RESEARCH HIGHLIGHTS

CROP IMPROVEMENT

- Under irrigated conditions, the genotypes viz., PBH 116, Phule Yamuna, and PBH 116 were the best for yield, whereas for fibre quality, TCH 1828, SHJ 23 and RAH 0603, were the best under normal spacing. Similarly in rainfed situation, CPD 1751 and GSHV 191 were the best for yield and CPD-1751 showed promise for bundle strength.
- The compact genotypes viz., PBH 115, RHC HD 1420 and CSH 1613 were the best for yield in irrigated situation and RAHC 1039 was showing promise for fibre quality under closer spacing. In rainfed conditions, ARBC 1651 and DSC 1651 were the best for seed cotton yield.
- ELS *G. barbadense* cultures like DB-1701 and CCB 143B were promising for yield.
- ELS interspecific hybrid RHB 1002 was the best in both Central and south Zone.
- For yield, promising desi cultures were FDK 281, NDLA 3116-4 and GAM 259 and for fibre quality PA 839 and PAIG 377 were promising.
- In North Zone, the hirsutum genotype F 2462 (2663 kg/ha) showed promise for yield under normal spacing while RS 2814 (2869 kg/ha) was promising in closer spacing trial.
- None of the desi genotypes (both varieties and hybrids) showed yield superiority over the best check variety / hybrid in north zone.
- In Central Zone, RHC 1217 (2319 kg/ha) was the best in preliminary variety trial and GSHV 172 (2251 kg/ha) was the best in coordinated variety trial under irrigated conditions with normal spacing. Under rainfed conditions, CPD 1652 an d ARBH 1551 were the top yielders.
- For closer spacing, ARBC-1601 (1931 kg/ha) was the best in central zone in irrigated situation and GISV 272 (1704 kg/ha) was the best in rainfed condition.
- In Central zone, ELS *G. barbadense* cultures like DB 1602 and ARBB 1502 were the best yielders.
- Similarly, ELS interspecific hybrid RHB 1008 was the best in central zone for yield.
- Among desi varieties, CNA 1031 was the best for yield and PAIG 373 was the best for quality.
- Desi hybrid BDAA 011 was showing promise in central zone under rainfed condition.
- In South zone, under irrigated condition, HS 298 (2024 kg/ha) and BGDS 1033 (1887 kg/ha) were promising hirsutum cultures in different trial under normal spacing and LHDP 1 (1571 kg/ha) was the best under closer spacing.
- In rainfed conditions, CPD 1652 (1080 kg/ha) and ARBH 1551 (1357 kg/ha) were promising for yield in normal spacing and ARBC 1651 (1133 kg/ha) was promising in closer spacing.
- In both central and south zone trials, the culture CCH 15-1 was showing promise for fibre quality consistently.
- Among ELS cultures, RHcb 1014 was promising for yield and interspecific hybrid ARBHB 1602 was promising for yield.
- Among desi cultures, JLA 110 was showing promise for yield and PA 812 and PA 808 were promising for fibre quality.
- The naturally coloured cotton genotypes were evaluated in AICRP for the first time belonging to both hirsutum and arboreum. The culture 16301 DB was promising for yield in hirsutum and DDCC1 was promising in arboreum.

CROP PRODUCTION

- Optimization of spacing and fertilizer requirement is the pre requisite for releasing of promising genotypes. Agronomic requirements of HS294 in North Zone; GJHV497, SCS 1061, ARBB 1401, RHB 1122 and PA 785 in Central Zone; GSHV 177, CCH 14-1, DHB 1009, RHB 1122 and AKA 2008-7 in South Zone were worked out.
- Nutrient and geometry requirements were worked out for RS2727, GTHV 13/32, GISV 272, RAHC 1011, ANGC 1451, ANGC 1452, GTHV 13/32 and RAHC 1012 under High Density Planting System (HDPS).
- Weed infestation in cotton causes yield reduction to the extent of 85 per cent. The results of Banswara, Indore and Chamrajnagar revealed that poly mulch recorded significantly the highest seed cotton yield of 4251, 3023 and 2048 kg/ha and weed control efficiency of 97.21, 73.60 % and 85.8 % respectively.
- The highest water use efficiency of 4.19, 13.20 and 3.15 kg/ha-mm and water productivity of Rs. 41.93, 45.98 and 14.7 /m^3 were recorded with drip with poly mulch at Junagarh , Banswara and Indore respectively.
- Research on reducing nitrogen dose and enhancing of nitrogen use efficiency in Bt cotton found that at Faridkot, Bathinda, Junagarh and LAM , there are possibilities of reducing 25 % N for Bt cotton by making Spot application in four splits of 75 % RDF + Foliar application of 1% urea at three times. In Hisar, Rahuri, Khandwa, Banswara, Raichur and Dharwad, it is reported that there is saving of 25 % of N by applying 75 % of RDN in spot application of four splits and raising of Sunnhemp between rows incorporated before flowering.
- Organic nutrient management packages including seed treatment, soil application of recommended bio fertilizers, foliar application of **Pink Pigmented Facultative Methylotrops (PPFM)** at flowering, soil application of Neem cake @ 250 kg/ha and raising and incorporation of Sunhemp / fodder cowpea between rows registered significantly higher seed cotton yield at Akola (1543kg/ha) , Banswara (2279 kg/ha), Bhawanipatna (1434 kg/ha), Rahuri (1406 kg/ha), Dharwad (2010 kg/ha) , Coimbatore (1067 kg/ha) and Srivilliputtur (1701 kg/ha).
- Labour saving package including land shaping by machine, pre and post emergence application of weed control, intercultural operation by animal and boom / other sprayer for spraying registered the least labour requirement of 126.7,113.2,86,70,115 and 70 respectively at Bhawanipatna, Nanded, Kanpur, Akola, LAM and Nandyal respectively, which was 34.7,27.9,40.3,19.5,50.4 and 48.9 per cent less for one hectare of cotton cultivation as compared to control.
- Canopy management in HDPS cotton cultivation using growth retardant found that mepiquat chloride application @ 20 g a.i. / ha. at 60 and 75 DAS reduced sympodial length by 28.3, 22.2 and 16.2 per cent rspectively at Faridkot, Bathinda and Hisar.
- Testing of human hair product could not offer any significant impact on seed cotton yield at Faridkot, Bathinda, Sriganganagar, Bhawanipatna, Coimbatore and LAM. However, spraying @ 9 ml/l of human hair product at two times on 65-70 and 80-

90 DAS significantly increased seed cotton yield at Khandwa (1072 kg/ha) and Banswara (3385 kg/ha).

- Significantly higher seed cotton yield was recorded with Super absorbent application @ 18 kg/ha than control at Akola (1504 kg/ha), Nanded (2033 kg/ha) and Khandwa (1104 kg/ha).
- The Genotypes viz., CPD 1602, GSHV 520, GSHV-523, PH- 071, SIMA-5 and TCH-327 at Guntur, CPD-1652, Sahana, CPD-1651, GJHV-523, RAH-1071, L-1060, CNH-7012 and NDLH-2027 at Dharwad were identified for drought tolerance. The genotypes, H 1489, H 1524 and H 1506 were known for drought tolerance at Hisar. Chlorophyll stability index was found significantly high in CPD-1702, RHC-1346 and GSHV-199 at Surat. Genotypes TCH-1199 at Khandwa was known for drought tolerance.
- The genotypes viz., PA 255, PA 528, L 1060, GSHV 497 and LHDP 2 identified as saline tolerant at Guntur. High K/Na ratio was found with ARBB-1401 and GJHV-497 at Surat. H 1518 and H 1523 were screened for salinity tolerance at Hisar.
- The management of climate change was attempted by using genetic variability associated with cotton. The results found that *arboreum* genotype recorded significantly higher yield at different environments than *hirsutum* and Bt cotton hybrid at Guntur (Phule Dhanwanthari), Surat (G.Cot- 15 and G.Cot-19), Hisar (HD 432) and LAM (AKA 2004, AKA 7&Srinandi). At Dharwad, *hirsutum* genotypes (Sahana and ARBH-813) showed least reduction in yield under less suitable environment.
- The effect of Nano fertilizer on cotton found that higher seed cotton yield was recorded with foliar application of Nano Zinc @ 2 g per 10 litres of water at 45DAS & 60 DAS at LAM.
- Oil contents of different genotypes varied with the range of 15.67 to 20.7 at Hisar, 16.7 to 18.1 % at Surat and 9.7 to 26.64 at Dharwad. The gossypol content was varying with the range of 0.177 to 0.045 % at Hisar, 0.44 to 0.619 % at Dharwad and 37.4 to 156.4 (mg/ g) at Surat.
- The Effect of Plant Growth Regulators (PGRs) on insect resistance in cotton found that leafhopper population counted on 7th day after PGR spray was significantly less with application of NAA @ 20 ppm foliar spray at 60 DAS followed by MC @ 50 ppm foliar spray at 90 DAS at Dharwad and Surat. Levels of secondary metabolites and defensive enzymes were found altered significantly due to the PGR sprays and found higher with MC @ 50 ppm foliar spray at 90 DAS.

CROP PROTECTION
ENTOMOLOGY

- Genotypes tolerant to sucking pests were identified from national and zonal breeding trials of the three cotton growing zones of India as follows:
  - ✓ From North zone, 3 and 11 entries were identified as moderately tolerant to leafhoppers in National and Zonal trials, respectively. Two entries were identified as moderately tolerant to whitefly in National trial.
  - ✓ From Central zone, 7, 8 and 18, 15 entries were identified in National and Zonal trials, respectively against leafhopper and Whitefly.
  - ✓ From South Zone, 5 and 15 tolerant entries were indentified against leafhopper through National and Zonal trials, respectively.
  - ✓ Through advanced screening of promising entries, 7 from North zone, 2 each from Central and South Zones were identified as tolerant/ moderately tolerant against leaf hopper.
- Pest dynamics was recorded in all the three zones under experimental field conditions. In north zone leafhopper was above ETL during 25^{th} to 32^{nd} SW in all centres, except in Sriganganagar. Whitefly and thrips was above ETL during few standard weeks in all the centres. Boll worm infestation was negligible and adult moth catches of all the boll worms in pheromone traps were recorded in north zone centres.
- In central zone, among the sucking pests, leaf hopper was the major pest which was observed above ETL and occurred throughout the cropping season in Surat. Infestation of whitefly was above ETL in Nanded and Banswara for a short period during the crop season. Thrips were below ETL, however in Nanded, Rahuri and Surat the population crossed ETL during mid August to mid September. Activity of natural enemies namely Spiders, *Chrysopa*, *Chryptolaemus*, Syrphids and Coccinellids were observed at all centres. Among the boll worms, pink boll worm *Pectinophora gossypiella* was the prominent pest in all the centres except Banswara and Bhawanipatna. The pest was recorded on *Bt* hybrids in Akola, Nanded, and Junagadh. Adult moth catches of all the boll worms were observed.
- In south zone, leaf hopper was the major sucking pest in all the centres, infestation of whitefly and thrips was at below ETL. However, in Dharwad thrips crossed ETL during mid August to mid October. Mirid bug infestation was noticed at moderate level at Dharwad and Chamarajanagar. Peak infestation of flower bud maggot was observed during November only in Dharwad. Among the boll worms, *P. gossypiellla* was the prominent pest and it occurred in DCH 32, in Andhra Pradesh and Karnataka, which remained below ETL in Tamil Nadu. Pheromone trap catches of adult boll worms was also recorded.
- Weekly survey report in farmer's fields in all the three zones indicated the locations with maximum pest infestation, which in turn facilitated for effective management of the pests in farmers field.

- New formulation Pyrifluquinazone (RIL – 125/F (20%WG) @ 75 and 100g a.i /ha) tested against sucking pests in north and central zones were comparable in terms of efficacy with the standard insecticides. Population reduction of natural enemies was recorded in the chemical treatments when compared to biopesticides and control.
- New combination insecticide molecules *viz*., Spinetoram + Sulfaxaflor 40% WG @ 120 and 140 g a.i., / ha and Pyriproxyfen 5% EC + Fenpropathrin 15% EC@ 37.5 + 112.5 g a.i., / ha and its individual molecules were effective in reducing the sucking pest population in all the three zones.
- Among the different pheromone traps evaluated, higher number of moth catches with lower larval infestation and locule damage with maximum good opened bolls were recorded in Pherosensor TM-SP and TM-BB sleeve traps at densities 20 and 8 followed by PCI delta traps with replacement of sticky liner (season long).
- Percentage reduction of whitefly population in the whitefly adult suction trap operated plots was comparable with the insecticide treated plots.
- Phero-sensor TM-SP Sleeve trap performed better in reduction of larval population of pink bollworm, damage to green boll and locule and yielded higher compared to PCI-Delta Trap fitted with Pectino-lure SL in all the centres.
- Infestation of pink bollworm, boll and locule damage were significantly low in insecticides treated plots which was on par with *Trichogramma bactrae* released plots.
- In general, evaluation of various seed treatments against cotton pests under organic cotton production technology indicated that the population of sucking pests, square, open boll and locule damages were significantly lower in the treatments of seed treatment and soil application of recommended bio-fertilizer and foliar application of PPFM + neem cake 250 kg /ha + raising of sun hemp between rows incorporated before flowering sowing and Intercropping with green gram.

CROP PROTECTION
PATHOLOGY

- Cotton leaf curl virus in north zone, *Alternaria* leaf blight, bacterial blight and tobacco streak virus in central zone and *Alternaria leaf blight*, bacterial blight, grey mildew and rust in south zone were the major diseases reported during 2017-18 crop season.
- Cotton leaf curl virus disease (CLCuD) appeared in 22nd week (SMW) at Hisar and 25th week at Sirsa in Haryana; 25th week at Faridkot in Punjab and 26th week in Sriganganagar in Rajasthan.
- The maximum leaf curl disease was noted in Punjab followed by Rajasthan and Haryana during the 2017 season. In Punjab, maximum CLCuD was noted in Fazilka district followed by Muktsar and Faridkot. The Minimum PDI was observed in Bhatinda district. In Rajasthan, Sriganganagar district showed maximum CLCuD followed by Hanumangarh. In Haryana the maximum CLCuD was recorded in Fatehabad followed by Sirsa and Hisar.
- The occurrence of Tobacco streak virus (TSV) was observed from second fortnight of July on most of the Bt cotton hybrids sown on farmers fields in Rahuri, Maharashtra up to a maximum incidence of 23 per cent. Tobacco Streak Virus disease incidence was very low in Andhra Pradesh (< 1% only). The incidence of TSV was found in Tamil Nadu only in TNAU Coimbatore (5-10%).
- The screening against various diseases in Bt hybrids/varieties trials was done and their reaction was reported. In addition to that, the breeding lines in various national and zonal trials were screened against important diseases in the area with respect to susceptible checks for the diseases planted in each trial and their reaction was reported.
- In trial regarding Confirmation and maintenance of disease resistant lines, out of 24 entries tested under field conditions against cotton leaf curl disease (CLCuD) at Faridkot, nine entries *viz.,* F 2648, F 2662, F2577, F2522,RS 2734, RS 2765, RS 2814, RS 2821 and H-1489 gave moderately resistant reaction against highly susceptible reaction in check (RST 9). Out of the 21 entries screened in pots by artificially inoculating ALB, four entries ie., ARBB1401, RACH 1021, CSH 31292, CCB 51 were disease free. Fourteen entries including two hybrids were screened through artificial inoculation at Surat against bacterial blight, six entries *viz*., GSHV 191, GSHV 199, GISV 312, GShv 894/13, GShv907/13 and GShv 898/13 and one hybrid GSHH 2970 were observed as disease free against the Bacterial leaf blight disease. Genotypes G.Cot.21, Digvijay, G.Cot.19, and GBhv 270 were found to be resistant in Seedling Resistant Test as well as in Adult Plant Resistant Test against *Fusarium* wilt at Pune.
- In trials on IDM, Module 6 (ST - PF CICR @ 10 g/ kg of seed + Soil Application of *Trichoderma viride* @ 2.5 kg/ ha *Trichoderma viride* (TNAU1) in 250 kg of Compost or FYM and foliar spray with Kresoxim methyl @ 1 ml/ litre followed by Captan + Hexaconazole @ 1.5 g/ litre for fungal diseases or COC (0.3 %) + Streptocycline

(0.01 %) for BLB) showed lowest incidence of Bacterial blight, *Alternaria*, Grey mildew and Wilt with higher seed cotton yield at Nanded. At Surat also this module showed the best results against Bacterial blight and ALB.

- Pooled results of five sprays of different interventions showed lowest CLCuD PDI in Cow urine + Calcium nitrate treatment followed by Cow urine, Buttermilk and Neem oil treatments at Hisar, Sirsa, Bhatinda, Faridkot and Sriganganagar. Highest seed cotton yield was observed in treatment Cow urine + Calcium nitrate followed by Calcium Nitrate, Digitalis and Butter milk treatments.
- Two sprays of Copper oxychloride 50 WP @2.5g/L & Mancozeb 50WP @2.0 g/L in poly house experiment of sooty mould control at Sirsa, showed maximum reduction of sooty mould followed by Copper oxychloride 50 WP @1.25g/L & Propiconazole 25EC @1ml/L. In field trial at Hisar, Faridkot and Coimbatore, the maximum reduction was observed at Copper oxychloride 50 WP @2.5g/L followed by Propiconazole 25EC @1ml/L & Copper oxychloride 50 WP @1.75g/L. Similar yield trend was also observed.
- Pooled data of Hisar, Faridkot and Rajasthan showed that seed cotton yield reduction (Grade wise from 1-6) due to CLCuD in different Bt hybrids varied from 10.97 to 72.46, 7.30 to 69.72, 9.89 to 57.72 and 7.94 to 71.02 percent in Bt hybrids Bioseed 6588 BG II, RCH 650 BG II, Ankur 3028 BG II and MRC 7017 BG II respectively.