



- ◆ Thirty-five cotton germplasm materials (25 perennials of *G. barbadense*, 10 traditional cultivars of *G. arboreum* and *G. herbaceum*) were collected from Manipur, Nagaland, Meghalaya, Assam, Maharashtra and Gujarat and established in pots. The endangered land races of *desi* cotton (*G. arboreum* and *G. herbaceum*) viz. Ponduru, Mathio, Karunganni, Wagad and Uppam cotton were collected from their traditional cultivated home.
- ◆ Seven hundred and twenty three (723) exotic accessions of *Gossypium hirsutum* were added to the cotton gene pool. Trait specific 349 germplasm lines (*G. barbadense*-209, *G. hirsutum*-75, *G. arboreum*-2, *G. herbaceum*-43 and wild species-20) were selected from Germplasm Resource Information Network (GRIN).
- ◆ Fifteen long linted *G. hirsutum* accessions (staple length, 30.8-32.9 mm) and 38 high fibre strength accessions (23.0 – 24.8 g/tex) were identified and documented for utilization in breeding programme. Four cultures viz. CNA 441, CNA 443, CNA 444, CNA 445 and CNA 447 were identified suitable for absorbent and surgical purpose.
- ◆ One high yielding *G. arboreum* culture, CNA 2023 was found suitable under narrow spacing (60 x 22.5 cm). A medium maturing high yielding culture, CNH 2015 was developed.
- ◆ Two thousand *G. hirsutum* germplasm accessions were screened for waterlogging of which 200 were identified as tolerant lines.
- ◆ Two high yielding promising cultures (CNH 09-7 and CNH 09-9) tolerant to jassids were identified. Among the 200 introgressed derivatives evaluated for CLCuV resistance at Abohar, two derivatives (Rai 4B and MSH 126) showed tolerance.
- ◆ Thirteen cultures of *G. hirsutum* and four of *G. arboreum* have been sponsored for testing in AICCIP trials.
- ◆ Five cultures, four of *G. hirsutum* (CNH 7008, CSH 1110, CNH 28I and CNH 1111) and one of *G. arboreum* (CNA 1016) were promoted for further testing based on their performance in various trials of AICCIP.
- ◆ The GMS based hybrid CSHG 1862 was released by Central Varietal Release Committee vide notification No. S.O. 952(E) dated 10th April 2013. Intra-hirsutum GMS hybrid CSHG 1862 was tested in 27 locations and recorded an overall mean seed cotton yield of 21.02 q/ha as against 18.82 q/ha of CSHH 198 (Common Check) and 19.87 q/ha of local checks.
- ◆ CSH-3088 ranked fourth in Br03a trial of north zone of AICCIP during 2012-13, however it could not yield more than 10% and hence was retained in the Br03a trial of north zone for evaluation in 2013-14. Entries CSH-3175, CSH-3178, CISA-158-1 and CISA 27 (GMS based hybrids) were sponsored in Br02a, Br06a, Br22 a/b & Br 25a/b trials respectively for evaluation during 2013-14.
- ◆ CSH-3075 evaluated in Br06a compact type trial (67.5 x 10 cm) of AICCIP ranked first (zonal mean 3050 Kg/ha in comparison to local check 2625 kg/ha) and promoted for north zone trial of 2013-14.
- ◆ Three progenies cross SA-977x SA-112 viz; P-70, P-86 and P-164 were at par in seed cotton yield in comparison with check H-1226 (1876.5 kg/ha) and possessed more than 40% GOT.
- ◆ 10 compact lines with maximum 120 cm height and 20 cm width having superiority for yield and tolerance to sucking pest and CLCuV were identified.
- ◆ A set of 56 SSR primers were surveyed for polymorphism between bacterial blight susceptible and resistant lines of which 20 SSR markers were found to be polymorphic with Ganganagar ageti and S 295.
- ◆ DNA fingerprinting of 28 *desi* genotypes (3 of *G. herbaceum* and 25 of *G. arboreum*) carried out using 15 SSR markers revealed three (DPL 209, HAU 0058 and MCU 022) to be polymorphic.
- ◆ Molecular markers effectively and efficiently differentiated *G. hirsutum* varieties from *G. barbadense* varieties (Sujata and Suvin) and grouped them in separate clusters.
- ◆ Among the 14 treatments applied directly to the soil, high seed cotton yield was obtained with Vermicompost (2019 kg/ha), Cotton stalk compost (2080 kg/ha) and FYM (2015 kg/ha) in both transplanted and direct sown seeds.
- ◆ Among different seed treatments, Thiram @ 2.5 g/kg seeds gave the highest seed cotton yield (1893 kg/ha.) followed by Thiamethoxam @ 10 g/kg (1791.25 kg/ha) and Imidacloprid (Gaucho) @ 7 g/kg seeds (1711 kg/ha).
- ◆ A staining method (using Carbol fushcin) was

identified to clearly observe and manually quantify leaf and marginal hairs.

- ◆ Sufficient variability for leaf trichome density as well as stellar branching could be observed among 50 varieties studied in *G. hirsutum*. The possibility of quantifying the visual grades provided in the DUS test guidelines for leaf hairiness was confirmed.
- ◆ Breeder seed of five varieties viz., Suraj, PKV 081, NH 615, CISA 614 and AKA 7 and parents of CICR 2 hybrid were supplied for production of Foundation Seed and 136 q of Suraj and 17.3 q of NH-615 seeds (Foundation stage) were produced. Breeder seed of 1.14 q of Suraj was also produced. Resources worth 13.94 lakhs was generated through the sale of these seeds.
- ◆ To generate multigene construct, chitinase gene cassette in plant expression vector with double 35s promoter, AMV enhancer and NOS terminator was sub-cloned downstream of CICR truncated Cry 2 Ab1Ac gene cassette and confirmed through restriction analysis and transformed in *Agrobacterium*. Transformation was carried out using shoot organogenesis, somatic embryogenesis and also by *In-planta* transformation methods in cv Suraj, AKA 7 and Coker 310 respectively. In all, 136 new events were generated.
- ◆ Four new events carrying Cry I Ac and 3 events carrying Cry I F have been established for event selection trial.
- ◆ For leaf curl virus resistant cvs H 777, F 846 and HS 6 carrying ACP (Anti-sense Coat Protein) gene was confirmed by PCR with gene specific primers and were selected for event selection trial. Also for fungal resistance, *G. arboreum* cv PA 255 carrying Chitinase gene representing three events were selected for event selection trial.
- ◆ Gene expression analysis was carried out in mapping population from diverse parents with contrast fibre strength (High-25 g/tex, Medium – 22 g/tex and low 17 g/tex). Full length selected candidate gene e.g Sus A1, Ghces A1, Ghces A2 and Ghces A7 were cloned and subjected to sequencing.
- ◆ dsRNAi gene construct for silencing gossypol biosynthesis in cotton seed was developed and used in transforming *G. hirsutum* cultivars by *Agrobacterium*.
- ◆ Available EST from NCBI database for secondary wall synthesis of fibre was obtained and assembled into contigs and nucleotide blastn analysis identified 63 contigs which were uncharacterized. Four contigs that showed differential expression (18 and 25 DPA) in Suraj variety, were chosen for validation using mapping population.
- ◆ Full length nucleotide sequence of gene coding for *G. hirsutum* cobra like protein (Ghco BL 4) associated with fibre quality was isolated and cloned.
- ◆ Under High Density Planting System on shallow soils, yield under 45 x 10 cm (2.2 lakh plants/ha) and 60 x 10 cm (1.66 lakh plants/ha) was significantly higher than that at 45 x 15 cm (1.48 lakh plants/ha). Based on 38 genotypes evaluated under HDPS, Suraj, PKV 081 and NH 615 were found suitable for central India, Anjali and KC₃ were found suitable for south India and F 2383 for north India.
- ◆ Two new genotypes viz. CSH 3178 (*G. hirsutum*) and Phule Dhanwantary (*G. arboreum*) were identified for high density planting.
- ◆ Among *Desi* cotton varieties evaluated for surgical purpose, Yaganti, RG-8 and Phule Dhanwantary were found to be high yielders.
- ◆ 12 HDPS trials conducted in seven villages of Sirsa district increased yields by 15.63, 26.48 and 15.29% in CISA- 310, CISA 614 and F-2383 respectively as compared to normal sowing of CICR-2 and Ankur 3028 BGII.
- ◆ Twenty four advance cultures of *G. hirsutum* evaluated in randomized block design, the highest yield was recorded by CSH 2931(2494 kg/ha) followed by CSH 2932(2247 kg/ha) and CSH 2930 (2099 kg/ha) as compared to 1975 kg/ha of LH 2076 check variety. The culture CSH 2931 also recorded the highest lint yield and minimum CLCV incidence (28.17 PDI). The culture CSH 2838 recorded the highest fibre strength of 23.2 g/tex.
- ◆ 10 *G. arboreum* lines identified superior for surgical properties were evaluated for yield potential in replicated trial. The highest yield was recorded in cultivar CISA-17-93 (31.0 q/ha) followed by CISA-6-295 (30.0 q/ha) RG-540 (29.0 q/ha), CISA-504 (26.75 q/ha) and HD-432 (25.0 q/ha).
- ◆ Among the eleven cover crops evaluated for allelopathic effects and weed control efficiency, sorghum, bajra, sunflower and sunnhemp had fewer weeds and weed biomass. They were comparable to the newspaper mulch and polythene mulch treatments.
- ◆ Stale seed bed technique of weed management with residual herbicide pendimethalin (1.0 kg a.i. ha⁻¹)+ non residual pre plant foliage herbicide (Glyphosate 0.8 kg a.i. ha⁻¹) in 125 L water ha⁻¹ on germinated weeds before planting controlled germination of weeds up to 35-40 DAS.

- ◆ Among the cover crops evaluated for management of weeds wheat, barley, and sunn hemp suppressed the weeds efficiently and significantly enhanced the seed cotton yield.
- ◆ Sunflower produced allelopathic effect not only to weeds but also to cotton and recorded the lowest seed cotton yield and hence is not suitable.
- ◆ Weeds in cotton could be managed by integrated approach with pre emergence pendimethalin 1.0 kg on third day of cotton sowing followed by *in situ* cover crops around 35 - 40 DAS combined with one hand weeding around 70 -75 DAS .
- ◆ In Namakal district, a weed shift was observed wherever glyphosate was applied continuously. The shift was in favour of broad leaved weeds (*Cynotis culculata* and sedges (*Cyprus rotundus*) from grasses (*Echinochloa colona*). Dominance of *Trianthema portulacastrum* under continuously pendimethalin applied cotton field was observed under CICR fields at Coimbatore.
- ◆ Periodical monitoring of the reddening of cotton leaves showed that methomyl treated plants had more red leaves while plants treated with 1% potash, 0.5% lime, 1% DAP and 1% urea + 0.5% magnesium sulphate showed less incidence of leaf reddening. Leaf chlorophyll content, on an average, was found to be high (1.5 – 1.8 mg/gm fresh wt of leaf) in lime, potash, urea + magnesium sulphate treatments. Anthocyanin concentration was found to be highest in methomyl treated plants.
- ◆ Eighty four lines of the 2000 cotton germplasm lines grown were identified for earliness (drought avoidance) phenological trait. Leaf samples of 52 cotton germplasm lines had higher epicuticular wax content which is considered as a drought tolerance trait.
- ◆ A self propelled riding type cotton harvester was fabricated using a power tiller with 17 hp diesel engine. The harvester designed for narrow row cotton cultivation was tested in Suraj var. sown at 80 cm x 10 cm. The field capacity of the machine was 4.2 hrs/ha. The cost of picking was Rs 1.2 /kg for a yield of 2000 kg/ha and Rs 2403 /ha harvesting efficiency obtained was 90 % which improved to 98 % with modification of picking arrangements.
- ◆ Fourteen compact plant genotypes were evaluated along with Anjali, Supriya and Suraj as check varieties with spacing of 45 cm x 15 cm. There were significant differences among the genotypes on seed cotton yield and the highest yield was recorded in PI 36-2-4-1(3539 kg/ha) and in Surabhi x MM02-16-5-2-4 Bk. Several compact plant types with super okra leaf have been identified which will be amenable for further closer planting.
- ◆ Nine genotypes (Anjali, KC-3, NH615,MCU 7,SVPR-3, LH 900, PKV081, Suraj and Supriya) planted at 45x 15 cm (1,48,148 plant/ha) were compared with RCH 2 Bt planted at 90 x 60 cm. KC-3, highest yield (4663 kg/ha) an was on par with Anjali, NH 615 and Suraj.
- ◆ Eight *arboreum* genotypes were screened for yield performance at Coimbatore. Among them, Yaganti, a genotype from Nandyal, Andhra Pradesh recorded 2494 kg/ha, RG-8 ranked second with 1864 kg/ha and NDLA 3047 from Nandyal ranked third with the yield level of 1654 kg/ha.
- ◆ Inclined plate planter, cotton planter, cultivator mounted seed drill, pneumatic planter and animal drawn seed drill were compared with manual sowing. Manual sowing recorded the significantly highest yield (4031 kg/ha) and was on par with inclined plate planter (3843 kg/ha).
- ◆ Sowing by using inclined plate planter is economical as compared to manual sowing.
- ◆ Cotton raised under elevated CO₂ (650 ppm) gave significantly higher yield of 132 g/plant compared to 108 g/plant under ambient condition.
- ◆ Nutrient consortia spray increased the yield significantly by 12-15% irrespective of the atmosphere in which the plants were grown.
- ◆ Lenticel formation was found to be a good index in screening water logging tolerance. Culture nos- 2186, 2605, 2709, 2728, 2853, 3164, 3341, 4481 initiated lenticel formation within 3 days after water logging while culture no like 193, 891, 1093, 1422, 2648, 2698, 2711, 4261, initiated lenticel formation after 6 days out of the 125 cultures tried.
- ◆ Eighteen cultures developed at CICR, Nagpur was screened for drought tolerance under lab (Petri plates and pot culture) and field conditions. None of the genotypes were found to be superior over the tolerant variety LRA5166.
- ◆ Irrespective of the genotypes, pruning the crop after the harvest resulted in second fruiting cycle.
- ◆ Yield realized in Suraj crop in the second fruiting cycle due to pruning was 109 g/plant apart from the first crop yield of 170 g/plant. Quality parameters were not adversely affected, due to pruning.
- ◆ A Hydroponic method of culture was developed to study the nutritional deficiencies due to essential nutrients viz. Nitrogen, Phosphorous Potassium, Magnesium and Calcium. The deficiency symptoms were visible within seven days of culture. The pots were continuously aerated and also replenished

with nutrient solution regularly.

- Deficiency of N – Chlorosis of the leaves, particularly the older leaves.
 - Deficiency of P – Stunting; dark purple stems, purpling on upper and lower leaf surfaces; leaves small.
 - Deficiency of K – Stunting; interveinal chlorosis; leaves small, shiny, and deeply veined; some necrosis.
 - Deficiency of Mg – Stunting; leaves shiny, with a bronze cast; necrotic spots; older leaves appear normal
- ◆ Box Jenkins, a multiplicative time series model for forecasting was used to forecast the price of cotton at Karnataka and Andhra Pradesh cotton markets. The forecast was done for the first two markets in each State up to Dec'2014. Narrow variation was observed between actual and forecasted prices with an accuracy of 72%.
 - ◆ A total of 73,711 farmers were registered into a database called *e-kapas farmers' database*. Recorded noise free, short length, meaningful and timely messages were delivered through voice messages in the form of automatic phone calls to the registered farmers of Nagpur and Coimbatore.
 - ◆ Highest incidence of pink bollworm on non-Bt cotton was recorded in Junagadh (78.68 %) followed by Sirsa (61.21%) and Amreli (51.06 %) while the lowest incidence was recorded in Jalna and Nanded.
 - ◆ *Bracon lefroyi* (Dudgeon and Gough), a multiple braconid endoparasitoid causing larval mortality in pink bollworm was recorded from Nagpur.
 - ◆ In resistance monitoring of pink bollworm populations to Cry1Ac and Cry2Ab toxins during 2013-2014, Srivilliputtur, Sirsa, Junagadh and Khandwa populations recorded 2, 9, 4, and 20 fold resistances to Cry1Ac over susceptible check. Faridkot, Mansa, Sirsa, Rahuri, Akola, Junagadh and Khandwa populations recorded 25, 35, 35, 30, 40, 45, 140 and 330 fold resistances to Cry2Ab over the susceptible check.
 - ◆ Three high strength lines (CSH 3313, CSH 3047 and GTHH 032), identified as resistant source for bacterial leaf blight using CIR 246 marker were crossed with variety Suraj for incorporation of the trait through introgression breeding.
 - ◆ Among microbial inoculums, *Bacillus* sp. alone recorded highest seed cotton yield (1258 kg/ha) followed by TrichoCash alone (1255 kg/ha) and *P. fluorescens* alone (1208 kg/ha) compared to control (1035 kg/ha).
 - ◆ TrichoCash alone recorded statistically significant lowest PDI for Bacterial blight (11.38) followed by microbial consortia alone (15.51), Imidacloprid +Thiram (16.08), *Cedeceae davisae* alone (16.36) and *P. fluorescens* alone (18.32) compared to control (22.46).
 - ◆ Arogya (7.13) and CINHTi2 (8.99) recorded lowest PDI for bacterial blight, Supriya (9.25) and CINHTi2 (13.75) for myrothecium leaf spot, Suraj (6.66), Arogya (9.44) and ADB 532 (9.44) for grey mildew among 14 genotypes in HDPS under shallow soil. Spacing 45x10 cm recorded lowest average PDI for bacterial blight (32.0) and grey mildew (11.4).
 - ◆ CINHTi2 (20.75) and ADB 532 (23.93) recorded lowest PDI for bacterial blight, C1412 (12.69), Supriya (14.94) and Vikram (16.0) for Myrothecium leaf spot, Supriya (3.44), CINHTi1 (4.55) and Suraj (7.22) for grey mildew in medium soil. Spacing 60x10 cm recorded lowest average PDI for bacterial blight (30.75), 75x10 cm for Myrothecium leaf spot (19.28) and grey mildew (12.74).
 - ◆ *Anabaena laxa* + *Providencia* based formulation recorded highest seed cotton yield (1039 kg/ha), lowest Myrothecium leaf spot incidence (30.18 PDI) compared to control seed cotton yield (877 kg/ha), Myrothecium leaf spot incidence (42.11 PDI).
 - ◆ *B. subtilis* biofilm based formulation recorded highest seed cotton yield (5.03 q/ha) compared to control (3.62 q/ha) in genotype AKA7.
 - ◆ *Providencia* based formulation recorded lowest PDI for bacterial blight (7.1) followed by *Anabaena* – *P. fluorescens* biofilm based formulation (10.7) compared to control (33.3) in natural conditions in Suraj under HDPS.
 - ◆ *Anabaena* – *Bacillus* sp. biofilm based formulation, *Anabaena* - *Azotobacter* biofilm based formulation and *Providencia* based formulation recorded lowest PDI for bacterial blight of 7.1, 10.1 and 11.3 respectively and significant over control (44.0) in artificial inoculation of Suraj under HDPS.
 - ◆ PSP 8000 ppm seed treatment recorded lowest PDI for bacterial blight (20.2) followed by Agrisil 500 ppm spray (28.0), Agrisil 4000 ppm spray (28.6) and Agrisil 500 ppm seed treatment (31.5) and on par with each other and significant over control (47.60) under natural conditions in Suraj under HDPS.
 - ◆ PSP 2000 ppm seed treatment recorded lowest PDI for bacterial blight (19.64) followed by PSP 1 kg soil application (27.38) and Agrisil 4000 ppm spray (32.74) and the treatments were on par with each other and statistically significant over control (52.38) under artificial inoculation conditions in Suraj under HDPS.

- ◆ Nematode resistance and susceptibility were validated using molecular markers in genotypes Bikaneri Narma (resistant to rootknot nematode), American Nectariless and GCot-10 (resistant to Reniform nematode) and Suraj, Surabhi and NH615 (susceptible to nematodes).
- ◆ Three markers viz. CIR316, BNL3279 and NAU2152 have been validated for nematode resistance using 27 AICCIP high strength lines from Coimbatore.
- ◆ During mid season survey in Warud, Bhandara, Wardha, Katol, Kalmeshwar and Narkhed areas of Vidarbha region, lesion nematode *Pratylenchus goodeyi* was observed in samples from Warud and Bhandara districts.
- ◆ *P. goodeyi* was characterized based on 18sRNA sequence and populations and significant variations observed among populations. Molecular characterization has been done for *Rotylenchulus reniformis* and *Hoplolaimus columbus* isolated from cotton fields of Buldhana which were heavily infested with reniform nematode.
- ◆ Peak infestation of leafhoppers was observed between 38th to 41stSW, whitefly population with its peak at 39thSW (7.47 whiteflies/ 3 leaves). Two peaks of aphid incidence, first at 34th SW and second at 2nd SW (harvesting stage) were recorded. Thrips incidence was high at 3rd SW (6.23 thrips/3 leaves) and 5th SW (7.77 thrips/3 leaves).
- ◆ Pink bollworm incidence was below ETL during the entire crop season. Though large numbers of *Spodoptera* pheromone trap catches were recorded, the field damage was not correlated with trap catches.
- ◆ Life cycle of mealybug *P. solenopsis* was studied on five different constant temperatures (i.e. 12, 15, 18, 38, and 40°C) with respect to different developmental stages. Slow and lengthy growth recorded at lower temperature and fast and reduced growth recorded at higher temperature. The average total life cycle of female and overall development stage were found to be higher at 18°C.
- ◆ Biological diversity revealed five mealybug species viz. *Phenacoccus solenopsis* Tinsley, *Paracoccus marginatus* Williams and Granara de Willink, *Maconellicoccus hirsutus* (Green), *Nipaecoccus viridis* (Newstead) and *Ferrisia virgata* infesting cotton in a sporadic manner. Three mirid species viz. *Creontiades biseratense*, *Campylomma livida* and *Hyalopeplus lineifer* Walker and regular sucking pests viz. leafhoppers, thrips, whiteflies and aphids were recorded. Bollworms *H. armigera*, *E. vitella* and *P. gossypiella* were recorded from non-Bt cotton. The *Spodoptera litura*, semilooper and leaf folder damage was negligible.
- ◆ Forecasting models based on AICCIP historical data for sucking pests have been worked out. ARIMA model fitted and the goodness of fit statistics for different pests of seven years (2005-11) average data from Junagadh and Akola. Model indicated that R² values for Junagadh are 0.84, 0.93, 0.78, 0.86 and Akola are 0.73, 0.67, 0.63, and 0.60 for aphids, jasids, thrips and whiteflies respectively.
- ◆ Five parasitoids viz. *Aenasius bambawalei*, *Acerophagus papayae*, *Anagyrus kamali*, *Aprostocetus* sp., *Homalotylus* sp. found parasitizing different species of mealybugs infesting cotton in central zone. Average parasitism of *P. solenopsis* by *A. bambawalei* was 11%, *P. marginatus* by *Acerophagus papaya* was 8%, *N. viridis* by *Anagyrus kamali* was 14% and *N. viridis* by *Aprostocetus* sp. was 7.5%. The highest population of general predator *Cheilomenes sexmaculata* recorded during 1st week of August to first fortnight of September. Dipteran fly *Cacoxenus perspicax* (Knab) was found to predate on *N. viridis* (26.3%). *Hyperparasitoids Promuscidea unifasciiventris* was recorded from *N. viridis* colonies parasitized by *Anagyrus kamali* and *Aprostocetus* sp. Nine species of spiders have been identified from cotton fields during crop season 2013-14.
- ◆ Un-infested plants emit low ethylene while infested plants (Grade II to IV) emit significantly higher ethylene. The corresponding ethylene emission under protected and unprotected plants for the grades I, II, III and IV were 1.24, 1.54, 1.49 & 1.52 and 1.11, 1.44, 1.60 & 1.65 ppm respectively. A leaf hopper stressed plant at 60 DAS released up to 4 ppm ethylene while the levels were undetectable in control plants.
- ◆ Over the season, average per cent insect fauna trapped by yellow sticky trap for whiteflies were 4.90 & 6.39, leafhoppers 37.93 & 44.40, aphids 1.19 & 1.74, ladybird beetle 0.86 & 0.95, Hymenoptera 0.10 & 0.11 and Dipteran flies 0.70 & 0.74 under protected and unprotected fields respectively.
- ◆ Five cultures with elite fibre properties and comprehensive pest tolerance were developed with yield potential of 8 q/ha under unprotected conditions at normal spacing. One of these is compact with short sympodia, is highly suitable for HDPS.
- ◆ Ethylene responsive factors 1 and 2 (ERF 1 and 2) were over expressed by 2.94 and 17.4 times in leaves of leaf hopper infested plants as compared to control plants while ERF3 remained unaffected.
- ◆ Sticky trap (28.5 cm x 22 cm) was used as a mobile trapping unit for sucking pests at 65 DAS. Leaf

hopper and whitefly adults were trapped effectively while nymphal population was under estimated. Manual counting of leaf hopper adults was positively correlated (0.8) with mobile sticky trap count in 14 varieties.

- ◆ Pyridalyl recorded an LC₅₀ of 68.74 ppm while nano pyridalyl recorded an LC₅₀ of 43.88 ppm against one day old *H. armigera* in diet incorporation bioassays. The EC₅₀ of nanopyridalyl (16.74 ppm) was 3 fold higher than pyridalyl (51.26 ppm).
- ◆ Pyridalyl recorded an LC₅₀ of 13724 ppm while nano pyridalyl recorded an LC₅₀ of 9166 ppm against 3rd instar larvae of pink bollworm in diet incorporation bioassays. The EC₅₀ of nano pyridalyl was 11.8 fold higher (346 ppm) than Pyridalyl (4094 ppm).
- ◆ Topical bioassay of Thiodicarb against 2 strains of *H. armigera* (Coimbatore and Washim) at the 3rd instar larvae recorded LC₅₀ of 2.51 and 1.91 ppm, respectively. Topical bioassay of Flubendiamide (new molecule) against 3rd instar larvae of 2 strains of *H. armigera* from Sirsa and Parbhani exhibited an LC₅₀ of 0.297 and 0.117 ppm respectively.
- ◆ Cotton semilooper *Anomis flava* recorded 1000 fold more tolerant to Cry2Ab (LC₅₀=0.212 µg/ml) as compared to Cry1Ac.
- ◆ *H. armigera* larvae were collected from Sirsa on BGII and non-Bt cotton. The non-Bt population exhibited minimal mortality for Cry1Ac at highest concentration of 1.97 µg/ml of diet and EC₅₀ of 0.469 µg/ml of diet in F₁ generation. Cry2Ab exhibited an EC₅₀ of 27.26 µg/ml of diet on field resistant Sirsa population. Populations generated from BGII collections exhibited LC₅₀ and EC50 values of 2.46 and 0.061 µg/ml of diet for Cry1Ac.
- ◆ F₂ screen study of *H. armigera* was carried out using 256 iso-females from Gujarat and 215 iso-females from Maharashtra. Resistance to Cry1Ac was detected in the F₂ population of Surat (A7, 2, 5) and F₁ population of Buldana (A10). The resistant Surat *H. armigera* (Surat A7, 2, 5, 1, 5) line exhibited no mortality at the highest concentration of 1.97µg/ml of diet of MVP11 with an EC₅₀ of 0.071 µg/ml for Cry1Ac while LC₅₀ to Cry2Ab was 2.66 µg/ml of diet and EC₅₀ was 0.712 µg/ml of diet.
- ◆ Full length cDNA sequence of Chitin synthase A (4704bp) of *Helicoverpa armigera*, and exons of alternative spliced variants (A1 and A2) was isolated based on the sequence information from BAC clone of *Helicoverpa zea*. Homology based search with nucleotide sequence (blastn) and translated nucleotide query (blastx) showed 98% and 99 % similarity with *Helicoverpa zea*.
- ◆ qPCR analysis using the primer designed for conserved region of chitin synthase A and B indicated that chitin synthases A and B remain highly expressed in the midgut tissue of all the larval stages tested.
- ◆ Maximum percent reduction in whitefly population was observed with insecticide Diafenthiuron (55.76%) and Triazophos 40EC (52.00%) treatment followed by Neemazal-T/S, 1%EC (45.51%) and Flonicamid 50%WG (33.60).
- ◆ University recommended dose of diafenthiuron @ 312.5 g/ai gave maximum percent reduction (51.36%) in whitefly population followed by its label claim dose @300gai/ha. Resurgence in whitefly population was observed at both label claimed and university recommended doses of Fipronil 5% SC.
- ◆ Overall Pink bollworm (PBW) % recovery ranged between 4.7 to 19.90 % upto 160 DAS from Non Bt bolls collected from different locations of North Zone. No larval recovery as well as damage was recorded from the collected Bt cotton fields from different locations at different intervals.
- ◆ Peak catch of PBW moths was recorded during 42nd SMW (25.62/trap/week), American bollworm (ABW) during 12th SMW (48.1/trap/week), Spotted bollworm during 39th SMW (29.29/trap/week) and Tobacco caterpillar during 18th SMW (205.7/trap/week) was observed.
- ◆ The cotton leaf curl virus disease appeared in 24th meteorological week and reached 100% at 33rd week in the screening nursery of Sirsa regional station. The incidence and severity of disease was higher compared to 2011-12 & 2012-13. The incidence of whitefly was also very high during the period with a maximum of 32 whiteflies /3 leaves in the 30th week. Flare up of whitefly population might be due to less rainfall received during June and July in north zone. The whitefly range from 4.5 to 32.0 /3leaves during the period. The range of maximum temperature between 31.5-39.9 °C and minimum temperature between 25.4-29.5 °C was recorded during the period. The morning and evening relative humidity varied from 59.4-90 and 31.9-81.3 % respectively.
- ◆ Based on station and field experiments, the minimum PDI was noted in case of Cow urine treatment (51.32) @ 6.6% followed by neem oil (51.91) @ 1% and calcium nitrate (52.95) @0.5% as compared to control (56.28). Reduction of whitefly population from 9.8 -13.3 in case of neem oil as compared to -34.5 to 37.4% in control was also noted. There was improvement in yield upto 1.1 q/ha in cow urine spray treatment.