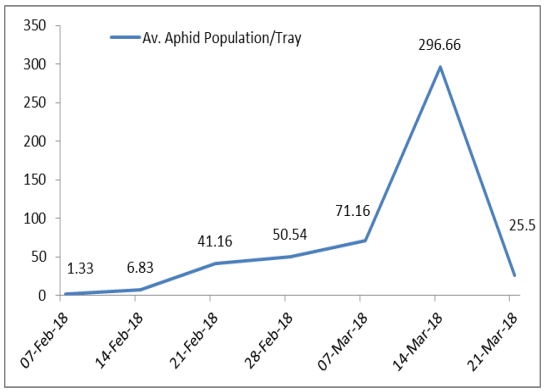

Fig. Aphid population counts per tray

IPM studies against gram pod borer

A non replicated trial was conducted by using different IPM components in the gram against pod borer. Results showed that pod borer population was significantly reduced in the gram field in comparison with field having farmer practices.

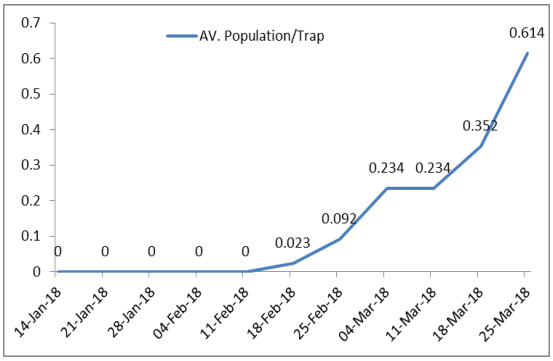

Fig. Population captures of pod bore/pheromone trap

Light traps efficacy studies

Two light traps installed at research area of the institute. The moth catches /night was recorded daily The results are shown graphically. The data was correlated with meteorological factors as shown in Fig.

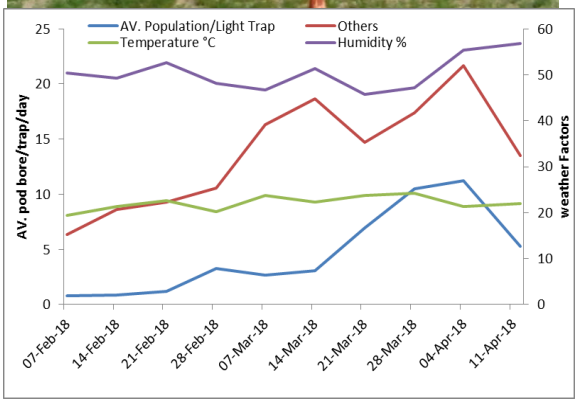

Fig.Population captures of pod borer and others/traps

LIST OF SCIENTISTS

1. Dr. Khalid Hussain, Director
2. Muhammad Ramzan, Entomologist
3. Dr. Muhammad Aslam, Assistant Botanist
4. Dr. Muhammad Irshad, Assistant Botanist
5. Niaz Hussain, Assistant Research Officer
6. Muhammad Nadeem, Assistant Research Officer
7. Abdul Ghaffar, Assistant Research Officer
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