

RESEARCH HIGHLIGHTS

CROP IMPROVEMENT

National Trials

- Nine National Trials (conducted in all the three zones), four North Zone trials, eight Central Zone trials and seven South Zone trials were conducted during the year in 221 locations.
- In irrigated national trials, *G. hirsutum* cultures viz., F 2228 was promising in North zone whereas, MR 786 was promising in both Central and South zones.
- In the preliminary intra *hirsutum* hybrids trial, the hybrids FHH 200, BHH 624 and RAHH 951 ranked first respectively in North, Central and South Zone.
- All the twelve *barbadense* cultures recorded higher seed cotton yield over the common check variety Suvin in both Central and South zone locations. The entry GSB 40 occupied first rank in Central zone and GSB 41 occupied first rank in South zone.
- In the preliminary interspecific hybrids (*G. hirsutum* x *G. barbadense*) trial, the hybrids GSHB 929 and ARBHB 1011 were promising in Central and South Zone, respectively.
- Promising *G. arboreum* genotypes like RG 585 and JLA 505 have been identified for promotion in different zone which was found better than the check varieties in terms of seed cotton yield.
- Similarly desi hybrids like Simulai, RAJDH 444 and NACH 18 showed promise in different zones.
- In Central zone locations, the *G. hirsutum* genotype GBHV 164 was promising and occupied the top rank under rainfed situations, whereas in South Zone locations, CPD 168 was the best culture.
- In the preliminary intra *hirsutum* hybrids trial under rainfed conditions, the hybrid NHH 421 was promising in both Central and South Zone locations.
- *G. herbaceum* culture GBhv 288 was found to be superior to the zonal check variety G.Cot 23 in Central Zone.



Zonal Trials

North Zone

- In the *G. hirsutum* Preliminary Varietal Trial, six cultures showed promise and F 2164 recorded the highest yield of 2686 kg/ha.
- In the Coordinated hybrid trial, all the five test hybrids performed better than both the check hybrids and RAJHH 743 (3021 kg/ha) was the best hybrid.
- *G. arboreum* genotypes viz., CAD 3 and RG 542 were promising.

Central Zone

- In irrigated trial, culture CCH 2623 was the best in the Preliminary Varietal Trial and the genotype BS 279 was superior in the Coordinated varietal trial. In rainfed trials, GISV 218 was promising.
- In the Coordinated hybrid trial, the hybrid RAHH 259 was superior in intra hirsutum category and RAHB 189 was the best in interspecific (*G. hirsutum* X *G. barbadense*) hybrid category under irrigated conditions.
- In the Coordinated intra hirsutum hybrid trial, the hybrid NHH 206 was the best and MRDC 233 was the best in *desi* hybrid group under rainfed situations.
- GAM 141 was the best performing genotype in the coordinated varietal trial of *G. arboreum*.

South Zone

- The *G. hirsutum* genotype, GSHV 155 was the best in Preliminary Varietal Trial and BS 279 was superior in Coordinated Varietal Trial under irrigated situations.
- The hybrid NSPL 423 was the best entry under irrigated conditions in Coordinated hybrid trial.
- In interspecific hybrid category, the highest seed cotton yield was recorded in JKCHB 217.
- Under rainfed situation, the NHH 59 was found superior.
- In *desi* category, *G. arboreum* variety CINA 1003 and the hybrid MRDC 233 were the best performing entries.



CROP PRODUCTION

- Agronomic requirements like spacing and optimum fertilizer dose for hirsutum variety H-1300, intra-hirsutum hybrid SVHH-139, arboreum variety FDK-124 and *desi* hybrid FMDH - 7 were worked out in North Zone locations.
- Similarly, agronomic requirements were also worked out for hirsutum varieties *viz.*, GJHV 374, GSHV 152, GTHV 02/45, TCH 1705, P 72-9-37, Intra-hirsutum Hybrids *viz.*, ARCHH 8188, GGCH 70 and Interspecific Hybrids *viz.*, JKCHB 214 and RAHB 170 in Central Zone locations under irrigated situations and in rainfed conditions for hirsutum varieties *viz.*, NH 630, GTHV 0/35, KH 155, GSHV 01/26 and *desi* hybrid – GGCH 81.
- In South zone also, agronomic requirements were also worked out for intra-hirsutum hybrid – KDCHH 712 and interspecific hybrids *viz.*, JKCHB 214, RAHB 170 under irrigated conditions and for *desi* hybrids like NACH 12 and GGCH 81 in rainfed situations.
- For optimization of nutrient requirement and plant geometry for Bt cotton, RCH –134 Bt was used at Ludhiana, Sirsa and Sriganaganar. The normal spacing shows its superiority at Sriganaganar but wider spacing is seen favourable at Ludhiana and Sirsa. The 100% R.D.F seems to be optimum at all the locations of North Zone.
- In Central Zone, for RCH –2 Bt, normal spacing seems to be optimum with 100% RDF at Khandwa, Surat and Akola, while 125% RDF was suitable at Nanded, Indore and Rahuri.
- For Bunny Bt in South Zone, normal spacing with 125% RDF was seen optimum.
- Effective integrated weed management strategy has been worked out in different locations.
- Foliar feeding of micronutrients with $MgSO_4 @ 1.0\% + ZnSO_4 @ 0.5\%$ at Kanpur and Banswara, $MgSO_4 - 1.0\%$ at Faridkot and $FeSO_4 - 0.5\%$ at Ludhiana gave significantly higher seed cotton yield in North Zone locations.
- Similarly in Central and South Zone locations, spraying of $MgSO_4 @ 1.0\% + ZnSO_4 @ 0.5\%$ gave significantly higher seed cotton yield.
- In a study with foliar application of KNO_3 to increase yield and yield attributes in Cotton, it was found that full dose of MOP at sowing at Sriganaganar and four sprays of 2% KNO_3 at Kanpur were effective in North Zone, whereas in Central and South Zones, three sprays of 3% KNO_3 at Nanded and Banswara, four sprays of 3% KNO_3 at Indore, four sprays of 2% KNO_3 at Rahuri and two sprays of 3% KNO_3 at Siruguppa gave significantly higher seed cotton yield.
- Effective management strategies for the control of leaf reddening in Bt cotton has been worked out in both Central and South zones.
- Under crop canopy management studies, narrow spacing of 60 x 30cm combined detopping after 55 DAS recorded higher seed cotton yield at Khandwa.
- The plant height, stomatal conductance, relative water content, transpiration rate, number of bolls, biomass, boll weight and yield was significantly reduced due to moisture stress in genotypes of *G. hirsutum*. Genotypes with least susceptibility index have been identified under stress.



- Seed cotton yield decreases with the increase of ethrel concentration and maximum reduction was observed when ethrel was applied at 130 DAS as compared to 145 DAS in different concentration.
- Per cent defoliation was higher when ethrel was applied at 145 DAS as compared to application at 130 DAS for all concentration.
- Parawilt affected plants recovered with the timely treatment of Cobalt chloride.
- Free amino acid and proline content were higher in the leaf under rainfed condition as compared to irrigated condition, while reducing sugar and protein declined under rainfed condition. The higher amount of free amino acid and proline might have helped in building the osmotic potential for the tolerance.
- Highest oil content was recorded in G. Cot. 10 (20.0%) followed by entry no. 9117 (19.67 %) and it was lowest in 9112 (16.03 %). Gossypol content in different genotypes ranged from 0.3 to 0.5 per cent.
- Maximum protein content was recorded in G.Cot Hyb.10 (25.6%).
- Different biochemical parameters *viz.*, total chlorophyll content, chl a: chl b ratio, anthocyanin content and nitrate reductase activity were studied at boll developmental stage and all these parameters showed significant variation in response to various leaf reddening management applications.
- Biochemical parameters like reducing sugars, tannins, total phenols and orthodihydroxy phenols were studied in leaf and square tissues of thirty four entries which indicated progressive decreased in squares as compared to leaf.
- Cry 1Ac expression was found to be significantly variable among the Bollgard I and Bollgard II hybrids and also between different parts like leaf, squares and boll rinds. The leaves of the Bt cotton hybrids were found to have highest levels of endotoxin protein expressed compared to squares and boll rinds.
- The Cry 1 AC expression decreased drastically over the crop growth with endotoxin level falling below the critical level of 1.9 µg/g after 110 DAS.
- The high oil containing genotypes 26.01 per cent (CSH-7106), 26.50 per cent (B-58-1290), 25.55 per cent (3HS) and 25.02per cent (F-1861) has been identified at Dharwad which can be used in breeding programme to increase the oil content keeping the present level of fatty acid composition intact.



ENTOMOLOGY

- Cultivars tolerant to Jassid and bollworms were identified in 28 breeding trials of the three cotton growing zones of India.
- **North zone:** Population dynamics study revealed that jassid population was at higher level (8.5 to 33.0 / 3 leaves) in Ludhiana, at moderate level (5.8 to 8.8) in Hisar and at below threshold level throughout the season in Faridkot and Sriganaganagar. Whitefly was in higher level only in Sriganaganagar (31.2 to 35.8 / 3 leaves), while thrips were at below threshold level in all the centres.
- There were no incidences of *H. armigera* and *S. litura* in Sriganaganagar, Faridkot and Ludhiana. Sriganaganagar and Ludhiana had moderate to higher level of Spotted bollworm (5.0 to 9.5 larvae / 5 plants). Pink bollworm was at higher level (2.0 to 6.2 / 20 green bolls) only in Sriganaganagar and almost no incidence was noticed in Faridkot and Ludhiana
- **Central Zone:** Except Khandwa in all other centres viz., Akola, Banswara, Junagadh, Bhawanipatna, Nanded and Rahuri high population of jassid was recorded ranging from 7.8 to 47.1 / 3 leaves. Junagadh recorded higher thrips population (33.2 to 63.6 / 3 leaves), while Banswara had higher whitefly population (32.6 to 35.6 / 3 leaves). Junagadh also had higher aphid population (35.0 to 64.0 / 3 leaves). Very low intensity of mealy bug damage was observed in Junagadh, Surat and Rahuri and it was absent in other centres.
- *H. armigera* bollworm was at moderate level (3.0 to 8.0 larvae / 5 Plants) in Akola, Bhawanipatna, Junagadh, Khandwa, Rahuri and Surat while *Earias* bollworm was at higher level (4.0 to 10.0 larvae / 5 Plants) in Bhawanipatna and Rahuri. Pink bollworm was at higher level in Junagadh (6.4 to 5.6 larvae / 20 green bolls), Surat (5 to 9.4), Rahuri (4 to 8) and in Akola (3.4 to 6.4).
- **South Zone:** Jassid population was at higher level in Lam (13.8 to 52.7 / 3 leaves), Srivilliputtur (10.2 to 18.4), Coimbatore (6.0 to 15.7), Dharwad (6.2 to 13.2) and Raichur (6.9 to 13.2). Aphid was at higher level in Lam (2.6 to 52.7 / 3 leaves) while thrips were higher in Dharwad (37.0 to 41.0 / 3 leaves).
- The intensity of mealybug infestation was 2.0 to 4.0 grade in Coimbatore and 1.0 grade in Srivilliputtur. Mirid bug was at higher level in Dharwad (10.0 to 29.0 / 25 squares).
- *H. armigera* was at higher level in Dharwad (5.3 to 10.2 larvae / 5 plants) and at moderate level in Raichur (2.2 to 4.6). *Earias* bollworm was at moderate level in Srivilliputtur (2.0 to



4.0 larvae / 5 plants) and at higher level in Dharwad (4.3 to 8.2). Pink bollworm was at higher level in Dharwad (5.0 to 23.0 larvae / 20 green bolls), Nandyal (6.0 to 9.0), Raichur (2.8 to 4.4) and Srivilliputtur (2.0 to 5.0).

- Acephate 75 SP (750 g) and the new formulation of Acephate 95 % SG (562.5 & 750 g) were effective against major sucking pests (Jassid, aphid, thrips and whitefly) and resulted in higher yield ranging from 63.3 to 76.0 %, followed by Imidacloprid (57.3 %) and Acetamiprid (51.1 %) in **North zone**.
- Acephate 95 % SG and Acephate 75 SP (750 g) were effective against major sucking pests (Jassid, whitefly, thrips and aphid) and gave higher yield by 52.0 to 59.6 % over control in **Central zone**.
- Acephate 75 SP, Thiomethoxam, Acetamiprid and Acephate 95 % SG were effective against major sucking pests (Jassid, aphid, thrips and whitefly) and resulted in higher yield by 35.0 to 38.0 % over control in **South zone**.
- Profenophos, chlorpyrifos and Buprofezin were effective against mealybug and resulted in higher yield in North, Central and South zone. Biopesticides viz., Mealy kill, Mealy quit, *M. anisopliae*, *B. bassiana*, *V. lecanii* were moderately effective.



PLANT PATHOLOGY

- Cotton leaf curl disease (CLCuD) appeared in epidemic form in Ferozepur district of Punjab on RCH BG II and non descript susceptible genotypes resulting in considerable yield losses. In Rajasthan, out of 6 districts the disease was present in two districts only i.e., Sriganganagar and Hanumangarh which is traditionally cotton growing belt of state. The remaining four districts viz., Nagour, Jodhpur, Alwar, and Palli were found completely free from leaf curl attack. It was observed that Sriganganagar district was having higher average disease intensity compared to Hanumangarh district. Whereas, CLCuD was observed in traces at farmer's fields in different *Bt* cotton hybrids in Haryana.
- Low rainfall, high temperature and moderate relative humidity during the vegetative phase of crop favoured high population build up of white fly early in the season with available virus inoculum and some susceptible *Bt* cotton hybrids especially in the hot spots led to higher disease incidence.
- Bacterial blight was reported as important disease in Central zone in Khandwa in Madhya Pradesh (32.3%), Maharashtra (Vidahrbha- 5.5-21.11%, Rahuri-%, Nanded 2.2-16.2 %) and in South zone in Karnataka (5.0-15.0 %) and Andhra Pradesh (27.0%).
- *Alternaria* blight was serious in Gujrat's Saurashtra area (2.0-25.0%), Bharuch (5-60%), Khandwa in Madhya Pradesh (48.2%) and Maharashtra's Rahuri (0-29.3 %) and Nanded(3.0-21.5%) and in South zone in Karnataka (5.0-15.0%) and Tamil Nadu (10.0-26.0%). *Myrothecium* was severe in Madhya Pardesh (39.3%). *Cercospora* was reported to be severe in Tamil Nadu (12.0-50.0%).
- Grey mildew occurred in Maharashtra in the irrigated areas of Vidahrbha region (14.6-21.0%). In south zone it was severe in two states i.e., Karnataka (5.0-30.0%), and Andhra Pradesh (23.3%).
- Tobacco Streak Virus incidence upto 28.06 % was also observed in Andhra Pardesh in January.
- Tetraconazole 11.6% w/w ME @ 900ml/ha followed by Tetraconazole 11.6% w/w ME @ 800ml/ha and Tetraconazole 11.6%w/w ME @650ml/ha showed the lowest PDI of *Alternaria*. Maximum yield increase of 22.97% was observed in Tetraconazole 11.6%w/w ME @ 900ml/ha followed by 15.14% in Tetraconazole 11.6%w/w ME @ 800ml/ha.



- Seed treatment with *Pseudomonas fluorescens* (TNAU) @ 10 g/kg seed plus foliar spray @ 0.4% on 60 and 90 DAS has given a good per cent disease control of 53.73 followed by SAR inducing chemical (Salicylic acid) @ 50ppm on 60 and 90 DAS with per cent disease control of 50.75 in case of Grey mildew.
- Five sprays of carbendazim at 35, 50, 65, 80 and 95 days after sowing showed reduction of Grey mildew PDI from 14.46 to 5.61 and reduction of yield loss upto 27.51%.
- Five sprays of COC (0.3%) + SS 500 ppm at 35, 50, 65, 80 and 95 days after sowing showed reduction of bacterial blight PDI from 28.06 to 14.26 and reduction of yield loss upto 22.85%.
- Five sprays of Propiconazole (@ 0.1%) at an interval of 35, 50, 65, 80 and 90 DAS at Khandwa showed reduction of *Myrothecium* leaf spots PDI from 22.36% to 7.56% and reduction of yield loss up to 40.66 percent.
- Four sprays of Propiconazole (0.1%) at an interval of 15 days starting from 75 days after sowing has given a good disease control of leaf rust at Dharwad (47.46%) with maximum yield of 3598 kg/ha as compared to 3071 kg/ha in control.
- Number of bolls (40.9% & 31.4%) and seed cotton yield (41.9% & 41.4%) were significantly reduced by CLCuD in RCH 134 in farmer fields and MRC 6304 Bt at research farm, respectively, when the DI was 100.0 with mixed infection grades in Faridkot distt. Whereas reduction in seed cotton yield ranging from 8.0 to 77.6% in different severity grades were noted in Bt cotton hybrid RCH 134 at Abohar.

