

### 3.18 : Seasonal Dynamics of Insect Pests and Diseases

#### Nagpur

#### Seasonal dynamics of cotton sucking pests and bollworms

Peak infestation of leafhoppers was recorded between 38<sup>th</sup> to 41<sup>st</sup> (SW) (Fig. 3.18.1). Similarly whitefly population was also at peak during this period (Fig. 3.18.2). Where as for aphids, two peaks were recorded at the beginning of the season (34 SW) and at harvesting

stage of crop (2<sup>nd</sup> SW) (Fig. 3.18.3). The late infestation, severely affected the quality of seed cotton as sooty mold developed on leaves and lint. During initial phase of crop growth thrips population recorded was upto 5.03 thrips/ 3 leaves at 38 SW, however it declined subsequently and reappeared at the later part of season with peak at 3<sup>rd</sup> and 5<sup>th</sup> SW (Fig. 3.18.4). During the entire season, mirid *C. livida* population was low and negligible population of *H. armigera*, *E. vitella*, *P. gossypiella* and *S. litura* was recorded on Bt cotton during the season. Non Bt cotton recorded small population of the bollworms during 40–43 SW.



Fig. 3.18.1: Seasonal dynamics of leaf hopper

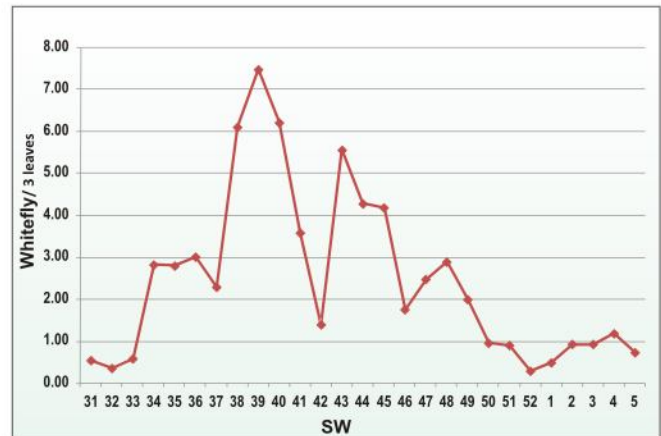


Fig. 3.18.2: Seasonal dynamics of whitefly

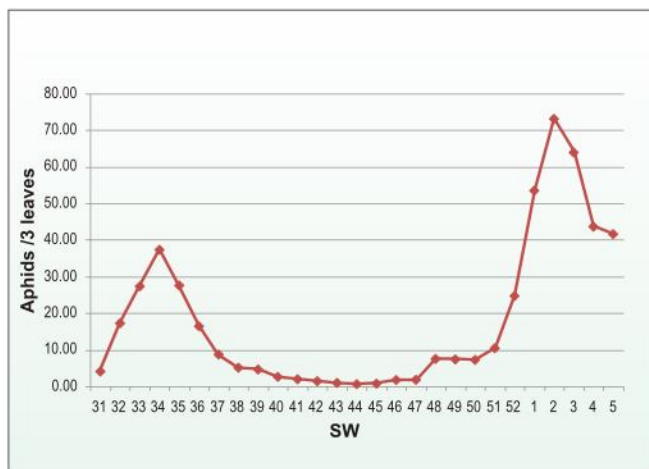


Fig. 3.18.3: Seasonal dynamics of aphid

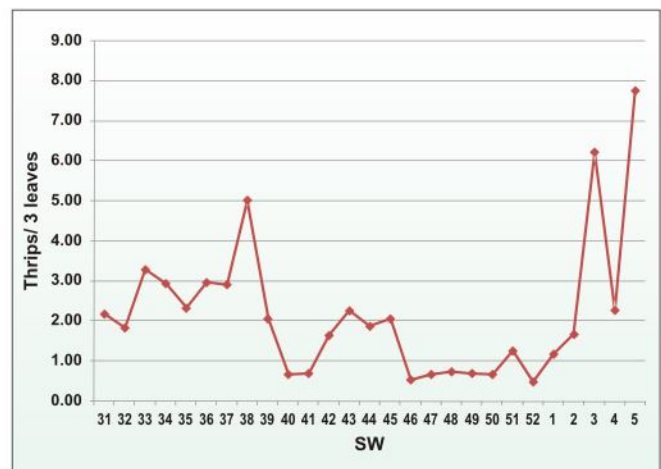


Fig. 3.18.4: Seasonal dynamics of thrips

The population dynamics of insect pests under high density planting system of cotton was recorded throughout the season. The incidence of sucking pests was low at initial stage of crop at 33 DAS. In the entire cropping season leaf hopper was recorded below ETL except 70 DAS where it crossed ETL @ 7.43 Jassid nymphs /3 leaves /plant. The incidence of bollworm was low during the season with 3.5 – 8.7% square damage between 70 and 80 DAS. The per cent boll damage by bollworms

was negligible throughout the season.

#### Correlation of insect pest with weather parameters

Leafhopper population was positively correlated with temperature and humidity while negatively correlated with rainfall and rainy days. Aphid population has positive correlation with T min, RH max & RH min and rainy days while negatively correlated with T max and rainfall. All the weather parameters were negatively correlated with mirid population.

Weather parameters	Leafhoppers /3 leaves	Aphids/3 leaves	Thrips/3 leaves	Whitefly/3 leaves	Mirid in top 1/3 <sup>rd</sup> portion
T Max	0.556	-0.195	0.279	0.326	-0.030
T Min	0.459	0.2165	0.647	0.360	-0.634
RH Max	0.236	0.398	0.586	0.179	-0.610
RH Min	0.231	0.342	0.596	0.224	-0.654
Rainfall	-0.019	-0.422	-0.141	0.044	-0.095
Rainy days	-0.347	0.465	0.771	-0.18	-0.863

### Pheromone trap catches of bollworms

Negligible pheromone trap catches as well as field damage of spotted bollworm was recorded during the season. American bollworm catches up to five moths/trap/week were recorded during 36-37<sup>th</sup> SW, subsequently decreased significantly, reappeared during the month of December at the boll opening stage with maximum catches during January (10 moths/trap/week). Population of pink bollworm never crossed ETL (8 moths/trap/night for three consecutive nights) during the normal season. Though large numbers of catches were recorded in case of *Spodoptera*, damage was not correlated with the pheromone trap catches.

### Correlation between pink bollworm damage and pheromone trap catches

Pink bollworm damage on DCH32 and pheromone trap catches were positively correlated ( $r=0.41$ ) during the crop season. The trapped moth catches and boll damage were initiated during second fortnight of October when T max and T min were 30°C and 21°C, respectively. Damage was seen to be increasing with decreased T max and T min subsequently. Highest moth catches and boll damage was recorded during last week of January (Fig. 3.18.5). Thus management of pink bollworm is crucial during second fortnight of October till the end of January. Bt cotton genotypes (BGII) were free from pink bollworm infestation.

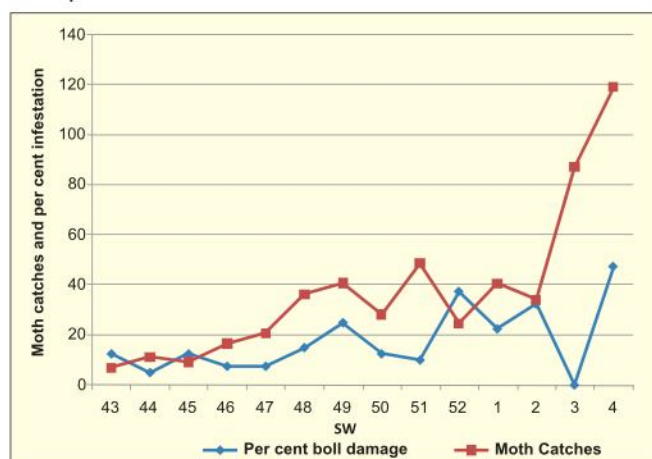


Fig. 3.18.5 : Pheromone trap catches vs percent boll damage

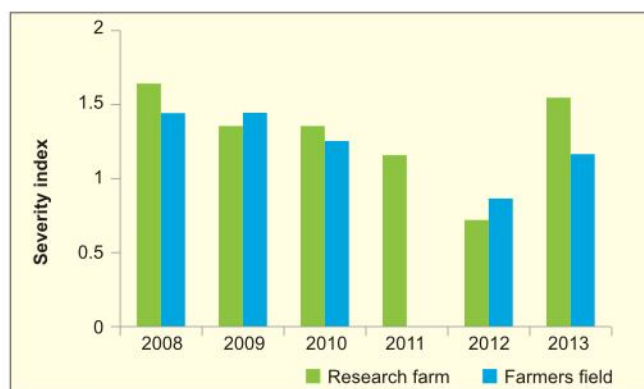
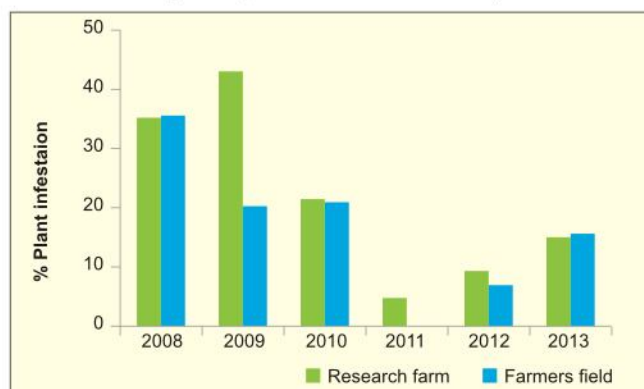
### Developmental studies of mealybug *P. solenopsis* on 5 extreme constant temperatures

Life cycle of mealybug *P. solenopsis* at 5 constant temperatures (*i.e.* 12, 15, 18, 38, and 40 °C) with respect to fecundity, nymphal development, duration and average total life period, was studied. Maximum percent oviparity (97.7) was observed at 38 °C followed by 18 °C (94.9). Adult longevity was maximum (28.6 days) at 18 °C followed by 12 °C, (27.1 days). The average total life cycle of female was longest at 18 °C of 82.8 days, followed by 12°C (54.1 days).

### Sirsa

#### Population dynamics of cotton mealybug in north zone

Population dynamics of cotton mealybug in north zone indicated declining mealybug incidence from 2008-09 to 2011-12. However, the incidence and severity increased in the last two years (2012-13 and 2013-14).



### Population dynamics to develop suitable forecasting model

Four varieties i.e. RCH-134 BG-II, RCH-134 Bt, HS-6 and Ganganagar Ageti (GA) were sown during 2013-14 to ascertain population dynamics of sucking pest (leafhopper, whitefly, thrips and mealybug), natural enemies (spider, chrysoperla and lady bird beetle) and bollworms. On the basis of 17 weekly observations, peak population of leafhopper, whitefly and thrips was recorded at 26, 30-31 and 30-32 SMW respectively in RCH-134 Bt, RCH-134 BGII, HS-6 and Ganganagar Ageti. No bollworm incidence was recorded in BG and its BG-II counterpart whereas in non Bt (HS-6: and Ganganagar Ageti) the bollworm incidence was recorded.

### 3.19 : Biological Diversity of Insect Pests and Pathogens

#### Nagpur

#### Biological diversity of insect pests of cotton in central zone

**Mealybugs:** During the crop season five mealybug species viz., cotton mealybug *Phenacoccus solenopsis* Tinsley, papaya mealybug *Paracoccus marginatus* Williams and Granara de Willink, pink hibiscus mealybug *Maconellicoccus hirsutus* (Green), spherical mealybug *Nipaecoccus viridis* (Newstead) and striped mealybug *Ferrisia virgata* Cockrell were recorded infesting cotton in sporadic manner. *P. solenopsis* was recorded from almost all the cotton growing districts of Vidarbha and Marathwada of central zone. *P. marginatus* which devastated cotton and other crops in South India is now being recorded on cotton in central zone. The mealybug was recorded from fields of Saoner of Nagpur district, Khairi–Taygaon village of Sausar Taluka of Chhindwada district (MP), and few locations of Aurangabad districts of



*Paracoccus marginatus*

*Nipaecoccus viridis*



*Ferrisia virgata*

*Maconellicoccus hirsutus*

Marathwada region at the maturity stage of crop. *P. marginatus* infestation varied between 5-10% in the infested fields. *M. hirsutus* (Green), *N. viridis* (Newstead) and *Ferrisia virgata* Cockrell were recorded from Nagpur district. *Ferrisia virgata* was recorded on variety Suvin from experimental fields of CICR, RS, Coimbatore. Mango mealybug *Rastrococcus iceryoides* (Green) was not recorded in this season. Another mealybug species *Coccidohystrix insolita* Green has been recorded on pigeon pea which is the most preferred intercrop in central zone. *P. marginatus* was free of parasitoids in Nagpur.

**Mirids:** Three species of mirids *Campylomma livida* and *Hyalopeplus lineifer* Walker in central zone and *Creontiades biseratense* (Distant) in south zone were recorded infesting cotton. Nymphs and adults feed on squares and small developing bolls by piercing the plant tissues with their stylet. The affected area becomes dull in colour, then blackens and ultimately results in death of cells in the region. Feeding by these insects led to heavy shedding of medium sized squares and tiny bolls. Larger



*Phenacoccus solenopsis*



*Creontiades biseratense*



*Campyloomma livida*



*Hyalopeplus lineifer*

squares suffer damage that may cause development of deformed bolls which is often referred to as 'parrot beaking'. Diverse colour morphs (green, yellow and red) were noticed in *H. lineifer*.

**Vertebrate pests :** On an average, rodent pest caused 0.5 % loss by destroying whole cotton plants at maturity stage at CICR experimental fields during January 2014. Rodents made burrows in the cotton field and gnawed the tap root causing the separation of main stem from its tap root. Stored cotton were also damaged by rodents. Rat species *Bandicota bengalensis*, *Tatera indicia*, *Mus booduga* are known field rodents that cause damage in central India.

**Monitoring of pink bollworm in India**

The incidence of pink bollworm on BG, BG-II and non Bt cotton fields was monitored across India. The intensity of pink bollworm on non Bt was higher in Junagadh (78.68 %), Sirsa (61.21%) and Amreli (51.06 %) as compared to Surat, Bharuch, Anand, Rajkot, Surendranagar, Sriganaganagar, Hisar, Faridkot, Raichur, Rahuri, Dharwad and Khandwa. The lowest intensity of pink bollworm on Non Bt was recorded in Jalna and Nanded. The intensity of pink bollworm was more in Madhya Pradesh as compared to other cotton growing states in India.

**Other minor pests :** Green bug *Nazara virudula* at boll development stage was noticed. A large number of red cotton bug population was recorded at the boll opening



stage while dusky cotton bug was in lesser number.

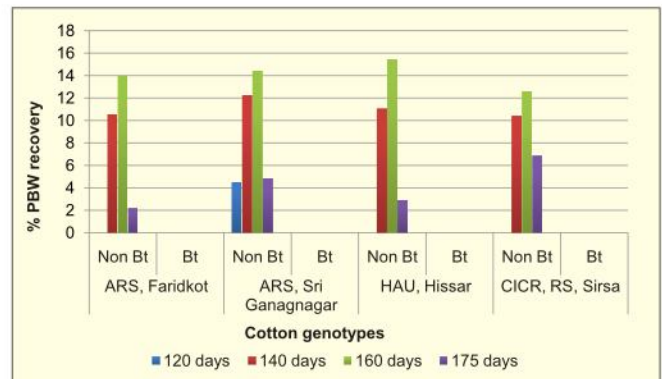
**Nematodes as pests of cotton**

Characterization of plant parasitic nematodes associated with cotton in Vidarbha through pre-season and mid season surveys in Warud, Bhandara, Wardha, Katol, Kalmeshwar and Narkhed was initiated. Lesion nematode *Pratylenchus goodeyi* was found associated with cotton in samples from Warud and Bhandara districts. Populations in some samples ranged between 50-105 nematodes per 250 cc soil. Population of reniform nematodes crossed threshold (1 nematode /cc/soil) only in irrigated conditions. *P. goodeyi* characterized based on 18sRNA and populations were found to have significant variation in 18sRNA sequences. Molecular characterization of *Rotylenchulus reniformis* and *Hoplolaimus columbus* isolated from cotton fields at Buldhana heavily infested with reniform nematode was done. Sequences of 18sRNA genes KF275666 (*Hoplolaimus columbus*) and KF267455 (*Rotylenchulus reniformis*) deposited with NCBI.

All the common dicot weeds associated with cotton were found as good hosts of reniform nematode, *Rotylenchulus reniformis*

**Sirsa**

On the basis of three year data collected during 2010-2013, the average larval recovery at different locations in the north zone ranged from 0 to 15.54 % at different stages of crop. (Fig 3.19.1). No larvae were recovered from BG II cotton at any of the locations.



**Fig. 3.19.1 : Pink bollworm (%) larval recovery from green bolls of Bt and Non Bt cotton collected at different stages of crop in north zone**

## Coimbatore

### Occurrence of tailed mealy bug *Ferrisia virgata* (Cockerell) on cotton

*Ferrisia virgata* (Pseudococcidae: Hemiptera) was recorded on variety Suvin from experimental fields of CICR, Regional Station, Coimbatore. Percent infestation ranged from 16-83 during June – August 2013. The nymphs and adults were observed causing damage on the squares, leaves and bolls. Predator diversity was recorded on *F. virgata*. Grubs and adults of *Cryptolaemus* sp., *Scymnus* sp., and *Spalgis epius* fed on nymphs and adults of the mealy bug.

### Tobacco Streak Virus (TSV) disease

Survey was carried out in two districts each in Andhra Pradesh (Guntur and Nandyal) and Tamil Nadu (Erode and Coimbatore). Of the 23 fields from ten mandals surveyed in Guntur district, TSV incidence was recorded in 20 fields; one field in Tularu mandal and two fields in Pedanandipadu mandal were found free from the disease. One of the fields in Prattipadu mandal had the higher disease incidence of 27 %. Ten villages belonging to three mandals namely, Nandyal, Gospadu and Dornipadu of Karnal district were surveyed. No incidence of TSV was observed in one field in Bimavaram village (Nandyal mandal) and in two fields in Dornipadu village (Dornipadu mandal).

In Tamil Nadu, Coimbatore and Annur taluks in Coimbatore, and Anthiyur and Bhavani taluks in Erode districts were surveyed, where 1.5 % disease incidence was observed only in one field in Anthiyur block of Erode District. Others were completely free from TSV incidence.

At CICR Regional Station Coimbatore, 305 germplasm lines of *G. barbadense* L. were observed for natural incidence of TSV, as cotton with *G. barbadense* blood are considered to be more prone to TSV infection. Plants with typical TSV symptoms were observed in these germplasm lines and are documented.



TSV Symptoms on infected cotton plants

## 3.20 : New Genes and Gene Sources for Pest Management

### Nagpur

Native lectin gene from *Trichoderma* cloned into expression vector and expression of lectin confirmed in the crude samples through ELISA. Also lectins produced from *Trichoderma* cross reacted with *Colocasia/Amorphophallus* lectins.

**Novel genes being deployed at CICR :** CICR truncated toxin, Cry2Ab CICR, Fusion CICR were evaluated against *Spodoptera litura* F<sub>1</sub> neonates in a leaf dip assay. Also included in the bioassay were Cry2Ab corn leaf powder (96ug Cry2Ab/ml), MVPII 19.7ug Cry1Ac/ml and buffer control. Mortality was low varying from 6-13% with Cry2Ab CICR and Cry2Ab corn leaf powder. Cry2Ab CICR was on par to Cry2Ab corn leaf powder in terms of larval mortality but was superior to Cry2Ab from corn leaf powder in terms of growth regulation and percent larvae exhibiting growth regulation.

The crude toxin of CICR truncated Cry1Ac, Cry2Ab CICR, Fusion CICR were evaluated against *H. armigera* (F<sub>1</sub>, one day old) in a diet incorporation bioassay. These were found inferior to the analogous toxins being produced in transgenic cotton in terms of larval mortality despite exhibiting excellent growth regulation. Further purification may help improve their toxicity in terms of larval mortality.

Isolated full length cDNA sequence of Chitin synthase A (4704 bp) of *Helicoverpa armigera*, and exons of alternative spliced variants (A1 and A2) 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 of chitin synthase A and B in whole insects of first and second instar, different stages and tissues (trachea, midgut and cuticle, of the 3<sup>rd</sup>, 4<sup>th</sup> and 5<sup>th</sup> instar larvae) of *Helicoverpa armigera* showed differential expression. The qPCR analysis using primers designed for conserved region of chitin synthase A and B remain highly expressed in the midgut tissue of all the tested larval stage.

### RNAi mediated silencing of parasitism genes of *Meloidogyne incognita*

For molecular characterization rDNA sequences, the large subunit, small subunit and the internal transcribed spacer regions (ITS) were considered. The forward primer TW81 (GTTCCGTAGGTGAACCTGC) and the reverse primer AB28 (ATATGCTTAAGTTCAGCGGGT) were used in the PCR reaction for amplification of the

complete ITS region. Amplicon was sequenced and blasted to confirm identity as cotton race of rootknot nematode.

RNA was extracted from Root-knot nematode females, males and juveniles. Quality of RNA was confirmed by running on Agarose gel and cDNA was synthesized. Based on sequences of oesophageal parasitism genes in data bases, primers were synthesized for twenty parasitism genes.



**Egg masses of root knot nematode visible as brown specks**



**Reniform nematode infected field showing patchy growth**

#### **Screening for Lectins in cotton germplasm**

Eight hundred and forty eight germplasm lines that were being evaluated for water logging and drought were also evaluated for the presence of lectins with cross reactivity to CEA/AMTL lectin in the seed and leaf using ELISA. None of the lines tested positive for the presence of the CEA/AMTL class of lectins.

### **3.21: Development of New Methods, Tools and Protocols**

#### **Nagpur**

##### **Evaluation of ethylene sensor**

Digital hand held ethylene detection gadget (Portable ethylene gas detector 601 manufactured by Premier Controls, India) was evaluated for the first time for quantification of ethylene production under biotic stress. A leaf hopper stressed plant released upto 4 ppm ethylene at 60 DAS while ethylene levels were undetectable in control plants.



Three stress related genes (ERF 1,2,3) were studied for their expression in cotton leaves of leaf hopper infested and un-infested plants of *G. hirsutum* through RT PCR. 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 un-infested plants while ERF3 remained unaffected.

Diurnal variation in ethylene emitted from seventeen varieties was recorded using the hand held monitor. Ethylene emission was significantly higher in the morning as compared to the evening.

Ethylene sensor observations indicated insignificant difference between within infestation grades under protected and unprotected cotton plants while they were significantly different between different grades (Grade I and grade II to IV). Non infested plants emit least 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 and 1.65 ppm, respectively.

Sticky trap (28.5 cm x 22 cm) was used as a mobile trapping unit at 65 DAS. While it effectively trapped only leaf hopper and whitefly adults, nymphal population was

under estimated. If it is used early in the season it could help in mechanically controlling leaf hopper population build up in the field. The trapping of natural enemies was minimal when the sticky mobile trap was operated between 9.30 am to 12 noon.

Using this mobile sticky trap as a monitoring unit in 14 varieties manual counting was positively correlated (0.8) to the mobile sticky trap count with respect to leaf hopper adults.

### Identification of suitable sensors for the development of electronic gadgets for the detection of pink bollworm

To detect the pink bollworm larva inside the bolls, techniques such as ultra sound and CT scan were applied. On using ultra sound, it was observed that the thick outer coat and cotton fibers inside the bolls prevented the penetration of the sound waves to get the clear picture of larva or boll content. However detection of pink boll worm using acoustic vibration sensors is found feasible in the development of the pest detection gadget.

#### 1. Weather based population prediction model for sucking pests

##### a. *Campyloomma livida* in rainfed cotton of central India

Weather based population prediction model for Mirid *Campyloomma livida* that was developed, revalidated and prediction accuracy was 92%. The criteria was satisfying  $\geq 5$ , four and  $\leq 3$  of the six weather based parameters viz., temperature maximum  $> 31^{\circ}\text{C}$  and minimum  $21-24^{\circ}\text{C}$ , relative humidity maximum  $> 85\%$  & minimum  $30-70\%$ , rainfall  $< 25$  mm and rainy days between 2 and 4 days on weekly basis predict the severity of *C. livida* on Bt cotton as to high ( $> 4$  nos/plant), moderate ( $> 2-4$  nos/plant) and low ( $0-2$  nos/plant), respectively.

##### b. *Creontiades biseratense* in cotton with pulses as intercrop in south India

Mirid bug *Creontiades biseratense* prediction modeling was developed in cotton with pulses as intercrop in south India. By using the mirid population data for (2008-09 to 2010-11) and weather parameters criteria taken for *C. livida*, a prediction model was developed. Prediction modeling developed for *C. biseratense* showed prediction accuracy of 80.00% during 2013-14.

#### 2. Testing of weather based prediction for sucking pests

a. **Jassids** : Weather based heuristic rules for predicting jassids validated with data sets (2009 -2013) of Nagpur location indicated average 89 % accuracy.

The prediction rules was developed by taking historical data sets (2001-2008). The criteria were mean temperature ( $25-28^{\circ}\text{C}$ ), mean humidity ( $65-85\%$ ), total rainfall ( $50-80$  mm) and rainy days (2 to 4). Severity levels based on mean jassid population per three leaves were high ( $>8$ ), moderate ( $> 4-8$ ) and low ( $<4$ ). All four, three and two or less of the formulated weather criteria being satisfied predicted high, moderate and low levels of jassid severity, respectively. Drawback of this rule was higher prediction accuracies at low levels of pest severity. The rules developed for Nagpur location tested across other locations of central zone indicated varying degree of accuracies and need fine tuning for individual locations.

b. **Thrips** : Weather based heuristic rules for predicting thrips were validated with independent testing data sets (2009-2013) of Nagpur location indicated average 97% accuracy. Weather based prediction rules was developed by taking historical data sets (2001-2008). Criteria were mean temperature ( $25-29^{\circ}\text{C}$ ), mean humidity ( $67-86\%$ ), total rainfall ( $30-80$  mm) and rainy days (3 to 6). Severity levels based on mean thrips population per three leaves were categorized as high ( $>10$ ), moderate ( $>5-10$ ) and low ( $<5$ ). All four, three and two or less of the formulated four weather criteria being satisfied predicted high, moderate and low levels of thrips, respectively. This rule predicted well only at low levels of pest severity and therefore needs fine tuning.

#### 3. Forecasting models for sucking pest

Forecasting models for sucking pest based on AICCIP historical data were worked out. Auto-Regressive Integrated Moving Average (ARIMA) model fitted. Goodness of fit statistics for the different pests for seven years (2005-11) average data for Junagarh and Akola indicated  $R^2$  values for Junagadh 0.84, 0.93, 0.78, 0.86 and Akola 0.73, 0.67, 0.63, 0.60 for aphids, jassids, thrips and whiteflies, respectively.

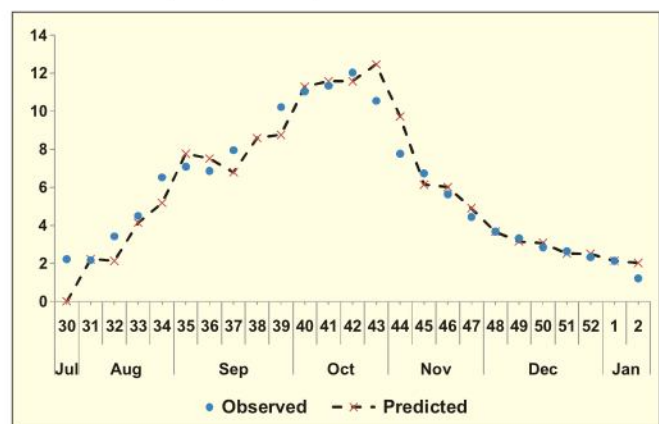


Fig. 3.21.1: Actual and predicted values of average Jassid incidence for seven years for the SMW 30-52 and 1 and 2 for Junagarh

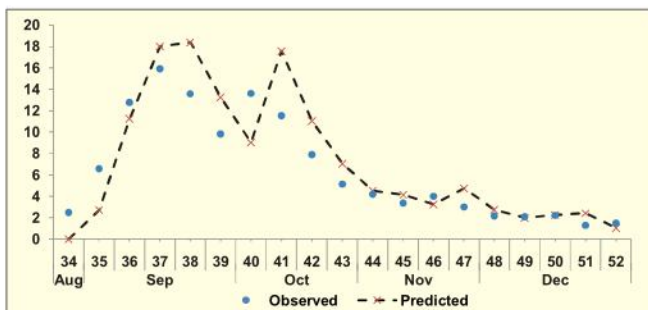


Fig. 3.21.2 : Actual and predicted values of average Jassid incidence for seven years for the SMW 34-52 for Akola

### 3.22: Host-Plant Resistance to Insect Pests and Diseases

#### Nagpur

Five cultures with elite fibre properties and comprehensive pest tolerance gave yields of 8 q/ha under unprotected conditions at normal varietal spacing. Of these 2 cultures ranked 3<sup>rd</sup> (14 q/ha) and 4<sup>th</sup> (13.9 q/ha) with respect to yields in station trial. One of these is compact with short sympodia, also making it suitable for HDPS.

CINHTi1 and CINHTi2 registered genetic stocks from the division were tested under HDPS. Minimal incidence and damage due to sucking pests were recorded on CINHTi2 while CINHTi1 recorded minimal pink bollworm infestation.

About 100 single plant selections for jassid resistance (ie those plants showing Grade 0) were made in Suraj plot at peak leaf hopper incidence.

Among the different cotton genotypes screened against reniform nematode, *Rotylenchulus reniformis*, G-Cot-10 was found to be moderately resistant and American Nectariless was found to be resistant. Based on biology and histopathological studies, all other genotypes were recorded with varying degrees of susceptibility to reniform nematode.

### 3.23: Biological Control

#### Nagpur

Three novel strains of *Trichoderma* (two *T. harzianum* and one *T. atroviride*) from wild mushroom and tree bark were isolated and evaluated for their biocontrol potential against *Sclerotium delphinii* infecting cultivated cotton seedlings. *T. harzianum* strain CICR-G, isolated as a natural mycoparasite on a tree-pathogenic *Ganoderma* sp. exhibited the highest disease suppression ability. This isolate was formulated into a talcum-based product and evaluated against the pathogen in non-sterile soil. This isolate conidiated profusely under conditions that are non-conducive for conidiation by three other *Trichoderma* species tested, thus having an added

advantage from commercial perspective. *Trichocash*, a *Trichoderma harzianum* formulation developed at CICR, was submitted to AICCIP for multi-location testing.

A strain of *Trichoderma* that is sold widely in India as *T. viride* was analysed and a DNA-sequencing (*tef1* gene)-based phylogeny revealed that this isolate is not *T. viride* (as claimed) but *T. asperelloides*. This analysis was also performed on a commercial formulation based on *T. viride* TNAU isolate (PhytoGuard 1% WP, Central Biotech, Nagpur, India) and the sequence was identical with that of the original TNAU isolate, thus confirming the identification. The *tef1* large (4<sup>th</sup>) intron sequence has been deposited with NCBI Gen Bank (accession no. KC679856). This finding necessitates the re-designation of more than 250 registered commercial formulations based on *T. viride* TNAU isolate as *T. asperelloides*.

Three native bio-control agents with demonstrated efficacy against cotton disease causing pathogens under *in-vitro* conditions registered with National Bureau of Agriculturally Important Microorganisms: *Trichoderma harzianum* CICR E: MTCC11500, *T. harzianum* CICR G: MTCC11511, *T. atroviride* CICR A: MTCC11512.

A native, rare, multiple Hymenopteran endo-parasitoid *Bracon lefroyi* (Dudgeon & Gough) caused large scale pink bollworm larval mortality in non Bt field populations of Nagpur for the first time. Dead pink bollworm larvae were placed individually in vials. Grubs of the parasitoid were seen in some vials along the body of pink bollworm. These grubs converted to pupae and adult emergence was noted. Emergence of the parasitoid was not recorded from all dead pink bollworm larvae indicating that parasitoid may have emerged prior to collection of pink bollworm larvae or that natural mortality of the pest may be due to more than one factor. This parasitoid was reported also from Iran on *Earias insulana* in 1976. Natural parasitisation of pink bollworm is being reported after a very long time in cotton. Avoidance of insecticide sprays from green boll - boll opening stage in this region would be necessary to conserve this endoparasitoid.



#### Sirsa

Seed treatment using IARI's biofilm technology was found effective in enhancing plant stand and seedling vigor of variety PKV 081 in Nagpur while it enhanced protection against *Rhizoctonia solani*.

## Coimbatore

Isolation and charatersation of micro flora from the gut system of the insects

Three bacterial endosymbionts were isolated of which 2 endosymbionts were characterized from *H. armigera* larvae.

Bacterial endosymbionts isolated from *H. armigera* gut, submitted to NCBI Gene Bank

S.No	Organism	Gene accession Number
1.	<i>Asaia bogorensis</i> strain CICR8	KF747356
2.	<i>Klebsiella variicola</i> strain CICR14	KF747357

## Nagpur

### Evaluation of TrichoCASH (*Trichoderma harzianum* 1% WP) under field conditions

Seed treatment with TrichoCASH (*T. harzianum*) CICR-G 1% WP - (10 g/kg seed) recorded highest mean single boll weight (3.87 g), seed cotton yield (8.98 q/ha) and lowest myrothecium leaf spot (20.63 PDI) and grey mildew disease (15.33 PDI) incidence compared to control mean single boll weight (3.25 g), seed cotton yield (8.46 q/ha), myrothecium leaf spot (31.74) and grey mildew incidence (19.0) and statistically non significant.

### Evaluation of microbial inoculants for seed treatment in cotton

Among microbial inoculums, *Bacillus* sp alone recorded highest root length (11.81 cm), shoot length (20.93 cm) and biomass (7.86 g) followed by Microbial consortia (MC)+TrichoCASH - root length (11.76 cm) and shoot length (20.90 cm) compared to control root length (10.41 cm), shoot length (19.76 cm) and biomass (6.05 g).

*Bacillus* sp. alone recorded highest seed cotton yield (12.58 q/ha) followed by TrichoCASH alone (12.55 q/ha) and *P. fluorescens* alone (12.08 q/ha) compared to control (10.35 q/ha).

TrichoCASH alone recorded significantly lowest PDI for Bacterial blight (11.38) followed by MC alone (15.51), Imidacloprid +Thiram (16.08), *Cedeceae davisae* alone (16.36) and *P. fluorescens* alone (18.32) compared to control (22.46).

*Cedeceae davisae* alone recorded lowest Grey mildew disease incidence (16.33) compared to control (17.33).

### Evaluation of bio-inoculants for growth promotion and bio-control in *G. hirsutum* and *G. arboreum*

*Anabaena laxa* + *Providencia* based formulation recorded highest seed cotton yield (10.39 q/ha) and lowest *Myrothecium* leaf spot incidence (30.18 PDI)

compared to control seed cotton yield (8.77 q/ha), *Myrothecium* leaf spot incidence (42.11 PDI) in genotype PKV 081.

*Anabaena* - *Azotobacter* biofilm based formulation recorded highest average single boll weight (2.17 g) compared to control (1.81 g) while *T. viride* – *B. subtilis* biofilm based formulation recorded highest seed cotton yield (5.03 q/ha) compared to control (3.62 q/ha) in genotype AKA7.

### Field evaluation of bio-inoculants against bacterial blight disease

*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 with Cv. 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.

### Field evaluation of potassium silicate formulations against bacterial blight disease

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) that were on par with each other and significant over control (47.60) under natural incidence 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 on par with each other and significant over control (52.38) under artificial inoculation conditions in Suraj under HDPS (Fig. 3.23.1).

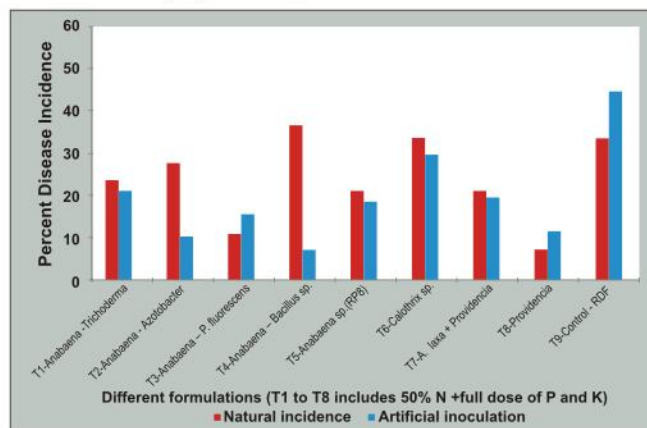


Fig.3.23.1: Field evaluation of bio-inoculants against bacterial blight disease in cotton using variety Suraj under HDPS

## Taxonomic diversity of bioagents of cotton pests recorded in central zone

### a. Parasitoids

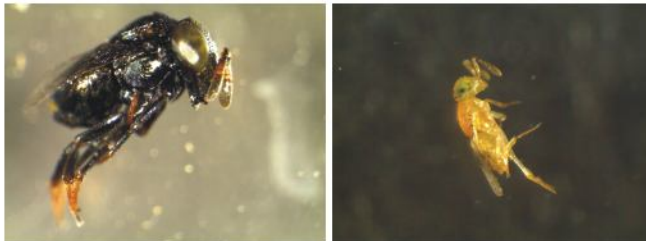
*Aenasius bambawalei* Hayat (Hymenoptera: Encyrtidae) was seen to parasitize mealybug *P. solenopsis* on cotton in central zone. This species played a very significant role in keeping *P. solenopsis* population under check. During the season, parasitism ranged from 1 to 35 % with an average of 11.01 %. Highest parasitism was recorded during January from mealy bug colonies collected from Amravati.

*Acerophagus papayae* (Hymenoptera: Encyrtidae): Coincidental natural occurrence of a solitary endoparasitoid *Acerophagus papayae* Noyes & Schauff was recorded from colonies of *P. marginatus* collected from infested cotton fields from Nagpur, Aurangabad and Chhindwada. Up to 21 % parasitism of *P. marginatus* by *A. papayae* with an average of 8.1% was recorded from the collected mealybug colonies.

*Anagyrus kamali* Moursi (Hymenoptera: Encertidae) was found to parasitize mealybug *N. viridis* upto 14%. The species was recorded from mealybug colonies collected from Nagpur and Chhindwada districts.

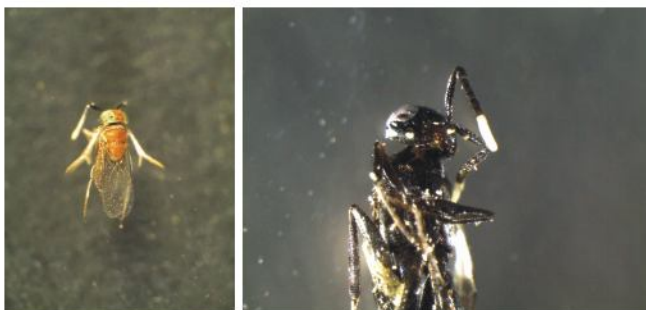
*Aprostocetus* sp. (Hymenoptera: Encertidae) was found to parasitize *N. viridis* about 7.5% from colonies collected from Aurangabad and Beed districts of Marathwada region.

*Homalotylus* sp. (Hymenoptera: Encertidae) was identified from the *P. solenopsis* colonies collected from Gujarat in the previous year. Insects from this genus hyper-parasitize ladybird beetles.



*Aenasius bambawalei*

*Acerophagus papaya*



*Anagyrus kamali*

*Homalotylus* sp.

### b. Predators

Lady bird beetle, *Cheilomenes sexmaculata* (Fabricius) (Coleoptera: Coccinellidae) is a general predator of cotton whiteflies, mealybugs, leafhoppers, mites, and early instar lepidopteran larvae. Population started increasing during mid August, fluctuating during entire crop season with the highest population during 1<sup>st</sup> week of August to first fortnight of September.

*Dipteran fly Cacozenus perspicax* (Knab) (Diptera: Drosophilidae) found to predate on *N. viridis* infesting cotton. The species predated 26.3% mealybug population at Amravati and Nagpur.

### c. Hyperparasitoids

*Promuscidea unifasciiventris* was recorded from *N. viridis* colonies parasitized by *Anagyrus kamali* and *Aprostocetus* sp. Hyperparasitism was about 9.5%.



*Aprostocetus* sp.

*Cacozenus perspicax*

*Promuscidea unifasciiventris*

Lace wings, *Chrysoperla carnea* (Stephans) (Neuroptera: Chrysopidae) feed on several species of small bodied insects especially aphids, mites, thrips, whiteflies, eggs of leafhoppers, etc. Negligible population was recorded during the current crop season.

Spiders (Arachnida) are the generalist predators, can kill a large number of insects per unit time and hence are of great importance in reducing and even in preventing outbreaks of insect pests in agriculture. Both nymphs and adult are predatory on host insect leafhoppers, aphids, mirids, whiteflies and all lepidopteran larvae feeding on cotton leaves, bolls and squares. In cotton agro ecosystem wide range of spiders are found which act as biological control agents of cotton insect pests. Nine species of spiders have been identified from cotton fields during crop season 2013-14. Spider population gradually increases with the increase in prey population with its first peak during 39<sup>th</sup> SW and another in 49<sup>th</sup> SW and thereafter declined.

### Identified species of spiders

1. *Bianor* sp. (Peckham & Peckham, 1886) Family- Salticidae
2. *Leucauge decorata* (Blackwall, 1864) Family- Tetragnathidae
3. *Lysiteles* (Simon, 1895)
4. *Neoscona theisi* (Walckenaer, 1841) Family- Araneidae

5. *Oxyopes pankaji* (Gajbe & Gajbe, 2000) Family-Oxyopidae
6. *Phintella vittata* (C. L. Koch, 1846) Family-Salticidae
7. *Thomisus spectabilis* (Doleschall, 1859) Family-Thomisidae
8. *Thomisus* (Walekenaer, 1805) Family-Thomisidae
9. *Thyene imperialis* (Rossi, 1846) Family-Salticidae



*Neoscona theisi*  
(Walckenaer, 1841)

*Oxyopes pankaji*  
(Gajbe & Gajbe, 2000)



*Thomisus spectabilis*  
(Doleschall)

*Thyene imperialis* (Rossi)

## Coimbatore

### Entomopathogenic-endophyte mediated plant defense as a novel approach for the management of boll worms

Twenty fungi and fourteen bacteria were isolated as endophytes from stem and leaf parts of cotton plant.

Bioassay was carried out with bacterial isolates, showed entomopathogenic activity (13.27% to 48.89%) against pink bollworm *P. gossypiella*.

Five endophytes were identified by morphological characterization. They were *Trichoderma pseudokoningi*, *Penicillium* sp, *Aspergillus flavus* and *Aspergillus terreus*.

Four bacterial and seven fungal endophytes were sequenced by 16S rRNA and 18S rRNA respectively. Two bacterial endosymbionts from *H. armigera* also sequenced by 16S rRNA.

Seven isolates of *Beauveria bassiana* were isolated from coffee berries. It has high virulence against aphids, spodoptera and pink bollworm. One *Beauveria bassiana* isolate was isolated from wild cotton plant.

Three virulent native nematode antagonists viz.,

*Purpureocillium lilacinus*, *Bacillus* sp and *Pseudomonas fluorens* were isolated from nematode suppressive soils and proved to be effective against root-knot and reniform nematodes. Molecular characterization of three native entomopathogenic fungi have been carried out and submitted to Gene Bank.

### Bacterial Endophytes

Totally fourteen bacteria were isolated as endophytes from stem and leaf parts of cotton plant. Among this nine belonged to *Bacillus* sp. Four bacterial endophytes were submitted to NCBI Gene Bank (Table 3.23.1).

**Table 3.23.1 : Bacterial endophytes submitted to NCBI Gene Bank**

S.No	Organism	Gene accession Number
<b>Bacteria (16s rRNA)</b>		
1.	<i>Enterobacter cloacae</i> strain CICR11	KF747358
2.	<i>Bacillus safensis</i> strain CICR13	KF747359
3.	<i>Aeromonas hydrophila</i> strain CICR9	KF747360
4.	<i>Bacillus stratosphericus</i> strain CICR10	KF747367

Optimum temperature and pH for the mass multiplication of *Cladosporium cladosporioides* were 25-30°C and pH 5-6 respectively. Sorghum grains supported maximum multiplication and virulence of *C. cladosporioides*.

Potato Dextrose Agar supported maximum multiplication of *C. cladosporioides* whereas Sabaraud Dextrose Agar with Yeast Extract supported maximum multiplication of *Lecanicillium lecanii*, *Metarhizium anisopliae* and *Fusarium pallidoroseum*.

## 3.24 : Integrated Pest Management

### Nagpur

Available new seed treatment methods for management of sucking pest population at 47 DAS were evaluated but the pests (jassid, whitefly and thrips) were below ETL. However, the treatment, *Pseudomonas fluorens* alone @ 5 % ( $10^{10}$  Cfu/ml) (5.83 aphids/ 3 leaves / plant) and Imidacloprid + Thiram @ 7ml + 3.0 g/kg (6.11 aphids/ 3 leaves / plant) were numerically significantly superior over other treatments.

### Evaluation of yellow sticky traps for monitoring IPM

Yellow sticky traps were employed to trap targeted pest whitefly and leafhoppers. Whiteflies were trapped in

large numbers during 38-43 SW that corresponds first week of September to last week of October (Fig 3.24.1). Leafhoppers were trapped in large numbers throughout the season (Fig 3.24.2). Aphids trapped were very small in numbers during the late season. Non targets insects trapped among them were Lady bird beetle, Dipteran

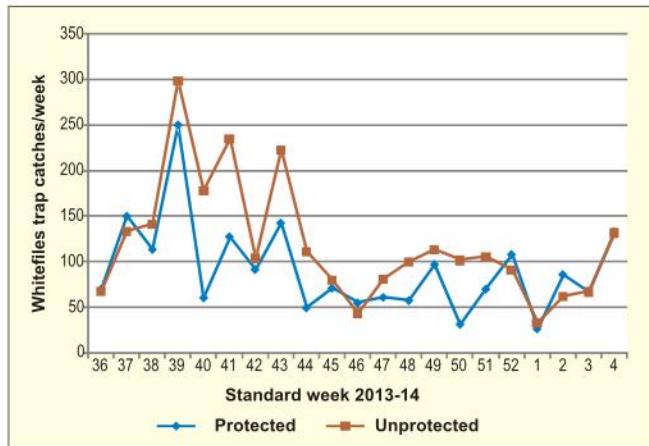


Fig 3.24.1: Yellow sticky trap catches of whitefly

Protection technologies for management of bollworms under high density planting (HDPS) in different windows of 60,80,100 and 120 DAS with five insecticides namely Cloranthraniliprole 18.5 SC, Flubendiamide 480 SC, Spinosad 45% SC, Indoxacarb 14.5 SC and Emamectin benzoate 5 % SG was attempted. Among all insecticides Cloranthraniliprole 18.5 SC and Flubendiamide 480 SC were best for bollworm management recording lowest fruiting bodies damages at 60 DAS and 80 DAS as compared to other insecticides. During the season, the American bollworm however did not cross ETL. Insignificant differences among the treatments were recorded for natural enemies.

### Insecticide and Bt resistance monitoring

#### Nagpur

#### Monitoring changes in baseline susceptibility to Cry toxins

Cotton semilooper *Anomis flava* is 1000 fold more tolerant to Cry2Ab ( $LC_{50}=0.212 \mu\text{g/ml}$ ) as compared to Cry1Ac.

*H. armigera* from Sirsa were collected on BG I  $F_1$ 's Demonstrated  $LC_{50}$  and  $EC_{50}$  value of 2.46 and 0.061  $\mu\text{g/ml}$  of diet for Cry1Ac.

$F_2$  screen study of *H. armigera* was carried out using 256 iso-females for Gujarat 215 and iso-females for Maharashtra. Resistance to Cry1Ac was detected in the  $F_2$  population of Surat A7, 2, 5 and  $F_1$  population of BuldhanaA10.

The resistant Surat *H. armigera* (Surat A7,2,5,1,5) line

flies and hymenopterans. Average per cent insect fauna trapped were whiteflies 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.

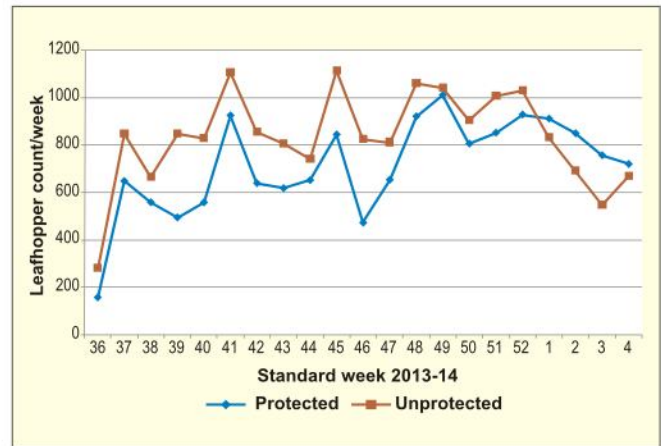


Fig 3.24.2: Yellow sticky trap catches of Leafhoppers

exhibited no mortality at the highest concentration of 1.97  $\mu\text{g/ml}$  of diet of MVPII with an  $EC_{50}$  of 0.071  $\mu\text{g/ml}$  for Cry1Ac while  $LC_{50}$  to Cry2Ab was 2.66  $\mu\text{g/ml}$  of diet and  $EC_{50}$  was 0.712  $\mu\text{g/ml}$  of diet.

Corn leaf powder was being used as a source of Cry2Ab protein for insect bioassays. Only Cry2Ab expressing cotton plants have been identified using ELISA in the segregating  $F_2$  progeny of Mallika BGII whose seeds will serve as a source of Cry2Ab hence forth. We now have lines identified from the segregating  $F_2$  population, expressing Cry1Ac alone, Cry2Ab alone, Cry1Ac and Cry2Ab together and lines without the Cry toxins.

Resistance to Cry1Ac and Cry2Ab in pink bollworm populations collected during 2013-2014 was monitored. Srivilliputtur, Sirsa, Junagadh and Khandwa recorded 2, 9, 4, and 20 fold resistance to Cry1Ac over susceptible check. Faridkot, Mansa, Sirsa, Rahuri, Akola, Junagadh and Khandwa populations of pink bollworm recorded 25, 35, 35, 30, 40, 45, 140 and 330 fold resistance over the susceptible check to Cry2Ab.

Ninety six iso-females were established using pink bollworms collected from non-Bt of Sirsa and Sriganaganagar among which 11 iso-females yielded larvae for bioassays of which progeny of 4 iso-females were subjected to bioassays with 10 ppm and 1 ppm of Cry1Ac and Cry2Ab, each, and were found susceptible.

#### Coimbatore

To monitor the development of resistance in Pink bollworm neonates, II and III instars to Bt cotton bioassays were conducted with Cry1Ac. The  $LC_{50}$  in ppm

were recorded for Cry1Ac as 0.079 - (neonates), 0.195 - (II instar) and 0.753 - (III instar) respectively. LC<sub>50</sub> values against neonates with cry 2Ab was recorded as 0.040 ppm.

### **Insecticide resistance**

#### **Nagpur**

Efficacy of a new insecticide Pyridalyl was compared to its nano formulation developed by IARI against one day old *H. armigera* in diet incorporation bioassays. Pyridalyl recorded an LC<sub>50</sub> of 68.74 ppm while nano pyridalyl recorded an LC<sub>50</sub> of 43.88 ppm. The EC<sub>50</sub> of nanopyridalyl (16.74 ppm) was 3 fold higher than pyridalyl (51.26 ppm). Utility lies in the fact that less load of pyridalyl, if used as nano pyridalyl, would be delivered into the environment.

Against 3<sup>rd</sup> instar larvae of the pink bollworm, using diet incorporation bioassays, Pyridalyl recorded an LC<sub>50</sub> of 13724 ppm while nano pyridalyl recorded an LC<sub>50</sub> of 9166 ppm. The EC<sub>50</sub> of nano pyridalyl was 11.8 fold higher (346 ppm) than Pyridalyl (4094 ppm). Pyridalyl (conventional and nano form) caused 100% mortality of neonate pink bollworm larvae in all the treatments except control and LC<sub>50</sub> of Pyridalyl against neonate pink bollworm is less than 5 ppm.

Thiodicarb topically bioassayed against 2 strains of *H. armigera* (Coimbatore and Washim) at the 3<sup>rd</sup> instar recorded LC<sub>50</sub> of 2.51 ppm and 1.91 ppm, respectively. Flubendiamide a new molecule topically bioassayed against 3<sup>rd</sup> instar larvae of 2 strains of *H. armigera* from Sirsa and Parbhani exhibited an LC<sub>50</sub> of 0.297 ppm and 0.117 ppm respectively. The commercial formulation Fame, was used in diet bioassays against third instar larvae of 4 populations (Palem, Hingoli, Buldana and Nagpur) of *H. armigera* recording LC<sub>50</sub>s of 0.0038 ppm, 0.009 ppm, 0.009 ppm and 0.0187 ppm respectively. Deltamethrin assayed topically against *H. armigera* from Sirsa demonstrated an LC<sub>50</sub> of 22.39 ppm.

#### **Sirsa**

#### **Lab and field monitoring of resistance in bollworms against Cry toxins**

Eighty six isofemale lines from *Earias insulana* population of Sirsa have been screened for presence of rare resistance allele. Two isofemale lines and 5 individuals had survived up to 19<sup>th</sup> day on cry toxin incorporated diet without any moulting and gain in weight.

LC<sub>50</sub> of Cry1Ac ranged from 0.14 to 0.70 µg/ml of diet for *H. armigera* population. LC<sub>50</sub> of Cry1Ac for *H. armigera* population from Hanumangarh district found to be highest (0.70 µg/ml of diet). LC<sub>50</sub> of Cry1C ranged from

1.59 to 4.05 µg/ml of diet for *H. armigera* population and highest being found for population from Bhiwani (4.05 µg/ml of diet). LC<sub>50</sub> of Cry1C was found to be 0.91 and 0.72 µg/ml for population of *Spodoptera exigua* from Mansa and Hanumangarh respectively.

### **Dissemination of insecticide resistance management programme**

#### **Sirsa**

A total of 757 acre area was covered for the implementation of IRM strategies in 7 villages of Sirsa. The weekly data on insects, diseases and beneficials was recorded in villages and used for decision making interventions. Major emphasis was given on the development of resistance in sucking pests against insecticides and bollworms against cry toxins. Farmers were encouraged to grow refugia around Bt cotton hybrids. This was followed by collecting information on insecticide consumption and number of sprays. Information on the seed cotton yield and cost of cultivation was also gathered to arrive at Cost Benefit ratios of IRM and non-IRM farmers. On the basis of 15 observations recorded under normal sown IRM field with Bt genotype, the population (per 3 leaves) of whitefly ranged between 9.91-38.51, thrips between 0.00-24.27 and leafhopper between 0.73-2.81/3 leaves where as in Non-IRM field the population of whitefly, thrips and leafhopper/3 leaves recorded was 8.95-46.65, 0.00-22.45 and 0.65-3.15.

#### **Innovative interventions for leaf curl management**

Based on two year pooled results the efficacy of best interventions (cow urine @ 6.6 %, kresoxim methyl @ 0.1 %, calcium nitrate @ 0.5 %, neem oil @ 1% and whey protein @ 5 %) were verified in larger plots with two CLCuD susceptible Bt hybrids (RCH 134 BG II and ABCH 157 Bt). The interventions were also validated under farmer field conditions at five locations with CLCuD susceptible Bt hybrids. 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 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.

Among various insecticides and biopesticides applied for CLCuD and its vector (whitefly) management in different modules, module- 3 (Nimbecidene at 30 DAS; Clothianidin at 45 DAS; Nimbecidene+YST at 60 DAS; *V. lecanii* at 75 DAS and Triazophos 40% EC at 90 DAS) resulted in maximum (63.03%) reduction of whitefly population after 7 days of spraying.



## Nagpur

### CICR demonstrates HDPS in cotton

The productivity of cotton in India is low, around 500 kg lint/ha and high density planting system (HDPS) with straight varieties appear to be a viable option to improve the productivity of cotton particularly under rainfed conditions at reduced production costs. Research efforts pioneered by the CICR, Nagpur culminated in a technology for high density planting system (HDPS). The peak water and nutrient demanding phase of long duration hybrids and varieties coincides with the post monsoon phase where the moisture release from marginal soils is low. Although no conscious efforts to breed dwarf, compact plant types have been made in the past. CICR tested several compact varieties and among them - AKH 081 (PKV 081), NH 615, Suraj, Anjali, F 2383, KC 3 (*G. hirsutum*) and AKA7, JK 5, HD123 (*G. arboreum*) could be planted at 60×10 cm, 45×15 cm or 45×10 cm under rainfed conditions depending upon the soil type. Thus by increasing the plant population from 50,000 plants/ha (for varieties) to 1.5 -2.0 lakh plants/ha, it is possible to realize 1800-2000 kg/ha seed cotton/ha with the above varieties on marginal soils under rainfed

conditions with minimum inputs. The important components of the HDPS technology area s follows:

- Early dry sowing after the receipt of pre-monsoon showers
- Maintain a plant population: 1.2 -2.5 lakh plants/ha depending on the soil type, variety and growing conditions.
- Planting at spacing: 45-75 cm between rows and 10 cm between plants using a sarta, bullock or tractor drawn seed drill @ 4-5 kg seeds/acre
- Planting semi - compact varieties:
  - SURAJ-best fibre quality with high adaptability
  - PKV 081-medium staple, early, tolerant to sucking pests
  - NH 615-medium staple, jassid resistant
- Sowing on ridges or ridges during inter-culture for moisture conservation
- Weed control : inter-culture and use of post-



emergence weedicides

- Low sucking pest incidence. Seed treatment and only 1-2 sprays depending upon the Economic Threshold Level to control bollworms

The production cost is low (Rs. 15000-20000/ha), high yield (20-25 q/ha) under shallow soils (rainfed) and moreover the seeds can be reused. Encouraged by the experimental results, CICR conducted 160 farmer participatory trials of HDPS of 1 acre each on shallow to medium soils under rainfed conditions in Vidarbha during 2012-13, which turned out to be a drought year, with a low cost input strategy. The varieties tested were Suraj, NH 615, AKH 081(PKV081), AKA 7 and HD 123. Across nine districts, the mean yields ranged from 15-18 q/ha which is more than twice the average yield of Vidarbha. Buoyed by the success and the enthusiasm among the farmers, CICR extended the on farm demonstrations to 2303 (of one acre each) in Maharashtra and other states Haryana, Madhya Pradesh, Andhra Pradesh, Karnataka, Tamil Nadu and Odisha with the active involvement of the State Agricultural Department and SAUs with financial assistance from the Centre under TMC MM-II. The results are summarized in table below.

#### Yield (q/ha) in demonstration trials of HDPS in cotton (60 x 10 cm spacing) during 2013-14

State	Trials	Seed cotton yield in q/ha		
		Minimum	Maximum	Average
Haryana	12	22.5	40	30
Rajasthan	10	20	30	22
MP	50	15	30	24
Maharashtra	1740	10	37.5	18
AP	308	10	30	22
Odisha	52	27.5	37.5	32
Karnataka	51	10	32.5	20
Tamilnadu	80	10	25	18
<b>Total</b>	<b>2303</b>			

The HDPS system is proving to be a boon for cotton farmers across the country many of whom are cultivating cotton on marginal soils with low inputs.

#### Crop pest surveillance and advisory

Cotton pest management strategies through ICT tools (computer, internet and mobile) were disseminated as a part of Crop Pest Surveillance and Advisory Project (CROPSAP) in 28 districts of Maharashtra. Updated the pest management strategies for target pests, monitored online pests situation through information/data uploaded on website since August 2013 and 14 personal visits (in 11 districts of Vidarbha and Marathwada),

analyzed pest situation weekly, alerted and issued advisories wherever required during the season.

#### IRM strategies for HDPS program

IRM strategies for the HDPS programme implemented in 2013–14 for Maharashtra, Madhya Pradesh, Andhra Pradesh, Odisha, Haryana, Karnataka and Tamil Nadu were extremely critical for non-Bt varieties that were being recommended under this programme. Pest management in Bt cotton was also disseminated through proactive strategies.

During 2013–14, IRM strategies were disseminated for 8982 farmers in 15,915 ha in a total of 371 villages of 35 districts from 10 different states across India.

A total of 918 field visits, 357 group meetings, 4 field days and 114 training programmes were organized for dissemination of the IRM strategies. Novel approaches such as 'Hello IRM' (live programme on radio), street plays, farmers' group meetings, field visits, training and demonstration etc. were also adopted as tools for dissemination of the IRM strategies to create awareness about the program among the farming community.

#### Coimbatore

##### Herbicide rotation technology

Application of pendimethalin 1.0 kg ai/ha on third day after sowing followed by one hand weeding and hoeing at 35–40 DAS and application of pyriithobac sodium 50 g ai/ha + quizalofop ethyl 50 g ai/ha at 60–65 DAS was demonstrated in three farmers' field of Kanjapalli village of Coimbatore district.

##### On-Farm demonstration of CICR technologies

Six promising cotton technologies were assessed through on-farm demonstration. Improved cotton genotypes, enhancement of seed quality by sequential pelleting, Integrated Pest Management and Insecticide Resistance Management, CICR nutrient consortia for boosting yield, manipulation of morpho-frame through foliar application of ethrel and herbicide rotation were demonstrated on cotton variety Suraj. All the treatments showed a significant yield improvement over the control by 15–40 per cent.

##### Dissemination of IRM strategies under HDPS in Tamil Nadu

The IRM strategies under HDPS were successfully implemented in 4 districts of Tamil Nadu namely Coimbatore, Virudhunagar, Dharmapuri and Perambalur. The project was implemented in a total area of 79 acres involving 81 farmers and the high-density planting system was accepted by the farmers after realizing its advantages.



## 5.1 : Training Received

### 5.1.1 : International Training

Name of the Scientist	Name of the course/training	Place	Period
Mr. K. Velmourougane	International Training Programme on Carbon Trading/ Carbon Sequestration/Climate Change (Crop Science)	Centre for Environmental Risk Assessment and Remediation (CERAR), University of South Australia, Australia	08-01-2014 to 14-03-2014

### 5.1.2: National Training

Name of the Officials	Name of the course/training	Place	Period
Dr. H. B. Santosh	CAFT Training on Advances in Statistical Genetics	IASRI, New Delhi	02.07.2013 to 22.07.2013
Dr. M. Sarvanan	Short-Term Workshop on Molecular Phylogenetics	IISc, Bengaluru	01.08.2013 to 05.08.2013
Dr. Rishi Kumar	Detection and Measurement of Insecticide Resistance including Molecular Aspects of Insect Pests	NBAII, Bengaluru	02.09.2013 to 11.09.2013
Dr. K. Sankaranarayanan	Forecast Modeling in Crops	ICAR, New Delhi	03.09.2013 to 23.09.2013
Dr. Punit Mohan	Training Programme on Management of Plant Genetic Resources	NBPGR, New Delhi	16.09.2013 to 25.09.2013
Er. Gautam Majumdar Mr. Sanjay Kushwaha	Online Examination system for ARS/NET under NAIP Developing, commissioning, operating and managing an online system for NET/ARS Prelim Examination in ASRB ICAR.	ASRB, New Delhi	22-11-2013

## 5.2: Training Imparted

### International training

#### Nagpur

#### Training programme on “Applied Cotton Biotechnology” under Cotton TAP for Africa

Technical Assistance Program for Africa (TAP) was launched by Hon'ble Ministry of Commerce, Industry and Textile, Government of India with IL&FS clusters, New Delhi as a project implementing agency. Ministry of Commerce identified CICR, Nagpur as implementing agency to undertake training on "Applied Cotton Biotechnology". Delegates from six African Countries viz., Malawi, Nigeria Uganda, Benin, Burkina Faso and Chad were participated. The training was conducted at Biotechnology section of Central Institute for Cotton Research, Nagpur from October 21<sup>st</sup> to December 20<sup>th</sup> 2013. Training programme was started with an orientation to the participants exposing them with the facilities available in biotech and other laboratories, field, polyhouses etc. Training was inaugurated by Dr. C. D.

Mayee, Former Chairman, ASRB, Govt. of India and Dr. R.G. Dani, Vice Chancellor, Dr. PDKV, Akola. The training modules were prepared to cover all the basic and applied research of biotechnology and molecular breeding. The program included 5-modules on general techniques in biotechnology, techniques in isolation and cloning of genes, transgenic cotton development and their molecular characterization, molecular cotton breeding, biosafety issues and IPR. The training was planned with lectures and practical's to infuse basic and applied knowledge on cotton biotechnology to fulfil the needs in their respective countries. More "hands-on



training" was given to participants in all the modules with trained faculties in field and laboratory techniques. To impart training more uniform and for better understanding for the participants from C-4 countries like Burkinafaso, Benin and Chad, the lecture and practical notes were provided in advance to them in French as well as English language. Evaluation of the module using prescribed proforma in 1- 10 point scale containing lectures and speaker was obtained from the all the participants. The feedback was encouraging and shows their complete satisfaction about the training programme with an overall rating of 9.23. Field visit and Study tour were performed as per their program planned. They have visited GTC, CIRCOT, Nagpur, Breeding support centre, Ankur seeds Nagpur, Morarjee textile Mills, Nagpur, Dr. PDKV University, Akola, Mahyco Seeds, Jalna and historical places of Maharashtra. The training course was coordinated by Dr. G. Balasubramani and Dr. K.P. Raghavendra and the Nodal Coordinator was Dr. D. Blaise.

## National Training

### Nagpur

#### Training on Pest Assessment and Management

A one-day training on "Pest Assessment and Management" for agriculture officials, SRFs and pest scouts under HDPS was organized at CICR, Nagpur on 10.09.2013. About 106 trainees were trained during the programme.



#### Training on HDPS and INM

Four programmes were conducted for training farmers from Amravati on 10/5/2013, those from Wardha on 3/10/2013, Chandrapur on 18/11/2013 and Jalgaon on 11/12/2013 on production and protection technologies for HDPS in cotton. More than 1000 farmers benefitted from these training programmes. Besides these, two more training programmes were conducted for the benefit of the officials (agriculture) of Maharashtra State from Amravati and Nagpur divisions.

A one-day training for farmers on 'High Density Planting System' and 'Integrated Nutrient Management in Cotton' was conducted each at Kothadi village in Muktainagr tahsil and Rel Pardhi in Dharangaon tahsil of Jalgaon district of Maharashtra by Dr. S. M. Wasnik, Principal

Scientist.

### Field Experience Training for ARS probationers

Six ARS probationers from 99<sup>th</sup> FOCARS batch from NAARM, Hyderabad completed their Field Experience Training [FET] of 21 days duration w.e.f. 23.2.2014 to 15.3.2014 at CICR, Nagpur. Dr. Sunil Rokde, Principal Scientist, Livestock Management and Dr. V. Santhy, Senior Scientist, Seed Technology, co-ordinated the training programme.

### Coimbatore

#### Training Programme on IRM/ HDPS - 2013

A one-day training programme on Insect Resistance Management/High Density Planting System (IRM/HDPS) was organized by CICR, RS, Coimbatore on 7 August 2013. The training programme was aimed to provide the technical details and guidelines on IRM/HDPS to the Agricultural Officers from the IRM/HDPS-implemented districts of Tamil Nadu. It was conducted under the leadership of the IRM State Coordinator (Tamil Nadu), Dr. (Mrs) B. Dharajothi, Principal Scientist. The trainees included State Agriculture Officers, Deputy Agriculture Officers and Agriculture Officers of Perambalur, Virudhunagar, Dharmapuri and Coimbatore districts of Tamil Nadu.

#### Training under TSP/AICCP

Three on-campus training programmes were conducted under AICCP-TSP for 50 tribal cotton growers from Vellore and Coimbatore districts during the months of February and March.



### Sirsa

#### IRM training for HDPS

A one-day training was organized on Insecticide Resistance Management under High Density Planting System in cotton on 22 July 2014. Dr A.M. Narula, Project Director of KVKs of Zone-I was the Chief Guest.

#### Training on Cotton Production Technology

Training programme was organized for farmers on "Cotton Production Technology" in association with Agricultural Technology Management Agency (ATMA), Bhilwara at CICR, RS, Sirsa from 17 to 22 February 2014.



## Awards

### CICR wins Mahindra Samridhi Krishi Sansthan Samman National Award 2014



The Central Institute for Cotton Research, Nagpur was conferred the 'National Award 2014-Best Research Institute-Krishi Sansthan Samman' by Mahindra Samridhi India Agri Awards 2014. Dr. K.R. Kranthi, Director, CICR, received a cash prize of Rs. 2.11 lakh, a shield and citation from Shri. Tariq Anwar, Minister of State for Agriculture and Food Processing in a glittering ceremony held on 24 February at Hotel Ashok, New Delhi. Dr. Kranthi was accompanied by Dr. M.S. Yadav, Chief Technical Officer, CICR to receive the award. The institute was recognized for its innovative inventions patented as Bt detection kits which empowered farmers to identify good-quality Bt seeds from spurious seeds. The institute was also recognized for developing concepts of eco-friendly pest management and pioneering implementation of insect resistance management strategies which resulted in significant reduction in the usage of insecticides in India. The Mahindra Samridhi awards in partnership with Zee News were given in seven categories to farmers and institutions from a total 40,000 applications. The Mahindra awards which are now recognized as one of the most prestigious



in agriculture recognize purposeful contributions, made by individuals and institutions, in the field of agriculture. Mr. Anand Mahindra, Managing Director, Mahindra and Mahindra, Shri. Ashish Bahuguna, Secretary, Agriculture, Ministry of Agriculture and Dr. Pawan Kumar Goenka, President - Automotive and Farm Equipment were present during the awards function.

### National Award for Technology Innovation



Dr. (Mrs.) P. Nalayini, Principal Scientist, Central Institute for Cotton Research, Regional Station, Coimbatore, was conferred a National Award for "Technology Innovation using Polymers in Agriculture and Water Conservation (2012-2013)" by the Department of Chemicals and Petrochemicals, Ministry of Chemicals and Fertilizers, Government of India. She received the award from the honourable Minister of State (Independent charge) for Chemicals and Fertilizers, Statistics and Programme Implementation, Shri. Srikanth Kumar Jena, in the presence of the Secretary, Petrochemicals at New Delhi on 7 May 2013.

### Dr. (Mrs.) Jagadiswari Rao Woman Scientist Award

Dr. (Mrs.) B. Dharajothi, Principal Scientist, Central Institute for Cotton Research, Regional Station, Coimbatore was conferred the Dr. (Mrs.) Jagadiswari Rao Woman Scientist Award-2012 by the Applied Zoologists Research Association (AZRA), Cuttack for her outstanding research contribution to the field of Plant Protection especially in Cotton Entomology at the AZRA Silver Jubilee International Conference on "Probing Biosciences for Food & Nutritional Security and Safer Environment" held from 16 to 18 February 2014 at the Central Rice Research Institute, Cuttack.



### Dr. B. Vasantharaj David Award

Dr. (Mrs.) J. Gulsar Banu, Principal Scientist (Nematology) was conferred Dr. B. Vasantharaj David Award by Applied Zoologists' Association, Central Rice Research Institute, Cuttack, Odisha for her outstanding contribution to research in the field of Plant Protection especially Plant Nematology. She was conferred this award during the International Conference on "Probing Bioscience for Food Security and Environmental Safety" that was held at the Central Rice Research Institute, Cuttack, Odisha during 16-18 February 2014.



### Best research article/paper presentation award

Dr. Blaise De Souza and Dr. M.V. Venugopalan received the Dhiru Morarji Memorial Award for Best Article in Agricultural Sciences by the Fertilizer Association of India, for their article entitled 'Soil Fertility Management Strategies for Maximizing Cotton Production in India', published in the Dec. 2012 issue of the Indian Journal of Fertilisers (Srinivas Rao C.H., D. Blaise, M.V. Venugopalan, K.P. Patel, D.P. Birader, Y.R. Aladakatti, S. Marimuthu, G.S. Buttar, M.S. Buttar, M.S. Brar, S. Ratnakumari and V.C Reddy).

### Dastur Award

Dr. S.E.S.A. Khader, Principal Scientist (Plant Physiology) was awarded the Dastur Award by ISCI, Mumbai on 26 March 2014 for lifetime achievement in Physiology of cotton.



Best Oral Presentation Award for the research article, "Refuge in Bag: A Concept in Resistance Management - An Experience" by S. Kranthi, Rishikumar, M. Bheemanna, H. Desai, G. M. V. Prasad Rao, B. Dharajothi and K.R. Kranthi presented at the National Seminar on Technology for Development and Production of Rainfed Cotton, held during 24-25 October 2013 at Navsari Agricultural University, Bharuch, Gujarat.

Dr. H. B. Santosh received the Best Oral Presentation Award for the research paper on "Wild Species and Introgression Breeding in Cotton" authored by Vinita Gotmare, Prachi Akhare, Kirti Kalmegh, M. Saravanan, H. B. Santosh & Punit Mohan in the National Seminar on "Technology for Development and Production of Rainfed Cotton" held during 24 & 25 October 2013 at Regional Cotton Research Station, NAU, Bharuch (Gujarat).

Best Oral Presentation Award for the research paper "HDPS - A Promising Option for Rainfed Cotton" by M. V. Venugopalan, D. Blaise, N.R. Tandulkar and Shubhangi Lakade during the National Seminar on "Technology for Development of Rainfed Cotton" at Navsari Agricultural University, Bharuch, Gujarat, 24 & 25 October 2013.

### Recognitions

- Dr. Prasun Mukherjee, Principal Scientist, elected as NAAS Fellow 2013.
- Dr. J. Gulsar Banu, Principal Scientist (Nematology), has been elected as Fellow of Association for the Advancement of Biodiversity Science.

## 7. LINKAGES AND COLLABORATIONS



Areas of Linkages	Institution
<b>NATIONAL</b>	
Fibre testing, fibre quality evaluation and nanotechnology	CIRCOT, Mumbai
Multi-location testing of promising cultures, Bt cotton evaluation	AICCIP (21 centres)
Germplasm collection, maintenance and plant quarantine clearance	NBPGR, New Delhi
Seed technological research and breeder seed production	NSP, New Delhi
Development of <i>cry1A</i> (a) gene construct	NBRI, Lucknow
Supply of gene construct and molecular evaluation of transgenic plant.	NRC Plant Biotechnology, New Delhi
DNA fingerprinting of cotton	NRC DNA Fingerprinting, New Delhi
Technology for pink bollworm resistance monitoring and management	State Department of Agriculture, Haryana, KVKS, CCS, HAU, Hisar, NCIPM, etc
Crop pest surveillance and advisory for cotton pests in Maharashtra	Agriculture Department, Government of Maharashtra
Mechanization	CIAE, Bhopal, Precision tools, Nagpur
Decision support system for major insect pests of rice- and cotton-based cropping systems	CRIDA, Hyderabad
Testing of biofilm technology in cotton, <i>G. arboreum</i> and <i>G. hirsutum</i> and evaluation of nano pyridalyl against lepidopteran pests of cotton	Indian Agricultural Research Institute, New Delhi
Vision-based expert system for picking of cotton	IIIT&M, Gwalior; Jamia Milia Islamia University, Delhi; CMERI&CoEFM, Ludhiana



Hon'ble Chief Minister Shri Prithviraj Chavan and Shri Radhakrishna Vikhe Patil, Agricultural Minister, Government of Maharashtra visiting CICR to review the progress of organization of Krishi Vasant 2014

Shri Ajit Pawar, Deputy Chief Minister & Shri Anil Deshmukh, Minister of Food and Civil Supplies Works, Government of Maharashtra





### Research Highlights

#### Crop Improvement

##### National Trials

- Eleven National Trials (conducted in all the three zones), six north zone trials, thirteen central zone trials and eleven south zone trials were conducted during the current year.
- In irrigated national trials, *G. hirsutum* cultures viz., SCS 1211 (2397 kg/ha), TCH 1777 (2150 kg/ha) and HS 292 (2596 kg/ha) were found to be the best in terms of seed cotton yield in north, central and south zones, respectively.
- In the initial evaluation trial under rainfed situations, IH 11 was found to be the best culture in both central (1525 kg/ha) and south zones (2489 kg/ha).
- In the preliminary intra *hirsutum* hybrids trial, the hybrid FHH 234 (2489 kg/ha) was found to be the best for seed cotton yield in the north zone, while RHH 1014 (2926 kg/ha) and SHH 818 (2842) were found to be the best in central and south zones, respectively.
- Thirteen intra *hirsutum* hybrids were evaluated in central zone and in south zone under rainfed conditions. In the central zone SHH 808 (2239 kg/ha) was found to be the best hybrid, while in the south zone, NHH 715 (1973 kg/ha) was the best.
- In the initial evaluation trial of compact genotypes in irrigated conditions with closer spacing, H 1465 was found to be the best in the north zone (2575 kg/ha), whereas in central zone and south zone, ARBC 3010 (3010 kg/ha) and F 2617 (4648 kg/ha) were the best, respectively.
- In initial evaluation trial of compact genotypes under closer spacing in rainfed situations, DSC 1352 was the best in central zone (1165 kg/ha), whereas, in south zone NH 635 (2274 kg/ha) was the best.
- Six *barbadense* cultures were evaluated in central and south zones. DB 1301 was the best genotype in central zone (1424 kg/ha), whereas, ARB 1302 was the best in south zone (1902 kg/ha). Quality-wise, Suvin was the best in both the zones.
- In the preliminary interspecific hybrids (*G. hirsutum* x *G. barbadense*) trial, DHB 1301 (2513 kg/ha) was the best hybrid in central zone and RHB-1014 (2645 kg/ha) was the best in south zone.

- Promising *G. arboreum* genotypes like LD 1026 (2601 kg/ha) in north zone and JLA 0603 (1730 kg/ha) in south zone have been identified for promotion which were found better than the check varieties in terms of seed cotton yield.
- Similarly *Desi* hybrid FMDH 36 (2897 kg/ha) was the best in north zone and NACH 433 (1808 kg/ha) was the top performer in central zone.

##### Zonal Trials – North zone

- In the *G. hirsutum* Preliminary Varietal Trial, LH 2306 (2123 kg/ha) recorded the highest yield.
- In the Coordinated Varietal Trial, LH 2256 was the best recording 1907 kg/ha of seed cotton yield.
- In the Coordinated Varietal Trial of compact genotypes, LH 2298 was found to be the best recording 2373 kg/ha of seed cotton yield.
- In the Coordinated Hybrids Trial, two hybrids performed better than both the check hybrids. FHH 209 (2362 kg/ha) was the best hybrid for seed cotton yield.
- G. arboreum* genotype, LD 949 was found to be the best culture recording 2575 kg/ha.

##### Zonal Trials – Central zone

- Under irrigated situation, culture GISV-267 (2134 kg/ha) was the best in the Preliminary Varietal Trial and the genotype GISV 272 (2152 kg/ha) was superior in the Coordinated Varietal Trial. Similarly, in rainfed trials, GBHV 180 (1402 kg/ha) and GBHV 170 (1268 kg/ha) were promising in various trials.
- In the Coordinated Varietal Trial of compact genotypes, LH 2298 was found to be the best recording 2552 kg/ha of seed cotton yield.
- In the Coordinated Hybrid Trial, the hybrid GSHH 2646 (2422 kg/ha) was superior in intra-*hirsutum* category while DB 40 (1252 kg/ha) was the best in interspecific (*G. hirsutum* X *G. barbadense*) hybrid category under irrigated conditions.
- In the preliminary varietal trial of *G. barbadense* under irrigated condition, DB 40 recorded the highest seed cotton yield of 1252 kg/ha. In the Coordinated Varietal Trial, GSB 21 (1243 kg/ha) recorded the highest seed cotton yield.
- In the Coordinated Varietal Trial of *G. arboreum*, the highest seed cotton yield of 1400 kg/ha was recorded in JLA 0614.

- Under rainfed situations, the hybrid GSHH 2646 (1549 kg/ha) was the best in the intra-*hirsutum* hybrid category, and AKDH 96 (1455 kg/ha) was the best in *Desi* hybrid group.

#### Zonal Trials – South zone

- The *G. hirsutum* genotype, SCS 1062 (2673 kg/ha) was the best in Preliminary Varietal Trial and GSHV 159 (2393 kg/ha) was superior in Coordinated Varietal Trial under irrigated situations.
- In the Coordinated Varietal Trial of compact genotypes, LH 2298 was found to be the best recording 3763 kg/ha of seed cotton yield.
- Among the intra-*hirsutum* hybrids tested, the highest yield of 2377 kg/ha was recorded in TSHH 0629, while in interspecific hybrid category, the highest seed cotton yield was recorded in RHB-0812 (2996 kg/ha).
- In the preliminary varietal trial of *G. barbadense* under irrigated condition, DB 40 was the best recording 1833 kg/ha of seed cotton yield. In the Coordinated Varietal Trial, GSB 21 was the best entry with 1873 kg/ha of seed cotton yield.
- Under rainfed situation, SCS 1062 (2293 kg/ha) was the best in the Preliminary *G. hirsutum* varietal trial. In the Coordinated Varietal Trial of compact genotypes, ARBC 64 was found to be the best recording 1552 kg/ha of seed cotton yield.
- In the coordinated hybrid trial under rainfed situation, the highest seed cotton yield of 2350 kg/ha was recorded in RAHH 455.
- In *Desi* category, *G. arboreum* variety CNA 1016 (1434 kg/ha) was the best performing entry.

#### Crop Production

- Agronomic requirements of promising Pre release *hirsutum* / *arboreum* genotypes/ hybrids of cotton has been worked out in all the three zones under both irrigated and rainfed production system.
- Experiments for developing suitable Agronomy for ruling Bt hybrids of the region indicated that different spacing were at par at Sriganaganagar, whereas, 67.5 x 75 cm at Faridkot and Bhatinda and 67.5 X 45 cm at Sirsa gave significantly higher seed cotton yield. 100 % RDF seems to be optimum at all the locations in north zone.
- In central zone, 90 x 45 cm (at Nanded, Akola and Banswara) 120 x 30 cm (Junagarh) and 60 X 60 cm (Indore) gave significantly higher seed cotton yield in Bt hybrids. Among the fertilizer levels, 75% RDF at Surat, 125% RDF at Banswara and Junagadh and 150 % RDF was optimum at Nanded, Akola and

Indore.

- In south zone, 90 X 45 cm (at Lam and Nandyal) or 90 X 60 cm at (Raichur and Srivilliputtur) gave significantly higher seed cotton yield in Bt hybrids where as all the spacing had no impact on yield at Coimbatore and Dharwad. Among the fertilizer levels, 100% RDF (at Nandyal and Lam) or 125 % RDF (at Coimbatore, Raichur, Srivilliputtur and Dharwad) was optimum.
- Herbicides like Pendimethalin, Trifluralin, Quiza-lofop ethyl, Pyriothobac Sodium, Glyphosate were evaluated in different combinations among themselves and with hoeing and the results are presented.
- Drip irrigation schedule at 0.6 ET gave significantly higher seed cotton yield at Lam and Banswara, whereas, all the irrigation schedules were at par at Rahuri, Dharwad and Indore. 100% RDN & K gave significantly higher seed cotton yield at Rahuri, Dharwad and Banswara, whereas, 75% and 50% RDN & K gave better yield at Lam and Indore respectively.
- Moisture conservation techniques of ET based Drip irrigation in Bt cotton showed that drip +poly mulch gave significantly higher seed cotton yield at all locations.
- Experiments for optimizing organic cotton (*G. arboreum* / *G. herbaceum* varieties) production was conducted in both central and south zone centres.
- Foliar spray of planofix at flowering and boll development stage significantly enhanced number of bolls and substantially improved boll weight and in turn the seed cotton yield.
- Nutrient consortia (CICR, Coimbatore) spray at 15 days interval from flowering gave significantly higher seed cotton yield.
- Field experiments were conducted with defoliants in different locations.

#### Crop Protection

##### Entomology

- Genotypes from zonal breeding trials were screened against insect pests and identified as resistant/ tolerant in all the three zones.
- In Faridkot, CSH 3129, FHH 200, Pusa 5760 and in Hisar CA 105, Pusa 5760, LH 2152, F 2276, LHH 1403, LH 1411 and FHH 200 were found to be tolerant to leaf hopper.
- In Surat, eight and seven entries were found to be promising against leafhopper population under field, field cage and morphological studies.

- In Akola, BS-30, BS-79 and P-1251 were found tolerant against spotted bollworm and BS-40 and P-2151 were found tolerant against pink bollworm with minimum open boll and loculi damage.
  - In Khandwa, minimum numbers of leafhopper were found in genotypes GSHH-2729 and GSHV-162.
  - In Rahuri, four genotypes GISH-272, TSHH-0629, RHH-707 and GJHV-445 were observed to be consistently resistance to leaf hopper.
  - In Dharwad, Raichur and Srivilliputtur entry TSHH 0629 recorded consistently tolerant to leaf hopper and the entries GSHV 159 and TSH 0250 were also showed tolerance to leaf hopper in LAM Guntur and Srivilliputtur, respectively.
  - Population dynamics of key pests of cotton in relation to climatic conditions were recorded at weekly intervals for both sucking pests and bollworms in various participating centers during 2013-14.
  - Neem formulation namely Neemazal-T/S 1% EC and Neemazal 5% WSC were evaluated against sucking pests.
  - For the revalidation of existing recommendation of insecticides, they were compared with label claim doses against sucking pests in cotton ecosystems.
  - Integrated cotton crop management options with emphasis on biotic stress management were evaluated in all the participating centers of the three zones.
- Plant Pathology**
- Cotton leaf curl virus disease (CLCuD) appeared in 24-26 meteorological week in North Zone and the incidence and severity of CLCuD and the whitefly was very high. The flare up of whitefly population in the entire north zone might be due to less rainfall received during June and July.
  - *Alternaria*, Bacterial blight and Grey mildew were the major diseases in Central and South zone. In addition, Leaf rust in Karnataka and Andhra Pradesh and Tobacco Streak Virus in Andhra Pradesh and Tamil Nadu are gaining ground in South zone. The presence of TSV was confirmed through sequence analysis and Dot Blot Immuno Binding Assay and its local lesion hosts were identified.
  - Based on two year field screening and one year artificial inoculation studies, lines viz., MR 786 and Bihani 251 were found tolerant against CLCuD, whereas, lines like LH 2132, NDLH 1938, TCH 1707 were resistant against *Alternaria* blight and lines like BGDS 801, BGDS 802, BS 47 and GSHV 159 were resistant against bacterial blight. The entries viz., Digvijay, GBav-229, GBav-251, GBhv-253, GBhv-255, GBhv-270, GBhv -677, and GVhv-637 showed consistent resistance against *Fusarium* wilt for the last three years.
  - Monitoring of breakdown of resistance against CLCuD in cotton revealed break down of resistance in earlier identified resistant / tolerant cultures.
  - Seedling mortality was reduced significantly due to seed dressing with chemicals at all four test locations i.e., Junagarh, Dharwad, Guntur and Coimbatore at all tested concentrations except for Thiram and Carboxin @ 2 g at Junagarh and Carboxin @ 1 g at Dharwad.
  - Significant reduction in mortality due to root rot pathogens (*Rhizoctonia spp*) was noted at Sirsa by seed treatment @ 10 & 5 g/kg seed with TrichoCASH either alone or in combination with Thiram. TrichoCASH @10 g/kg seed +Thiram @ 3 g/kg showed the maximum (18.67%) disease control due to *Fusarium* wilt at Pune.
  - Seed treatment of bioagent (PF TNAU1 @ 10 g/kg of seed), soil application (*T. viride* @ 2.5 kg/ha) and chemical sprays (Ergon @ 1 ml/litre at 60 DAS and Taqat @ 1.5 g/Litre at 90 & 120 DAS) were found to be more effective in minimizing the *Alternaria* blight disease intensity by 66.40 in Bt hybrid-2 (module 3) and 63.28 per cent in Bt hybrid-1 (module 3) at Rahuri. Module 1 and 2 significantly reduced *Alternaria* leaf spot in Jadoo BG II while all three modules significantly reduced *Alternaria* leaf spot in RCH 2 BG II at Guntur. Seed treatment with *B. subtilis* (BSC5 – TNAU) @ 10 g/kg on either RCH 2 Bt or Bunny Bt along with soil application of *Bacillus subtilis* (BSC5-TNAU1) combined with foliar spray of *B. subtilis* @ 1 % on 60, 90 and 120 days after sowing was effective in controlling root rot, *Alternaria* leaf blight and TSV at Coimbatore.
  - Reduction in boll number (ranging from 11.4 - 38.1%) and seed cotton yield (from 15.7- 46.3 %) was observed in different Bt cotton hybrids due to cotton leaf curl virus disease at Faridkot, Hisar and Sriganganagar.
  - Pooled results (2010-12) of management of foliar diseases through application of Systemic Acquired Resistance (SAR) inducing chemicals at Dharwad, Guntur, Coimbatore suggest that SAR chemicals like Salicylic Acid (SA) and Iso Nicotinic Acid (INA) at 100 ppm protect cotton from fungal (*Alternaria* blight, grey mildew and rust) as well as bacterial (bacterial blight) diseases with good yields and cost benefit ratios.

## Notification of Cotton Genotypes for Cultivation

During the year 2013-14, five cotton cultivars (five varieties and one hybrid) have been notified for commercial cultivation in the country for various

agro-climatic zones.

## Registration of Cotton varieties under PPV & FRA

List of registered cotton varieties during 2013-14 under PPV&FRA, 2001

Institute	Name of the Variety	Species	Variety/Hybrid	Remarks
CICR	CCH 510 -4	<i>G. hirsutum</i> L.	Variety	As New
CICR	CNHO 12	<i>G. hirsutum</i> L.	Variety	As extant
ANGRAU	NARASIMHA	<i>G. hirsutum</i> L.	Variety	As Extant
CICR	CSHH 243	<i>G. hirsutum</i> L.	Hybrid	As new

**Tribal Sub-Plan** A sum of Rs.15 lakhs was utilised to conduct exclusive training programme and

dissemination of cotton production technologies to the tribal cotton farmers to improve their economic status

S.No	Centre Name	Amount earmarked (Rs.)
1	MAU, PARBHANI (Nanded Centre)	2,00,000/-
2	UAS, DHARWAR (Dharwar Centre)	2,00,000/-
3	TNAU, Coimbatore (Coimbatore Centre)	2,00,000/-
4	USA, Raichur (Raichur Centre)	2,00,000/-
5	MPUAT, UDAIPUR (Banswara Centre)	3,00,000/-
6	NAU, NAVSARI (Surat Centre)	1,00,000/-
7	CICR,RS, Coimbatore (PC Cell Unit)	3,00,000/-
	<b>Total</b>	<b>15,00,000/-</b>



Shri Ashish Bahuguna, Agriculture Secretary and Shri Sanjeev Gupta, Joint Secretary, Extension, DAC, MoA, GOI, New Delhi visited CICR, Nagpur

Sh. J. S. Saharia, Chief Secretary and Dr. Sudhir Kumar Goel, Additional Chief Secretary (Agriculture), Government of Maharashtra visited CICR, Nagpur



## Training Achievements

Ninety eight short duration (1 to 3 days) on-campus and off-campus training courses were conducted in different disciplines (Crop Production, Horticulture, Plant Protection, Veterinary Science, Soil Science, Home Science and Extension) for training farmers, rural youth and extension functionaries. About 3331 participants including 924 SC/ST were benefited from the training programmes.

Fourteen sponsored training courses were organized in Crop Production, Horticulture, Plant Protection, Veterinary Science and Home Science for farmers and extension functionaries, deputed by State Agriculture Department of Maharashtra, ATMA, CIPMC, Nagpur,

RCF, MAFSU, Nagpur, MCED & ICDS Nagpur, and NGO. Around 853 participants attended these courses.

## Front Line Demonstrations

Eleven front line demonstrations on crops and seven FLDs on non-crops were demonstrated in the villages of Nagpur district viz., Manori, Pipra, Thana, Navegaon (Sadhu), Ranmangli, Datala, Sukli, Boruzwada, Angewada, Patkakhedi, Tirkhura, Karhandla and Patansawangi. Several extension activities like field day, field visit of farmers to FLD, group discussions, and scientists-farmers meet etc. were conducted for effective implementation of FLDs.

Details of assessment of technologies under Front Line Demonstrations and On Farm Trials (2013-14)

S.No	Crop	Technology Demonstrated	No. of farmers	Area (ha)	Yield (q/ha)		Increase over FP (%)
					FLD	FP	
1	Cotton	HDPS	30	12.0	14.97	12.95	13.49
2	Pigeon pea	BSMR-736	30	6.0	14.87	10.50	29.38
3	Linseed	PKV NL- 260	12	2.4	8.25	6.25	24.24
4	Wheat	AKAW-4627	12	4.8	31.50	23.75	24.60
5	Nagpur Mandarin	Management of pre-harvest fruit drop	10	4.0	60.00	49.00	22.44
6	Nagpur Mandarin	Weeds Management	10	4.0	54.00	45.00	20.00
7	Okra	Variety Akola bahar	10	04	46.78	40.00	16.95
8	Bt-cotton (FLD)	Sucking pests management	25	10.0	23.60	19.40	17.80
9	Red gram (FLD)	Production technology	30	12.0	19.62	14.50	26.09
10	Chickpea (FLD)	Production technology	30	12.0	17.50	13.65	22.00
11	Nagpur Mandarin (OFT-Assessment)	Thrips & mites management	06	2.4	63.62	54.67	14.06



OFT on Cotton (High Density Planting System)



FLD of Wheat & Linseed at Adopted Villages



- i) Dairy (Vitamin-mineral @ 30 g/day feed supplementation and De-worming repeated after 2 weeks) in Jersey Crossbred cows
- ii) Dairy (Detection of mastitis) in Jersey cross bred cows
- iii) Chelated mineral feeding for CB Jersey Cow

## FLDs on Home Science

The FLDs on Maize Sheller, Improved cotton picking bag, Bhendi & Brinjal plucker and Gujarat sickle were demonstrated.

## OFT

Under OFT on farmer's field, feeding bypass fat @ 200 g/day x 90 days for crossbred jersey cows, supplementary concentrate feeding @ 50 g/day for lactating dose (Goat) and breed assessment of Swarnadhara poultry were assessed.

Soy-laddu was assessed as a technology for reducing protein calorie malnutrition under OFT on farmer's field

## Assessment of Bio-Briquettes - an alternative cooking fuel under OFT on farmers' field

Description(N=10)	Cooking with Bio-briquettes	% increase over farmers' practice
Rice & Dal (g)	250	
Quantity of coal required (g)	300	25
cost of coal (Rs)	07	31
Time required for cooking (minute)	34	18
Ash recovered (%)	04	39

## Shetkari Melawa

Krishi Vigyan Kendra, CICR, Nagpur organized "Shetkari Melawa" on 13.12.2013 at Boruzwada, Taluka – Saoner, Dist, Nagpur. About 450 farmers from Ajni, Angewada, Bhivapur, Boruzwada, Kodegaon Malegaon, Manegaon, Patkakhedi, Patansawangi, Hingna, Kalmeshwar, Narkhed, Parseoni, Umred of Nagpur district participated in the event. Dr. A. R. Raju and Dr. Vishlesh Nagrare, Scientists from CICR, provided technical solutions to the problems faced by the cotton farmers. Dr. B.S. Chimurkar and Shri. G. C. Malwi, retired faculty members of Dr. P.D.K.V., Akola answered the queries of farmers on various crops. Dr. Raju discussed better cotton crop production practices and advocated cultivation of straight varieties of cotton like PKV-081, NH-615 and Suraj under High Density Planting System promoted by CICR. Dr. R. R. Gupta, SMS, KVK, convenor of Shetkari Melawa and demonstration trials on IRM technologies made introductory speech on the organizing of Shetkari melawa at farmers' location. Progressive farmer Shri. Anandrao Raut, shared his experience on cultivation of cotton in new areas like Bhiwapur. Former ZP office bearer Shri. Ashok Dhote, Shri. Sonba Musale, Shri. Nanaji Raut attended the function. Programme was conducted by Shri. Roshan Dambare, Agriculture Asst.,

Saoner. Vote of thanks was proposed by Dr. U. V. Galkate, SMS, KVK, CICR, Nagpur.

## Training Sponsored by ATMA, Nagpur

Three day training programme was organized by Krishi Vigyan Kendra for 36 members of Self Help Group of Hingna block on "Fruit and Vegetable Processing" at Community Food and Nutrition Extension Unit from 25<sup>th</sup> to 27<sup>th</sup> March, 2014. Smt. Sunita Chauhan, SMS, Home Science coordinated and trained the farmers.



## Horticultural crops at KVK farm

Krishi Vigyan Kendra, CICR, Nagpur has established horticultural crops such as Guava (L-49), Pomegranate (Bhagva), Orange (Nagpur mandarin), Sweet Orange (Katol Gold), Mango and Sapota (Kali Patti) at its farm, for the benefit of farmers and other visitors.



Pomogranate (Bhagva)



Sapota (Kali Patti)

### Ex-trainees Sammelan Organized

Ex-trainees Sammelan was organized at Wakeshwar village on 22.02.2014, with the objective to get the feedback information on the training programmes and field demonstrations conducted on horticulture crops. This village was adopted by KVK in 2002-2004 and several horticultural activities were undertaken. During the discussion, it was observed that the local ber plants which were budded by improved variety of "Umran" are yielding well. Three farmers are cultivating rose as commercial crop and some farmers are raising healthy seedlings of vegetables.

### HDPS in Nagpur district

High Density Plating System (HDPS) in Cotton was implemented in 3 Talukas of Nagpur District viz., Hingna, Kameshwar and Saoner in collaboration with State Department of Agriculture and KVK. Cotton varieties such as Suraj, PKV 081, AKA 7, NH 615 were demonstrated in 169 farmers' fields. The farmers were guided on production and protection aspects. Dr. K. R. Kranthi, Director, CICR and Heads of various Divisions of CICR visited and guided the farmers for better utilization of medium to light soils, where Bt cotton crop does not sustain in later growth period once the monsoon is recedes.

A Scientist- farmers' group discussion on HDPS was conducted in Ramgiri village of Kalmeshwar Taluka on September 7, 2013. Dr. K. R. Kranthi, Director, CICR, Programme Coordinator, KVK, Head Crop protection and Dr. M.V. Venugopalan attended the programme and replied the queries raised by the farmers on HDPS. TAO, Kalmeshwar and other staff were also present. Shri. Harish Kumbhalkar and Sh. Gulbir Singh were the coordinators of the programme.



### Soil Testing Activities

Four hundred and one soil samples were collected from

Umrer, Bhivapur, Katol, Kalmeshwar, Saoner, Ramtek, Narkhed, Kuhi and Parshivani blocks of the Nagpur district through Mobile Soil Testing Van provided under Human Development Programme by Govt. of Maharashtra. These samples were analyzed for different soil testing parameters and 390 soil health cards depicting soil test based fertilizer recommendation for different crops were distributed to the beneficiaries.

### Monitoring of Crop SAP programme of Nagpur district by KVK

Monitoring of Crop SAP programme in Nagpur district was done in twenty villages of 9 tahsils of Nagpur district on cotton, soybean and paddy. Incidence and damage of semiloopers, girdle beetle and stem borer was found under ETL in soybean crop due to heavy and continuous rains during the cropping period. The sucking pest in Bt cotton were observed in most of the cotton area. Cotton farmers sprayed the crop 2 to 4 times for sucking pest management. Low incidence of major insect pest and disease in paddy was also noticed.



Monitoring of Crop SAP in Paddy in Ramtek Taluka.

### Participation in Exhibitions

- i) Maharashtra Kapus Parishad cum Agriculture Exhibition at Jalgaon on 20.04.2013 and three days agricultural exhibition at Wardha during 31 May to 2 June 2013.
- ii) "Dharmmachakra Pravartan Din" at Deekshabhoomi, Nagpur during 12-14 October 2013.
- iii) MGNREGA WORKSHOP cum Agricultural Exhibition' organized by State Department of Agriculture on 14 December 2013.
- iv) Agro-Vision Exhibition held at Reshimbagh, Nagpur from 26 to 29 December 2013.



Participation in MGNREGA WORKSHOP cum Agriculture exhibition at Krida Sankul, Nagpur



Participation in Kapus Parishad cum Exhibition at Jalgaon

### List of publications

1. Behra, M.S., P.K. Mahapatra., Singandhupe R.B., Kundu D.K., Satpathy S. and Singh Amarpreet (2014). Drip fertigation effect on yield, quality, water use and economics of ashwagandha in rice based cropping system, in International Symposium on Integrated Water Resources Management (IWRM-2014) February 19-21, 2014 at CWRDM Kozhikode, Kerala, and Page. No. 1-11.
2. Sethi R.R., Kumar A., Sharma S.P., Singandhupe R.B., Das M., Jena S.K. (2012). Development and calibration of a soil water balance model for paddy field in humid climatic condition. *Indian Journal of Coastal Agricultural Research*, Vol. 30 (2): 55-59.
3. Chauhan, S. and Raju A.R. (2013). Innovative cotton harvesting bags. *International Journal of Agriculture Innovations and Research*, Vol.2 (1), ISSN (online) 2319-1473: 108-111.
4. Chauhan Sunita, Raju A.R. (2014). Participatory evaluation of ergonomically designed cotton picking bags. *Journal of Cotton Research Development*. 28(1): 140-144.
5. Gulbir Singh (2013). Integrated pest management in vegetables, *Swet Swarnima* 2013, 11.
6. Gulbir Singh (2013). Improved cultivation techniques from guava, *Swet Swarnima* 2013, 13.
7. M.V. Venugopalan, Keshav Raj Kranthi, Mahendra Singh Yadav and Vandana S (2014). *Saghan Ropan Padhhati se Kapas ki Bharpoor Pedavaar* (Bumper cotton yield through high density planting system).

*Kheti Monthly Magazine (Spl. Issue Krishi Vasant)*, No. 11 (Feb. 2014), 12-15.

8. Mahendra Singh Yadav and Vandana S (2014). *Kapas uttpaadan mein aatm nirbharta* (Self sufficiency in cotton production). *Kheti Monthly Magazine (Spl. Issue Krishi Vasant)*, No. 11 (Feb. 2014), 5-10.
9. Vandana S (2013). *Soochna Sanchaar Prodyogiki-Kisaano ke liye vardaana*. *Shwet Swarnima* 2013, 20-21.

### Leaflet Published

1. Fruit Processing – Preparation of Squash (2014) : Smt. Sunita Chauhan
2. Vegetable Processing – Cherry and Sauce preparation (2014) : Smt. Sunita Chauhan
3. Kapas Ke Nashikeeton Ka Prabhavi Prabandhan (2014) (in Hindi): Dr. Keshav Raj Kranthi, Dr. Chinnababu Naik, Dr. (Smt.) Sandhya Kranthi, Dr. Vishlesh Nagrare and Dr. RamRatan Gupta.

### Radio Talks

Delivered a radio talk on “*Are Sansar-Sansar Nivad Udhogachi*” (Selection of Enterprise for Supplementary Income) in Marathi programme in Otivar broadcasted by AIR, Nagpur on 18.06.2013 at 6.20 pm.

### T.V. Talk

Delivered T.V. Talk on “*Drudgery Reduction of Farm Women with Cotton Picking Bags*” in Marathi programme in Sheti Darshan telecasted by Nagpur Doordashan on 20.01.2014 at 6.00 pm.



## 10.1 List of Publications

### Research papers published in refereed Journals

1. Banu J.G. (2013). Effect of different storage conditions on spore viability of *Lecanicillium lecanii* formulations and infectivity to mealybug, *Paracoccus marginatus*. *International Journal of Plant Protection*, 6(2): 334-337. (NAAS Rating: 3.3)
2. Banu J.G. (2013). Effect of solid substrates on growth and sporulation of *Lecanicillium lecanii* and pathogenic activity to Mealy Bug. *Annals of Plant Protection Sciences*, 21(1): 208-209. (NAAS Rating: 3.7)
3. Bhattacharyya T., Pal D.K., Mandal C., Chandran P., S.K.Ray, Sarkar Dipak, Velmourougane K., A. Srivastava., Sidhu G.S., Singh R.S., Sahoo A.K., Dutta D., Nair K.M., R. Srivastava., Tiwary P., Nagar A.P. and Nimkhedkar S.S. (2013). Soils of India: Their historical perspective, classification and recent advances. (Review article) *Current Science*, 104 (10), 1308-1323. (NAAS Rating :7.4)
4. Blaise D., Venugopalan M.V., Singh J.V., Raju A.R. (2013). Fertilizer best management practices in cotton. *Indian Journal of Fertilisers*, 4 (2): 110-119. (NAAS Rating :3.8)
5. Dhamayanthi K.P.M., Rathinavel K. and Gotmare Vinita (2013). Induction of polyploidy in wild cotton species (*Gossypium armourianum* and *G. aridum*) by colchicine treatment. *Journal of Cotton Research and Development*, Vol 27 (2): 165-170. (NAAS Rating:4.3)
6. Dhamayanthi K.P.M. and Rathinavel K. (2013). Studies on flowering behavior and fruiting pattern of early maturing germplasm lines of Egyptian cotton (*G. barbadense* L.). *Cotton Research Journal*, 5 (2):150-157. (NAAS Rating :2.6)
7. Gotmare V., Mohan P., Balasubramani G., Rodge C., Katre M., Tule B.N., Chakrabarty P.K. and Kranthi K. R. (2013). NISC 40(IC0584261; INGR13033), NISC 40(IC0584262; INGR13034), NISC 40(IC0584262; INGR13035) (2013) Jassid tolerant compact plant type introgressed derivatives of Cotton. *Indian Journal of Plant Genetic Resources*, Vol 26(3): 253 – 254. (NAAS Rating :3.0)
8. Gotmare V., Mohan P., Balasubramani G., Waghmare V.N., Rodge C., Katre M., Tule B.N., Chakrabarty P.K. and Kranthi K.R. (2013). Vaidehi 95 (MSH 53) (IC0584260; INGR13032) dark brown linted introgressed derivative of cotton. *Indian Journal of Plant Genetic Resources*, Vol 26(3): 252-253. (NAAS Rating :3.0)
9. Hebbar K.B., Venugopalan M.V., Prakash A.H. and Aggarwal P.K. (2013). Simulating the impacts of climate change on cotton production in India. *Climatic Change*, 118(3-4):701-713. (NAAS Rating :7.9)
10. Kranthi K.R., Venugopalan M.V. and Yadav M.S. (2012). Hybrid cotton revolution in India. *Seed Times*, Vol. 5(4): 29-38.
11. Kumar R., Nagrare V. S., Nitharwal Mukesh, Swami Dinesh and Prasad Y. G. (2013). Within-plant distribution of an invasive mealybug, *Phenacoccus solenopsis*, and associated losses in cotton. *Phytoparasitica*, DOI 10.1007/s12600-013-0361-6. (NAAS rating 7.3)
12. Meena, R.A., Monga D. and Ghanshyam (2013). Economics of GMS based *Desi* cotton (*Gossypium arboreum*) hybrid seed production in north zone. *Journal of Cotton Research and Development*, 27(2): 175-178. (NAAS Rating :4.3)
13. Meena, R.A., Monga D. and Neha (2014). Studies to enhance cotton plant stand under north zone. *Journal of Cotton Research and Development*, 28(1): 12-17. (NAAS Rating :4.3)
14. Mukherjee, A.K., Kumar Sampath, Kranthi S. and Mukherjee P.K. (2013). Biocontrol potential of 3 novel *Trichoderma* strains: isolation, evaluation and formulation. *3 Biotech* 10 1007/s 13205 013.
15. Mukherjee, P.K., Mukherjee A.K. and Kranthi S. (2013). Reclassification of *Trichoderma viridae* the most widely used commercial biofungicide in India, as *Trichoderma asperelloides*. *The open Biotechnology journal*, 7:7-9.
16. Nalayini P., Sankaranarayanan K. and Velmourougane K. (2013). Herbigation in cotton (*Gossypium spp*): Effects on weed control, soil microflora and succeeding greengram (*Vigna radiata*). *Indian Journal of Agricultural Sciences*, 83(11):1144-8. (NAAS Rating :6.6)

17. Raghavendra K.P., Sheeba, J.A. and Santosh H. B. (2013). Sucrose synthase, a major biomarker for sink strength in cotton. *Cotton Research Journal*, 5 (2):158-172. (NAAS Rating :2.6)
18. Raju A.R. (2013). Impact of insect resistant cotton. *IOSR Journal of Agriculture and Veterinary Science*, (IOSR-JAVS) 5 (2): 13-25.
19. Raju A.R. (2013). Seed bacterization with Azotobacter, PSB and foliar application of urea on drought affected cotton. *Int. J. Curr. Microbiol. App. Sci.*, 2 (10): 44-51.
20. Raju A.R. (2014). Improving hybrid cotton profitability and micronaire with stripcropping of soybean+pigeon pea with conservation furrows, Mn and B application. *African Journal of Agricultural Research*, 9 (2): 183-195. (NAAS Rating :6.0)
21. Raju A.R., Majumdar G. (2013). Evaluation of Portable Cotton Picker. *International J of Agricultural Innovations & Research*, 2 (1): 104-107.
22. Raju, A.R., Thakare S., Majumdar G., Bharambe P.R. (2013). Risk aversion in shallow soils with innovative intercropping systems. *Journal of Cotton Research and Development*, 27 (1): 37-44. (NAAS Rating :4.3)
23. Raju, A.R., Thakare S.K. (2013). Profitability and FUE of Bt cotton based intercropping systems under changing rainfall patterns in Vertisols of India. *African Journal of Agriculture Research*, 8 (24): 3177-3185. (NAAS Rating :6.0)
24. Rani, U. S., (2013). Participation, decision making and drudgeries faced by women in cotton cultivation. *Journal of Extension Education*, Vol.25 (3): 5078-5085. (NAAS Rating :2.7)
25. Rani, U.S. and Selvaraj G. (2013). Bt cotton in Tamil Nadu: An evaluation of farmers' experiences. *Indian Research Journal of Extension Education*, 13 (3): 64-70. (NAAS Rating :3.5)
26. Rani, U S. and Nalayini P. (2013). Sustainability of diversified and non-diversified cotton farms in Tamil Nadu – An empirical analysis", *Cotton Research Journal*, 5 (2): 194-200. (NAAS Rating :2.6)
27. Santhy, V., Palve S.M., Virkhede Sonali, Mohan Pratibha, Khadi B.M. (2013). Characterization and genetic inheritance of temperature sensitive genetic male sterility in *Desi* cotton (*Gossypium arboreum*). *Indian Journal of Agricultural Sciences*, 83 (8): 809-14. (NAAS Rating: 6.6)
28. Singh J., Babar Shilpa and Venugopalan M.V. (2013). Interactive effect of moisture conservation and integrated nutrient management on yield and nutrient utilization efficiency of rainfed Bt cotton (*Gossypium hirsutum*). *Indian Journal of Agricultural Sciences*, 83 (10):1069-74. (NAAS Rating: 6.6)
29. Singh, J., Abraham Shalu and Sankaranarayanan, K. (2014). Impact analysis of Bt cotton production technologies on yield and profit of Vidharbha farmers. *Journal of Cotton Research and Development*, 28 (1): 62-65 (NAAS Rating: 4.3)
30. Rao, S., Kumar Dinesh S., Das S.N., Nagaraju M. S. S., Venugopalan M.V., Rajankar P., Iaghte P., Reddy M. S., Joshi Sharma (2013). Modified dubois model for estimating soil moisture with dual polarized SAR data. *Journal of the Indian Society of Remote Sensing*, 41 (4): 865-872. (NAAS Rating: 6.7)
31. Tiwary P., Venugopalan M.V., Blaise D., Chatterji S., Sen T.K. and Tandulkar N.R. (2013). Evaluation of sustainability of rainfed cotton yield under conventional and intergrated nutrient management practices. *Agropedology*, 23(1): 53-58. (NAAS Rating: 2.9)
32. Tuteja O.P. (2014). Studies on heterosis for yield and fibre quality traits in GMS hybrids of upland cotton (*Gossypium hirsutum* L.). *Journal of Cotton Research and Development*, 28 (1): 1-6 (NAAS Rating: 4.3)
33. Tuteja O.P. and Agrawal Manish (2013). Heterosis for seed cotton yield and other traits in GMS based hybrids of American cotton (*Gossypium hirsutum*). *Journal of the Indian Society for Cotton Improvement*, 5 (2): 131-141. (NAAS Rating: 2.6)
34. Tuteja O.P. and Banga Manju (2013). Combining ability estimates for yield and quality characters of parents and crosses based on genetic male sterility in cotton (*Gossypium hirsutum*). *Indian Journal Agricultural Sciences*, 83 : 987-91. (NAAS Rating : 6.6)
35. Velmourougane K. and Sahu Apeksha (2013). Impact of transgenic cottons expressing *cry1Ac* on soil biological attributes. *Plant, Soil and Environment*, 59 (3): 108-114. (NAAS Rating: 7.5)
36. Velmourougane K., Venugopalan M.V., Bhattacharyya T., Sarkar Dipak, Pal D.K., Sahu Apeksha, Chandran P, S.K. Ray, Mandal Champa, Nair K.M., Prasad Jagdish, Singh R.S., Tiwary Pramod (2013). Urease activity in various agro-ecological sub regions of black soil regions in India.

- PNAS, India, Sec. B Biol. Sci., 83 (4): 513-524. (NAAS Rating: 6.1)
37. Velmourougane K., Venugopalan M.V., Bhattacharyya T., Sarkar Dipak, Pal D.K., Sahu Apeksha, Chandran P, S.K. Ray, Mandal Champa, Nair K.M., Prasad Jagdish, Singh R.S., Tiwary, P.,(2013). Microbial biomass carbon in agro-ecological sub regions of black soil in India. *PNAS, India, Sec. B Biol. Sc.*, DOI 10.1007/s40011-013-0238-y. (NAAS Rating: 6.1)
38. Velmourougane K, Venugopalan M.V, Bhattacharyya T, Dipak Sarkar, Pal D.K, Apeksha Sahu, Ray S.K, Nair K.M, Jagdish Prasad, Singh R.S. (2013). Soil dehydrogenase activity in agro-ecological sub regions of black soil regions in India. *Geoderma*. (197-198): 186-192. (NAAS Rating: 7.7)
39. Velmourugane K., Venugopalan M.V., Bhattacharyya T., D. Sarkar., Pal D.K., Sahu A., Chandran P., Ray S.C., Mandal C., Nair K.M., Prasad J., Singh R.S. and Tiwary P. (2013). Microbial biomass C status in Agro ecological sub regions of black soils in India. *Proc. Matl. Acad. Sci. India, Sect B. Biol. Sci.*, DOI 10.1007/540011-013-0238-y. (NAAS Rating: 6.1)
40. Vennila S., Agarwal Meenu, Nagrare V. S., Prasad Y. G., Prabhakar M. (2014). Ornamental hosts of cotton mealybug (*Phenacoccus solenopsis*). *Indian Journal of Agricultural Sciences*, 84(1):161-163. (NAAS rating: 6.6)
41. Venugopalan M.V., Kranthi K.R., Blaise D., Lakde Shubhangi and Sankaranarayana K. (2013). High density planting system in cotton - The Brazil Experience and Indian Initiatives. *Cotton Research Journal, ISCI*. 5(2):172-185. (NAAS Rating :2.6)
42. Verma S.K., Tuteja O.P. and Monga D. (2013). Studies on stability parameters and sustainability index for selecting stable genotypes in Asiatic cotton (*Gossypium arboreum*). *Indian Journal Agricultural Sciences*, 83 (12): 1377-80. (NAAS Rating :6.8)
43. Wasnik S. M. (2013). Study on antecedents of cotton growers alienation from land in distress vidharbha region of Maharashtra. *International J. of Exten Edu.*, 9: 56-60. (NAAS Rating :2.9)
44. Wasnik S.M., Raju A.R., Palve S.M., Majumdar G., Parwate P.P. (2013). Technology interventions performance under front line demonstrations in Bt hybrid cotton (*Gossypium hirsutum* L.); *Journal of Cotton Research and Development*, 27 (1): 126-133. (NAAS Rating :4.3)

## 10.2 List of On-going Projects

No.	Name of project
1.	Collection, conservation, evaluation, documentation and maintenance of germplasm of cultivated species of <i>Gossypium</i> . (Dr. Punit Mohan (PL), Dr. S.Manickam, Dr. R.A. Meena, Mrs. Chakrabarty, Dr. KPM. Damayanthi)
2.	Improvement of tetraploid and diploid cottons for fibre properties through population improvement approaches. (Dr. V.N. Waghmare (PL), Dr. Vinita Gotmare, Dr. O.P.Tuteja)
3.	Fine mapping of fiber quality and economic traits using RILs in diploid cotton. (DBT) (Dr. V.N. Waghmare (PL), Dr. T.R. Loknathan)
4.	Fine mapping and advance backcross QTL analysis of fiber quality and economic traits in diploid cotton. (Dr.V.N. Waghmare (PL))
5.	Development of saturated genetic linkage map for <i>Gossypium hirsutum</i> L. using SSR and SNP markers. (DBT) (Dr. V.N. Waghmare (PI), Dr. Punit Mohan)
6.	Conservation, characterization and utilization of wild species, races of cultivated species and synthetic polyploids of <i>Gossypium</i> . (Dr.Vinita Gotmare (PL), Dr. Balasubramani)
7.	MAS/MAB for Water-logging in Cotton. (Dr.Vinita Gotmare (PL), Dr. SESA. Khade, Dr. M. Saravanan)
8.	Breeding of upland cotton for improved fibre quality and resistance to biotic stress (bollworms and jassid). (Dr. S.M. Palve (PL))
9.	Development of heterotic pool for superior medium staple in tetraploid cotton ( <i>G. hirsutum</i> ). (Dr.S.M. Palve (PL))

10.	Development of drought tolerant genotypes with good fibre quality in <i>G. hirsutum</i> . (Dr. Suman Bala Singh (PL), Dr. A.H. Prakash)
11.	Seed Production in Agricultural Crops and Fisheries. (MSP) (Dr.P.R.Vijayakumari (Nodal Officer), Dr. V. Santhy, Dr. K. Rathinavel, Dr. R. A. Meena)
12.	Studies on Genetic Purity of Public released Cotton Hybrids and its Parents with the help of SDS-PAGE. (Dr. P.R. Vijayakumari (PL), Dr. K.R. Kranthi)
13.	Characterization of public sector released genotypes of cotton ( <i>Gossypium</i> spp) based on molecular markers to serve as Special test for Varietal Protection. (Dr.V. Santhy (PL))
14.	Exploration, collection and conservation of perennials and land races of <i>Desi</i> cotton from different regions of India. (Dr. M. Saravanan (PL))
15.	Development of long staple <i>G. hirsutum</i> variety with improved fibre strength. (Dr.S. Manickam (PL), Dr. V.N. Waghmare, Dr. S.L. Ahuja)
16.	Development of extra-long staple high spinning hybrids with wider adaptability. (Dr.KPM. Dhamayanthi (PL))
17.	National Seed Project (Crops). (NSP) (Dr.K. Rathinavel (PI))
18.	Testing & Documentation of Extant Varieties, hybrids and their Parents for Distinctness, Uniformity & Stability (PVP & FR ACT, 2001). (DUS) (Dr.K. Rathinavel (Nodal Officer))
19.	Development of early maturing, medium staple varieties and hybrids Resistant to CLCuV. (Dr. O.P. Tuteja (PL), Dr. D. Monga, Dr. Rishi Kumar, Dr. S.M. Palve)
20.	Identification of male sterile plants in genetic male sterility (GMS) using molecular markers. (Dr. O.P. Tuteja (PL), Dr. S.B. Singh, Dr. M. Saravanan)
21.	Development of <i>G. hirsutum</i> genotypes with high yield and high GOT. (Dr.S.L. Ahuja (PL), Dr. R. A. Meena, Dr. D. Monga, Dr. Rishi Kumar)
22.	Association mapping of fibre traits in <i>Gossypium arboreum</i> L. accessions using SSR, ISSR and AFLP markers (UGC) (Dr.S.K. Verma (PA))
23.	Studies to improve the seed setting efficiency in cotton. (Dr.RA Meena (PL), Dr. RishiKumar, Dr. K. Rathinavel)
24.	Allelopathy as an alternative weed management strategy in cotton. (Dr. Blaise Desouza (PI), Dr. P. Nalayini, Mrs. M. Chakrabarty)
25.	Georeferenced soil information system for land use planning and monitoring soil and land quality for agriculture. (NAIP) (Dr. M.V. Venugopalan (CCPI))
26.	Identification of 'crop-cycle' for Extra Long Staple (ELS) Cotton in non-conventional regions. (Dr. R.B. Singandhupe (PI), Dr. Blaise Desouza)
27.	Herbicide resistance weeds and their management strategies. (Dr.A. R. Raju (PI), Dr. K. Sankarnarayanan)
28.	A Value Chain for Cotton Fibre, Seed and Stalks: An innovation for higher economic returns to farmers and allied stakeholders. (NAIP) (Dr. K. Shankarnarayanan (Co-PI))
29.	Synthesis and characterisation of nano-formulated micronutrient foliar spray for yield maximisation in different cotton genotypes. (Dr.D.Kanjana (PL))
30.	An accelerated process for preparation of bioenriched compost from cotton plant residues. (IICP(CIRCOT)) (Mr. K. Velmourougane (PA))
31.	Physiological manipulation for extending cotton crop. (Dr.S.E.S.A Khader (PI), Dr. A.H Prakash)
32.	Phenotyping of cotton for drought tolerance traits. (Dr.J.H. Meshram (PI), Dr. R.B.Singandhupe, Mrs. M. Chakrabarty)
33.	Role of Leaf Phytochemicals in cotton leaf reddening and plant responses to management through growth chemicals, nutrients and insecticides. (Mrs. M.Chakrabarty (PI))

34.	Impact evaluation of Bt cotton in Maharashtra. (Dr. A. R. Reddy (PI), Dr. R. B. Singandhupe, Dr. S. N. Rokde)
35.	Design & Development of a cotton picking head. (DST) (Er. Gautam Majumdar (PI))
36.	Identification of species specific dsRNA or siRNA or miRNA in cotton insect pest to explore their use in pest management through RNAi based technologies. (DBT) (Dr. K.R.Kranthi (PL), Dr. S. Kranthi, Dr. K.P. Raghavendra)
37.	Novel approaches for production of hybrid seeds with characteristics of improved insect resistance and higher yield. (CSIR-NIMITLI-Phase II) (Dr. K. R. Kranthi (CCPI), Dr. S. Kranthi)
38.	Evaluation of built in refuge for insect resistance management requirements for Bollgard II cotton. (Contract) (Dr. S. Kranthi, Dr. B. Dharajothi, Dr. Rishi Kumar)
39.	Research into development of decision support systems for management of insect pests of major rice and cotton based cropping systems. (NAIP) (Dr. VS Nagrare (CCPI), Er.G Majumdar, Dr. Rishi Kumar, Dr. B Dharajothi, Mr. M. Sabesh, Dr. M. Amutha)
40.	Crop pest surveillance and advisory project (CROPSAP) in Maharashtra. (Maha. Govt.) (Dr. V. S. Nagrare (PI))
41.	Isolation and characterisation of endophytes in cotton and endosymbionts in boll worms. (Dr. M. Amutha (PI))
42.	Use of innovative methods for management of cotton leaf curls virus disease. (Dr. D. Monga (PL), Dr. Rishi Kumar (PA))
43.	Development of nanoparticles based bio-control formulation for the management of major cotton pests and diseases. (Mr. A. Sampath Kumar (PL), Mr. K. Velmourougane)
44.	Disease monitoring of Tobacco Streak Virus (TSV) on cotton for South zone consisting of Andhra Pradesh, Karnataka and Tamil Nadu. (Dr. M. Gunasekaran (PI))
45.	Cloning and characterization of potent toxin gene from heat tolerant isolate of <i>Heterorhabdus indica</i> , an Entomopathogenic nematode. (DBT) (Dr. N.G. Narkhedkar (PI) Dr. P.K. Chakrabarty)
46.	Production, stabilisation, formulation and validation of microbial agents and their natural products against insects and nematode pests of cotton. (Dr. Gulsar Banu (PL), Dr. M. Amutha)
47.	Molecular characterization and validation of fiber strength genes with fiber specific promoter for improvement in cotton. (NFBSFARA) (Dr. G. Balasubramani (PI), Dr. K. P. Raghavendra, Dr. J. Amudha, Dr. S.B. Nandeshwar)
48.	Genomics of cotton boll and fibre development. (NAIP) (Dr. G. Balasubramani (PI), Dr. K.P. Raghavendra, Dr. J. Amudha, Dr. S.B. Nandeshwar)
49.	Development of drought resistant transgenic cotton and identification of new genes for high water use efficiency. (Dr. J. Amudha (PI), Dr. AH. Prakash, Dr. G. Balasubramani, Dr. R.B. Singandhupe)
50.	Isolation and identification of seed specific promoter and gossypol synthesis genes for silencing through RNA interference. (DBT) (Dr. K.P. Raghavendra. KP (PI), Dr. J. Amudha)
51.	Development of multi-gene constructs and Bt cotton varieties for sustainable pest management. (TMC 1.1) (Dr. K.R.Kranthi (PI), Dr. P.K.Chakrabarty, Dr. K.P.Raghavendra, Dr. S.B.Nandeshwar, Dr. G.Balasubramani, Mr. K.Velmourougane, Dr. S.Kranthi, Dr. S.B.Singh, Mrs. M. Chakrabarty)
52.	Marker Assisted Breeding for Cotton Leaf Curl Disease (CICuD), Bacterial Leaf Blight (BLB) and Nematodes Resistance in Cotton. (TMC 1.2). (Dr. V.N. Waghmare (PI), Dr. P. K. Chakrabarty, Mr. Sampath Kumar, Dr. N. Narkhedkar, Dr. S. Manickam, Dr. Dilip Monga, Dr. S. K. Verma)
53.	Consolidation of repository of high strength cotton genotypes and evaluation for quality traits and yield in specific agro-eco zones". (TMC 1.3) (Dr. S. Manickam (PL), Dr. T.R. Loknathan, Dr. S.M. Palve, Dr. P. Nalayini)

54.	Agrotechniques for high density planting system and surgical cotton varieties. (TMC 1.4) (Dr. Venugopalan (PI), Dr. Blaise DeSouza, Dr. C B.Naik, Dr. A R.Reddy, Dr. Punit Mohan, Dr. T.R. Lokanathan, Dr. A.R. Raju, Mr. Sampathkumar, Dr. K. Sankarnarayanan, Dr. S. L. Ahuja, Dr. R.A. Meena)
55.	Simulation models/Sensor based gadgets for Cotton Protection and Production. (TMC 1.5) (Dr. Sandhya Kranthi (PI), Dr. V. S. Nagrare, Dr .K.R. Kranthi, Dr. C.B. Naik, Dr. A.R. Reddy, Dr. N. Anuradha, Mrs. M.Chakrabarty, Dr. A. H. Prakash, Dr. M. Amutha, Dr. K. Sankarnarayanan, Dr. Isabella Agarwal, Dr. B. Dharajothi, Dr. Rishi Kumar)
56.	E-Kapas Network and Technology Documentation. (TMC 1.6) (Dr.S.M. Wasnik (PI), Mrs. M. Chakrabarty, Dr. S. Usha Rani, Dr. O. P.Tuteja)
57.	Development of Cotton Picking Machinery for Small Scale Cotton Production Systems. (TMC 1.7) (Er. Gautam Majumdar (PI))

### 10.3 : Consultancy, Patents, Commercialization of Technology

#### Revenue Generation

The Bt Referral lab generated a revenue of Rs.7,00,260/- through sale of Bt express, Bt Quant, GUS detection kits in 2013-14.

#### Patented Technology Published in IPINDIA website

Three patents submitted by Dr. P. K. Chakrabarty, Er. G. Majumdar and Dr. Nandini Gokte Narkhedkar were published, anticipated for the first examination report from Patent office, Mumbai.

Two bio-pesticides to control Mealy bug called "Mealy Quit" and "Mealy Kill" are ready for commercialization.

#### MoU between CICR and M/s. Padgilwar, Nagpur

Memorandum of Understanding (MoU) was signed between CICR and M/s. Padgilwar, Nagpur for Solar Powered Knapsack Sprayer on 17<sup>th</sup> Dec 2013 in which the term and conditions including license fee and 5% royalty on each unit sold were fixed.

### 10.4 : Significant Decisions of RAC, IRC, IMC and Other Important Meetings

#### Research Advisory Committee Meeting

Research Advisory Committee (RAC) meeting was held at Central Institute for Cotton Research (CICR), Nagpur from 14<sup>th</sup> to 15<sup>th</sup> March 2014. The RAC meeting was chaired by Dr. B.V. Patil, Vice Chancellor, UAS, Raichur, Karnataka. The following RAC members attended the meeting.

- Dr. T. Pradeep, Principal Scientist (Breeding), Maize Research Centre, ARI, ANGRAU
- Dr. A. K. Dhawan, Ex. Prof. & Head, Entomology, PAU, Ludhiana
- Dr. A. J. Shaikh, Ex-Director, Central Institute for Research on Cotton Technology

Dr. K. R. Kranthi, Director, CICR welcomed the RAC Chairman and the members, Heads of the Divisions and Regional Stations, Coimbatore and Sirsa. The proceedings started with the opening remarks by the Chairman, RAC. In his opening remarks, the Chairman, RAC, welcomed the members of RAC for the meeting and appreciated the suggestions made in QRT report. He emphasized the problem of lower yield levels in India and suggested that all the scientific efforts should be consolidated to achieve higher cotton productivity. He also congratulated the institute for bagging Mahindra Samridhi Krishi Sansthan Award for outstanding performance in cotton research. The action taken report for each of the institute, TMC and external funded projects was presented by Dr. M.V. Venugopalan, Member Secretary, RAC.



#### Recommendations of RAC

##### General recommendations (GR)

1. Identification of early maturing varieties for different situations under HDPS with incorporation of *Bt* gene, if possible and development of picker should be the overall objective

2. Plant type and mechanization of harvesting should be given priority
3. Time framing of the project objectives for effective monitoring and evaluation
4. Foreign training of young scientists should be arranged in the best laboratories especially in frontier areas of gene discovery aspects for crop protection

**Crop Improvement Division:**

1. DNA fingerprinting of all the public sector cotton varieties should be done on priority.
2. Reducing the number of projects to improve the focus of the research in crop improvement.
3. Strategies for improving seed vigour should be given emphasis. Changes in the biochemical profile within the seed during germination may be investigated.
4. Seed packaging material needs to be standardized for long term storage.
5. Breeding programme towards development of surgical cotton should be given impetus for meeting the future industrial requirement.
6. Registration of plant varieties should be taken up at the earliest.

**Crop Production Division:**

1. Trials to develop a comprehensive weed management strategy for HDPS are needed
2. Demonstration of one large scale precision cotton farming in all the zones with the latest HDPS concept
3. Variety 'F1054' along with other genotypes may be tested under HDPS in North India
4. Location specific agro-technology for HDPS in cotton to be worked out. The possibility of double cropping after HDPS cotton may be explored wherever earliness is obtained by this technology
5. Problems if any, pointed out by the farmers with HDPS system should be redressed. Seed production of varieties suitable for HDPS need to be given emphasis to enable wide spread adoption of technology by the farmers
6. Any herbicide (like paraquat) alone or in combination at low doses can be explored as an alternative to costly defoliant available in the market after ruling out its undesirable effects on fibre quality
7. Application of combination of herbicides should be done cautiously and checked for phyto-toxicity to popular cotton varieties

8. Bulletin on weed flora of cotton system may be published
9. Changes in soil health parameters should be monitored periodically from GPS fixed locations in CICR farm under continuous cultivation of Bt hybrids. Soil health card for these sites should be maintained.
10. Evolutionary significance of seed gossypol in relation to plant growth, stress abatement and crop development may be explored.
11. Cost benefit ratio of use of Pusa Hydrogel technology should be worked out for cotton
12. Ajwain as a cover crop may be explored.

**Crop Protection Division:**

1. Efforts can be taken to develop repository of the AICCIP entries known to be tolerant to different sucking pests and diseases at CICR
2. Collection and conservation of biodiversity of all the insect pests and natural enemies.
3. Management of jassids and whiteflies in cotton to be addressed on priority.
4. Role of pollinators in cotton ecosystem and the effect of different insecticides on pollinators needs to be studied.
5. Intensification of the work on gene silencing.
6. To investigate if north populations of pink bollworm undergo diapause when brought to central India and if so, the percentage of diapausing pupae.

**Biotechnology Section:**

1. Consolidate the efforts within a time frame towards development of Bt cotton varieties.

**CICR, RS, Coimbatore:**

1. Study of possible variation in Bt toxin levels in relation to elevated levels of CO<sub>2</sub>, pruning and leaf reddening.

**CICR, RS, Sirsa:**

1. Studies on the whitefly populations carried over.
2. Reconfirm the efficacy of neem based insecticides on the management of whiteflies.

**QRT meeting for finalization of recommendations**

A wrap-up meeting of QRT for finalization of recommendations was held on 12.07.2013 at CICR, Nagpur under the chairmanship of Dr. C.D. Mayee. The following members attended the meeting:

Dr. D. P. Biradar, Member, QRT

Dr. (Mrs.) Usha Barwale, Member, QRT

Dr. K.R. Kranthi, Member, QRT

Dr. M.V. Venugopalan, Member Secretary, QRT

The recommendations prepared by the members were finalized during the meeting. The final report of QRT for CICR & AICCIP (2007-12) was prepared and submitted to the Council for further needful. Later, the Chairman, QRT presented the recommendations before the

Director General, ICAR.

### Institute Management Committee Meeting

The 51<sup>st</sup> Institute Management Committee (IMC) meeting was held on 21<sup>st</sup> August 2013 under the Chairmanship of Dr. K.R. Kranthi, Director, CICR, Nagpur. The meeting was attended by the following members.

1.	Dr. K. R. Kranthi , Director	CICR, Nagpur	<b>Chairman</b>
2.	Dr. R.G. Dani, Vice Chancellor	Dr. PDKV, Akola	Member
3.	Joint Director of Agriculture*	Govt. of Maharashtra, Nagpur	Member
4.	Shri. Sharad Tasare, Ex M.L.A.	Maharashtra Assembly, Amravati	Member
5.	Dr. Dilip Monga, Head	CICR Regional Station, Sirsa	Member
6.	Dr. P.K.Chakrabarty, Head	Division of Crop Improvement, CICR, Nagpur	Member
7.	Shri G. C. Prasad, Sr. F & AO	NBSS & LUP, Nagpur	Member
8.	Shri Sachin Agnihotri, Sr. Admn. Officer	CICR Nagpur	Member Secretary
9.	Dr. C.D. Mayee, Ex-Chairman ASRB, New Delhi	Chairman QRT for CICR & AICCIP	Spl. Invitee
10.	Dr. (Mrs.) Sandhya Kranthi, Head	Division of Crop Protection, CICR Nagpur	Spl. Invitee
11.	Dr. Blaise Desouza, Head	Division of Crop Production, CICR Nagpur	Spl. Invitee
12.	Dr. S.B. Nandeshwar, Pr. Scientist	Biotechnology Section, CICR Nagpur	Spl. Invitee
13.	Shri. Deepak Maheshwari, F. & A.O.	CICR Nagpur	Spl. Invitee
14.	Dr. M.V. Venugopalan, Pr. Scientist & Head	PME Cell, CICR Nagpur	Spl. Invitee

\*Represented by Shri R. B. Chalwade, Superintendent Agriculture Officer, Nagpur Division

Dr. K.R. Kranthi, Director CICR & Chairman, IMC mentioned that this session of IMC was specially convened to facilitate an interactive meeting of the Chairman, QRT with the IMC for the presentation of the recommendations of QRT. The other major agenda was seeking approval of the committee for purchase of equipments, furniture & fixtures and execution of works proposed in XII Plan to be taken on priority as per ICAR guidelines and for proposing the same under R.E. of 2013-14. This is necessary as the XII Plan is yet to be approved by the Council. Elaborating on further, the Chairman informed that a recent accidental fire gutted the Bt. referral lab and the lab needs to be renovated. Losses caused due to the fire are being examined by the CPWD to write off the material damaged and the final report is awaited. Additionally, the training hall inaugurated on 12<sup>th</sup> Nov. 2012 needs to be furnished and fitted with audio-visual aids/fixtures to make it functional. Essential equipments are needed to carry forward the newly launched E-kapas programme (under TMC) which intends to connect farmers through voice mail.

The IMC unanimously recommended for approval from Council for purchase of proposed instruments, furniture/fixtures and also for renovation works.



Dr. R. G. Dani, Vice Chancellor, PDKV informed that with 93 % of the area under Bt hybrids, there are few takers for varieties like AKH 081 and AKA 7 even though these have a good potential under HDPS. Dr. Dani mentioned about the MoU signed with CICR and hoped that this would enhance the quality of PG research at Dr. PDKV and the collaborative programmes on biotechnology will be strengthened.

Shri. Sharad Tasare, Ex-MLA, Amravati appreciated the new initiatives in cotton by CICR but appealed the

research community to work hard to restore the confidence of farmers in the cotton production system so that they will get returns from the crop in commensuration with the investment made.

Shri. G.C. Prasad, SFAO, NBSS&LUP, Nagpur expressed satisfaction over the expenditure pattern and the resources generated of the institute. He added that the equipments / works / furniture / fixtures proposed are essential and need to be attended on priority.

Shri. R.B. Chalwade, Superintendent Agriculture Officer, Nagpur who represented the Joint Director of Agriculture, Nagpur endorsed that the farmers of the region are showing keen interest on two technologies - HDPS in cotton and broad bed- furrow system. He also informed that the cotton area in Nagpur division in 2013-14 was 419800 ha.

### Institute Research Committee (IRC) meeting

The Annual Institute Research committee (IRC) meeting of CICR was conducted as a combined IRC for all the centres from 20-22<sup>nd</sup> March 2014 at CICR, Nagpur. Dr M.V. Venugopalan, Member secretary, RAC presented the specific recommendations of Research Advisory Committee meeting held on 14<sup>th</sup> March 2014.

Dr M.V. Venugopalan also presented the Quinquennial Review Team (QRT) recommendations. Mrs. Mukta Chakrabarty presented Research Framework Document (RFD) of the Institute. Mr. K. Velmourougane, Secretary IRC, presented the Action Taken Report of the previous IRC (2013). The IRC confirmed the minutes of the last IRC meeting.

The results of research projects at CICR, Nagpur, RS, Coimbatore and RS, Sirsa were presented by individual project leaders, discussed and critically reviewed as per

the technical programme. The technical programmes for the year 2014-15 were also finalized for each project. The meeting was chaired by Dr. K. R. Kranthi, Director, CICR and scientists of Nagpur, Coimbatore and Sirsa participated in the deliberations.

The IRC recommended the closure of 5 projects, approved 8 new projects to be initiated during 2014-15.

### Project Monitoring and Evaluation Committee (PMC)

The Project Monitoring and Evaluation Committee of the Central Institute for Cotton Research (CICR) was re-constituted as per the ICAR guidelines to review and evaluate the progress of ongoing research projects of the institute consisted of the following members from CICR, Nagpur.

1.	<b>Chairman</b>	Dr. K. R. Kranthi, Director
2.	<b>Member</b>	Dr. P.K. Chakrabarty, Head, Division of Crop Improvement
		Dr. Sandhya Kranthi, Head, Division of Crop Protection
		Dr. Blaise Desouza, Head, Division of Crop Production
3.	<b>Member Secretary</b>	Dr. M. V. Venugopalan, I/c, PME Cell

The committee evaluated the implementation of projects twice during the year (15-16 June, 2013 & 12-13 Nov., 2013) at Nagpur. At Coimbatore, the evaluation was done on 12-13 Dec., 2013

The Chairman and the members visited experimental fields and verified the implementation of the IRC approved technical programme. Modification of the approved technical program was suggested to derive additional information.

## 10.5 : Results – Framework Document (RFD) Committee

ARFD Committee was re-constituted as per the guidelines of the ICAR with the following officials of this institute.

Name	Designation
Dr. K.R. Kranthi	Director
Dr. M.V.Venugopalan	Nodal Officer (Principal Scientist and I/c, PME Cell)
Shri. Sachin Agnihotri	Sr. Administrative Officer
Shri. Deepak Maheshwari	Finance & Accounts Officer
Dr. (Mrs.) S.B. Singh	Co-opted Member
Dr. P.K. Mukherjee	Co-opted Member (Deputation completed & relieved on 01.05.2013)
Mr. A.Sampath Kumar	Co-opted Member
Dr. (Mrs.) Mukta Chakrabarty	Co-Nodal Officer & Co-opted Member

The committee meets periodically to discuss the success indicators of the monthly RFD report before sending to ICAR. This committee also finalizes the mid-term and annual RFD performance achievement

reports.

RFD Cell has been constituted as per the guidelines of the ICAR with the following officials to manage the activities of the RFD.

S.No	Category	Name & Designation
1	RFD Nodal Officer	Dr. M. V. Venugopalan, Principal Scientist (Agronomy) and I/c, PME Cell
2	One Scientist	Dr. K. P. Raghavendra, Scientist (Biotechnology)
3	One Technical Officer	Dr. M. S. Yadav, Chief Technical Officer & Nodal Officer, PME Cell
4	One Administrative Staff	Mr. Ghanshyam D. Sakhare, Lower Division Clerk & Typist

The Institute set a high performance standard and achieved a total composite score of 91% (Ranked in Very Good category) in the Annual Performance

Evaluation Report (April 1, 2012 to March 31, 2013). The details are given in **Annexure-I**.

### 10.6 : Participation of Scientists in Seminars/Symposia/Workshops /Meetings

Sr. No.	Seminars/Conferences/Symposia/ Workshops/ Meetings	Place and Date	Participants
<b>Seminars</b>			
1.	National Convention on Indian Cotton: Gearing up for Global leadership	MCRS, Surat 6-8 Jan., 2013	Dr. Suman Bala Singh, Dr. M. Saravanan, Dr. T. R. Loknathan, Dr. Punit Mohan
2.	AICCIP Workshop	MPUAT, Udaipur 8 - 10 April, 2013	Dr. A. H. Prakash, Dr. S. Manickam, Dr. K. Rathinavel, Dr. B. Dharajothi, Dr. K.P.M. Damayanthi, Dr. J. Gulsar Banu, Dr. S. Usha Rani, Dr. T. R. Loknathan, Dr. S. M. Palve, Dr. Punit Mohan, Dr. V. N. Waghmare, Dr. M.V. Venugopalan, Dr. D. Monga, Dr. S. L. Ahuja, Dr. O.P. Tuteja, Dr. R. A. Meena, Dr. Rishi Kumar
3.	Brain Storming Session on Research in Agril. Extension	CIFE Mumbai 26 April, 2013	Dr. Blaise Desouza, Dr.M.V. Venugopalan, Dr. A.R. Raju, Dr. R.B. Singandhupe, Dr. S.M. Wasnik, Dr. S.N. Rokde, Mrs. Mukta Chakrabarty, Er. Gautam Majumdar, Dr. J.H. Meshram
4.	National Seminar on 'Soil Feasibility, Degradation and Contaminants'	BSKKV, Dapoli 8-9 May, 2013	Dr. Jagvir Singh, Dr. S.M. Wasnik
5.	41 <sup>st</sup> Joint Agriculture Research and Development meeting (AGRESO)	MAU Parbhani 30 May to 1 June 2013	Dr. S.M. Wasnik
6.	XIII National Seed Seminar	UAS, Bangalore 8-10, June, 2013	Dr. V. Santhy, Dr. P. R. Vijaya Kumari Dr. P.K. Chakrabarty

7.	Steering committee meetings for implementation of Technical Assistance Program (TAP) to seven African countries under Africa India Forum Sumit	New Delhi 3 July, 2013	Dr. D. Monga
8.	3 <sup>rd</sup> International congress of Global warming on Biodiversity of Insects: Management and conservation	B U, Coimbatore 26-28 August, 2013	Dr. J. Gulsarbanu Dr. M. Amutha
9.	6 <sup>th</sup> National Seed Congress organized by NSRTC Varanasi	Varanasi 12-14 Sept., 2013	Dr. K. Rathinavel
10.	Seminar on Possibilities of improving fibre quality through agronomic interventions	GTC, Nagpur 18 Sept., 2013	Dr. Blaise Desouza
12.	National Seminar on Technology for Development of Rainfed Cotton	Bharuch, 24 – 25 Oct., 2013	Dr. M. Saravanan, Dr. Vinita Gotmare, Dr. Punit Mohan, Dr. H.B. Santosh, Dr. M.V. Venugopalan, Dr. Sandhya Kranthi, Dr. A.H. Prakash, Dr. S. Manickam
13.	Zonal Extension and Research Advisory meeting (ZERAC) of Central Vidharbha Zone for Rabi 2013	Yeotmal, 28 Oct., 2013	Dr. S.M. Wasnik
14.	Seminar on 'Knowing the Biological Biodiversity Act'	TNAU, Coimbatore 26 Nov., 2013	Dr. K.P.M. Damayanthi
15.	Biopesticide International Conference	Palayamkottai 28-30 Nov., 2013	Dr. J. Gulsar Banu Dr. M. Amutha
16.	Water use and water use efficiency- Phenotyping and their relevance in improving adaptation of crops under water limited condition.	UAS, GKVK, Bengaluru 2-4 Dec., 2013	Dr. J.H. Meshram
17.	Third International Conference 'Extension Education Strategies for Sustainable Agriculture Development - A Global Perspective'	UAS, Bengaluru 5-8 Dec., 2013	Dr. S.M. Wasnik, Dr. S. Usha Rani
18.	Steering committee meeting of CROPSAP	Pune 6 Dec., 2013	Dr. V.S. Nagrare
19.	SIMA Farm to Finish Expo 2013 Workshop on Harnessing Cotton Cultivation Capabilities in India	Coimbatore, 13-15 <sup>th</sup> December, 2013	Dr A. H. Prakash
20.	Steering committee meetings for implementation of Technical Assistance Program (TAP) to seven African countries under Africa India Forum Sumit	New Delhi 23 Dec., 2013	Dr. O. P. Tuteja
21.	National Seminar on "Corporate Social Responsibility in Community Development"	ADU, Coimbatore 22-23 Jan. 2014	Dr. S. Usha Rani
22.	International Conference on Biodiversity, Bioresources and Biotechnology	Mysore 30-31 Jan., 2014	Dr. J. Gulsarbanu
23.	Institute Management Committee meeting of NCIPM	New Delhi 7 Feb., 2014.	Dr. Sandhya Kranthi
24.	Institute Management Committee meeting of NRC Citrus	Nagpur	Dr. Sandhya Kranthi
25.	Institute Management Committee meeting of NBSSLUP	Nagpur 27 Nov., 2013	Dr. M.V. Venugopalan

26.	AZRA Silver Jubilee International Conference on Security and Environmental Safety	CRRI, Cuttack 16 - 18 Feb., 2014	Dr. B. Dharajothi, Dr. J. Gulsarbanu
27.	8 <sup>th</sup> Review Meeting of DUS test centres	UAS, Bengaluru 28.Feb. to 01 Mar., 2014	Dr. K. Rathinavel
28.	Institute Technology Management Unit (ITMU) meeting	CICR, Nagpur 7 March,2014	Dr. Blaise Desouza, Dr. Sandhya Kranthi, Dr. M.V. Venugopalan, Dr. A.R. Raju, Dr. R.B. Singandhupe, Dr. J. Annie Sheeba, Dr. S.M. Wasnik, Dr. S.N. Rokde, Mrs. Mukta Chakrabarty, Mr. Gautam Majumdar, Dr. J.H. Meshram
29.	A brainstorming session on 'Where are the constraints for high cotton yields?' Organized by Indian Society for Cotton Improvement (ISCI).	CICR, Nagpur 15 <sup>th</sup> March 2014	Director, HODs, all Scientists from HQ, Dr. D. Monga, Dr. A.H. Prakash,



## 10.7 : Distinguished Visitors

Name & Designation	Organisation	Date
<b>Nagpur</b>		
Dr. M.S. Swaminathan, Emeritus Chairman	MSSRF, Chennai	11.07.2013
Dr. T.P. Rajendran, OSD	NIBSM, Raipur	19.08.2013
Dr. Atanu Purkayastha, Joint Secretary (Seeds/TMOP/TMC)	DAC, MoA, GOI, New Delhi	06.09.2013
Dr. Anupam Barik, Additional Commissioner, Crop	DAC, MoA, GOI, New Delhi	06.09.2013
Shri Ashish Bahuguna, Agriculture Secretary	DAC, MoA, GOI, New Delhi	06.09.2013 29.01.2014
Dr. Sudhir Kumar Goel, Additional Chief Secretary, (Agriculture)	Agriculture Department, Govt. of Maharashtra, Mumbai	06.09.2013
Shri Sanjeev Gupta, Joint Secretary, Extension,	DAC, MoA, GOI, New Delhi	06.09.2013
Shri Umakant Dangat, Agriculture Commissioner,	Agriculture Department, Govt. of Maharashtra, Pune	06.09.2013
Shri B. Venugopal Reddy, District Collector	Nagpur, Maharashtra	07.09.2013
Dr. Dath K. Mita, Crop Analyst	International Production Assessment Division, Global Analysis USDA, USA	18.09.2013
Dr. Santosh Kumar Singh, Senior Agrl. Specialist	American Embassy New Delhi	18.09.2013
Dr. J. Sandhu, Agricultural Commissioner	DAC, MoA, GOI, New Delhi	26.09.2013
Dr. N. P. Singh, Director	ICAR, Research Complex, Goa	10.10.2013
Sh. B. K. Mishra, Chairman cum Managing Director,	Cotton Corporation of India (CCI), Mumbai	19.11.2013
Sh. M. M. Chockalingam, Director, Marketing	Cotton Corporation of India (CCI), Mumbai	19.11.2013
Sh. P. K. Agarwal, Director, Finance	Cotton Corporation of India (CCI), Mumbai	19.11.2013
Sh. Prithviraj Chavan, Hon'ble Chief Minister	Govt. of Maharashtra, Mumbai	16.01.2014
Shri RadhaKrishna Vikhe Patil, Agricultural Minister	Govt. of Maharashtra, Mumbai	16.01.2014
Sh. J. S. Saharia, Chief Secretary	Govt. of Maharashtra, Mumbai	22.01.2014
Dr. Sudhir Kumar Goel, Additional Chief Secretary, (Agriculture)	Agriculture Department, Govt. of Maharashtra, Mumbai	23.01.2014
Sh. B. Venugopal Reddy, Divisional Commissioner	Nagpur Division, Maharashtra	23.01.2014
Shri Ajit Powar, Deputy Chief Minister	Govt. of Maharashtra, Mumbai	25.01.2014
Sh. Shivajirao Moghe, Guardian Minister	Govt. of Maharashtra, Mumbai	02.02.2014
<b>Coimbatore</b>		
Dr. N. Gopalakrishnan, ADG (CC)	ICAR Head quarters, New Delhi	05.07.2013, 07.09.2013, 29.09.2013, 13.01.2014
Dr. S.K. Dutta, DDG (Crop Science)	ICAR Head quarters, New Delhi	30.07.2013
Dr. R. R. Hanchinal, Chairman,	Protection of Plant Varieties & Farmers Right Authority, New Delhi	28.11.2013

## 10.8 : Personnel

<b>Director</b> K R Kranthi, Director, krkranthi@gmail.com	<b>A Sampath Kumar</b> , Scientist, sampath_a@rediffmail.com
<b>Project Coordinator (Cotton)</b> <b>Coimbatore</b> A H Prakash, P.C. (Cotton) & Head, prakashcicr@gmail.com	<b>Coimbatore</b> M Gunasekharan, Senior Scientist, mgsekar@gmail.com
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<b>Coimbatore</b> Smt. D Kanjana, Scientist, kanjana16@rediffmail.com	<b>Agricultural Economics</b>
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## 10.9 : Other Information

### Delegation visit to India

#### Visit of ITMF delegation

Members of the Spinners Committee of International Textile Manufacturers Federation (ITMF) visited CICR, Nagpur on November 16, 2013. The delegates had interactive session with Scientists of CICR, headed by Dr. C. D. Mayee, former Chairman, ASRB, Govt. of India and Dr. K.R. Kranthi, Director, CICR, regarding the various ongoing research activities at CICR. Dr. D. Blaise, Head, Crop Production Division, Dr. Sandhya Kranthi, Head, Crop Protection Division, Dr. Suman Bala Singh, Head I/c, Crop Improvement Division and Dr. S.B. Nandeshwar, Head I/c, Biotechnology Section coordinated the field and lab visits.

#### ITMF delegation members :

- 1) Mr. Andrew Macdonald, Chairman, Spinners Committee (Brazil)
- 2) Mr. Walter Simeoni, Member, Spinners Committee (South Africa)
- 3) Mr. Enrique Crouse, Member, Spinners Committee (South Africa)
- 4) Mr. M.N. Vijayshankar, Spinners Committee (Malaysia)
- 5) Mr. M. B. Patodia, Member, Spinners Committee (India)
- 6) Mr. Bashir Ali Mohammad, Member, Member Spinners Committee (Pakistan) and Former President, ITMF
- 7) Dr. Christian Schindler, Director General, ITMF (Switzerland)
- 8) Mr. Jose Sette, Incoming Executive Director, ICAC (USA)
- 9) Mr. Mahesh C. Thakker, Special Invitee (India)



### Visit of Delegates from African Countries

A team comprising of 30 international delegates from African Countries viz., Kenya, Liberia and Malawi visited CICR Regional Station, Coimbatore on 16<sup>th</sup> November, 2013. They visited the station as a part of their exposure visit under 'US- India- Africa Triangular International Training Programme on new dimensions in Agricultural Extension Management' for Extension functionaries, organised by MANAGE. Dr. A.H. Prakash (Project Coordinator & Head), Dr S. Manickam and Dr K. Sankaranarayanan delivered talks about cotton status, breeding programmes and production aspects. Dr. Prakash, during his welcome address briefed the activities of the Regional Station, AICCIP and Cotton Scenario in India. Dr. S. Manickam, Principal Scientist (Plant Breeding) exposed the delegates about the varieties and hybrids released by CICR. Dr. K. Sankaranarayanan, Principal Scientist (Agronomy) made a presentation on Cotton Production Technologies (multi-tier cropping system, cotton-sorghum rotation, low cost drip system, *in-situ* grown ragi for monocropping of cotton, high density planting system and poly mulch). During the interactive session, the delegates discussed about its viability under African Condition.

### National Agricultural Exposition- KRISHI VASANT 2014

Krishi Vasant -2014, the country's biggest ever Agricultural Exposition was organized at Central Institute for Cotton Research, Nagpur to celebrate farmers' great contribution to our economy from 9-13 February 2014 by the joint efforts of Govt. of India and Govt. of Maharashtra with Confederation of Indian Industry (CII) as the strategic partner. The event also marked the centenary celebrations of Late Shri. Vasant Rao Naik, Ex. Chief Minister of Maharashtra who played a major role in agricultural reforms in Maharashtra during the green revolution era. Honourable President of India, Shri. Pranab Mukherjee inaugurated the Krishi Vasant on 9<sup>th</sup> February, 2014. In his inaugural address, the President lauded the new dimension and new direction provided to Indian farming in the last ten years, which has seen the country achieving food security and becoming a top exporter of food grains. Mr. Sharad Pawar, Minister of Agriculture and Food Processing Industries, Government of India; Dr. S. Ayyappan, Secretary (DARE) & Director General (ICAR), Mr. K Sankaranarayanan, Governor, Maharashtra, Mr. Prithviraj Chavan, Chief Minister, Maharashtra; Mr. Ashish Bahuguna, Secretary, DAC; Mr. Anil Deshmukh, Minister of Food, Civil Supplies and Consumer Protection, Government of Maharashtra; Mr. Ajit Pawar,

Deputy Chief Minister, Maharashtra; Mr. Praful Patel, Minister of Heavy Industries & Public Enterprises, Government of India; Mr. Radhakrishna Vikhe Patil, Minister of Agriculture and Marketing, Government of Maharashtra; Mr. Shivajirao Moghe, Guardian Minister of Nagpur; Mr. S. Gopalakrishnan, President, CII were present at the inaugural function. Dr. S. Ayyapan, Secretary (DARE) and Director General (ICAR) proposed the vote of thanks.

Live crop demonstrations encompassing 321 varieties of 56 crops on 10 ha area were put up, an event of unprecedented proportions, at CICR, Nagpur. These included vegetable, fodder, fiber, oilseed, cereal as well as horticultural crops. Farmers were enthusiastic to visit these live crop demonstrations which were based on the novel way of cultivation used by progressive farmers. The theme pavilion was the biggest attraction of the exhibition in which the beautiful installations have been created representing the variety of farming in India. The exhibition not only gave the theoretical information about farming but also provided practical knowledge. Around 78 ICAR institutes/universities along with 8 zonal project directorates, state departments of various states and private companies from the country exhibited their innovative findings for the benefit of the farmers. The open areas dedicated to additional income sources like



poultry and animal husbandry also evoked very enthusiastic response from farmers. The open display-cum-demonstration of high end machinery was the special attraction for farmers. Farmers' technology schools were organised by CICR under the guidance of Dr. K. R. Kranthi, Director, CICR, to educate and train the farmers in various aspects of farming and around 20,000 farmers had been trained during the event. CICR had put up 5 stalls (3 on behalf of the institute, 2 on behalf of the Ministry of Agriculture) for exhibiting the technologies of the institute. Theme specific conferences, cultural events, skit shows, quiz shows and kisan goshthies were part of the event. Farmer- scientist interactions on



various themes / subjects related to agriculture were also conducted during 5 days period by inviting specialists from ICAR institutes, SAU's and their doubts were cleared by the scientists. Farmers were given direct access to latest technologies. Success stories of farmers were highlighted during the Krishi Vasant to encourage the farmers to adopt the latest innovative technologies. More than eight lakh people visited the event from various parts of the country which included seven lakh and eighty four thousand registered farmers. An Award Ceremony was organised on the concluding day of the event.

The institute received an appreciation letter from Mr. Ashish Bahuguna, Secretary, DAC, Ministry of Agriculture, Government of India for successful organization of the event.

### Kapus Melawa

'Kapus melawa' was organized by CICR on 11 December 2013 in which more than 700 cotton farmers from Jalgaon District, Maharashtra participated. The farmers' visit was coordinated by "Manish Dada Jain Foundation" Jalgaon District, Maharashtra. The scientists of CICR delivered lectures on various aspects of cotton cultivation. Dr. C. D. Mayee was the guest of honour and the event was coordinated by Dr. Sandhya Kranthi, Head, Crop protection & I/c Director.



### Kshetriya Kisan Goshthi

Dr. A. R. Raju and Dr. V. S. Nagrare participated in 'Kshetriya Kisan Goshthi' on September 27, 2013 at Jam, Samudrapur Taluk of Wardha District. *Kshetriya Kisan Goshthi* was organized under ATMA by Agriculture department, Government of Maharashtra. The CICR scientists interacted with the farmers and answered their queries on cotton production and protection aspects. Other invited experts discussed about cultivation of *Rabi* crops. About 100 farmers participated in the event.

## Library

### Additions

Forty two new books were purchased for the library during 2013-2014.

### Documentation services

- Computerized bibliographic database on Cotton was developed in the library to provide comprehensive and updated information on cotton. About 4463 references along with abstracts have been stored in it. Based on this bibliographic database, the library publishes a current awareness bulletin namely "COTTON RESEARCH ABSTRACTS". The Bulletin is circulated to all the scientists of the Institute and to all AICCIP Centers in India. In the reported period, four issues of COTTON RESEARCH ABSTRACTS (V27, (No. 1-4), January – December 2013) were published and circulated.
- The Library is actively participating in the E-Journal Consortium by responding regularly through E-mails and thus also receiving updates. More than 2000 on-line journals on agriculture and crop sciences are made available over the network through this consortium.
- Four User Terminals installed in the Library have facilitated the library users to access the databases uploaded in the Library Server. Users can also access the Internet on these terminals. Similarly the entire catalog of the library has been downloaded on these terminals for ease of use.
- The Web OPAC version of the Library software SLIM21 was updated and by using this Library Application Software, the entire catalogue of holdings of the Library (books and bound volumes) is available on all terminals within the Institute. By its virtue, the entire holdings and the catalogue of the Library are visible on the LAN terminals within the Institute by clicking on the following link. Library Catalogue Web-OPAC Link <http://dbserver/w27/>

### Progressive Use of Hindi

#### Nagpur

#### Hindi Week

Implementation of official language Hindi was taken on prime and priority basis. For this purpose, an Institute official language implementation committee was constituted and about four meetings of this committee have been organized this year for proper implementation.

Hindi awareness fortnight was celebrated at CICR Nagpur from 19.09.2013 to 11.10.2013 with enthusiasm and various competitions had been conducted to encour-

rage the staff to exhibit their proficiency in Hindi language.

The inaugural function held on 20.09.2013 was chaired by Dr. K R Kranthi, Director & Chairman, IOLIC, CICR, Nagpur. Dr. V. J. Shivankar, former Director, NRCC, Nagpur as the Chief Guest. Dr. Sandhya Kranthi, HOD, Crop Protection, DR. P. K. Chakrabarty, HOD, Crop Improvement, Dr. D. Blaise, Crop Production, Sh. Deepak Maheshwari, Finance and Accounts Officer and Sh. Rajnikant, Working Coordinator and Hindi Officer, addressed the audience on the occasion.



**Dr. K.R. Kranthi, Director, CICR, Dr. Shivankar, Chief Guest, Dr. P.K. Chakrabarty, Dr. Sandhya Kranthi, Sh. Deepak and Sh. Rajnikant.**

During the fortnight (20.Sept. to 11.Oct. 2013), various competitions like Hindi essay and poetry writing, general awareness quiz, dictation, slogan writing and other related competitions were organized. A total of 12 competitions were conducted, in which 90 staff members have participated.

Closing ceremony was held on 11.10 2013 under the chairmanship of Dr. K. R. Kranthi, Director and Chairman, IOLIC. Dr. M. S. Kairon, former Director, CICR, was the Chief Guest of the occasion. Heads of various divisions, Dr. Sandhya Kranthi, Crop Protection, Dr. Suman Bala Singh, Crop improvement, Dr. D. Blaise, Crop Production, and Coordinator Sh. Deepak Maheshwari, working coordinator Sh. Rajnikant and Senior AO Sh. Sachin Agnihotri were present. Children of Mundle Public School marvelously emphasized the importance of Hindi and seasons in Agriculture through songs and dance. Quiz competition (conducted by Mrs. Mukta Chakrabarty and Dr. M.V. Venugopalan) was held as a part of Hindi Day Celebration. Winning participants were awarded with first, second, third and consolation prizes and certificates. Cash encouragement prize was distributed for commendable work in Hindi to, scientific, technical and administrative staff members.

Entire function was organized under the able leadership of Dr. K.R. Kranthi, Director, & Chairman of Institute Official Language Committee, and ably coordinated by



**Inauguration of Closing Ceremony by Chief Guest Dr. M. S Kairon, Former Director CICR and Dr. K.R. Kranthi, Director,CICR**

the members of the Hindi function committee, Sh. Sachin Agnihotri, Sh. Deepak Maheshwari, Sh. Rajnikant Chaturvedi, Dr. M. V. Venugopalan, Dr.G Balasubramani, Dr. Mukta Chakrabarti, Dr. V. Santhy, Dr. Vinita Gotmare, Sh. Gokulpure, Smt. Vandana Satish, Smt. Sunita Chauhan, Dr. U.V. Galkate and Sh. Gulbir Singh and Sh. R.Lokhande.

### **One day Hindi Workshop**

One day workshop on Hindi was organized by the Hindi cell of the institute by following the guidelines of Hindi Nideshalaya, ICAR on 29 March 2014. Dr. Sandhya Kranthi, Director I/c & Head, Crop Protection Division inaugurated the function. Dr. Nandini Bhattacharya Sahu, Archaeological Survey of India, delivered a lecture on "The discovery of Rock Paintings at Gavilgarh Hills". In her talk, Dr. Nandini explained about ancient paintings and carvings on rock shelters and caves found in Gavilgarh hills near Betul, Madhya Pradesh. According to her, the paintings were similar to the paintings of Gond tribes and the paintings in Gavilgarh might belong to ancestors of the tribe. Mr. Rajanikant Chaturvedi, Convenor, Hindi Cell, proposed the vote of thanks.



**Dr. Nandini B. Sahu , delivering a talk during Hindi workshop**

## 10.10: Weather

### Nagpur

Month	Temperature (°C)		Relative Humidity (%)		Rainfall (mm)	No. of Rainy Days
	Max.	Min.	Max.	Min.		
June, 2013	34.13	25.03	75.23	57.4	426.00	12
July, 2013	30.24	24.24	93.1	78.8	513.00	16
August, 2013	29.42	23.60	91.8	96.0	261.50	15
September, 2013	33.48	23.28	87.5	59.4	93.00	5
October, 2013	31.31	22.13	91.6	72.5	99.00	5
November, 2013	30.56	15.83	64.4	40.1	0	0
December, 2012	29.01	11.86	75.0	63.83	0	0
January, 2014	28.58	14.77	81.3	62.0	4.0	1
February, 2014	30.85	15.10	81.1	70.3	26.2	5
<b>Total</b>					<b>1422.7</b>	

### Coimbatore

Month	Temperature(°C)		Relative Humidity (%)		Rainfall (mm)	No. of rainy days
	Max.	Min.	Max RH	Min RH		
Aug.2013	31.3	22.6	86.1	55.2	27.3	5
Sept. 2013	31.2	22.6	85.1	57.8	46.5	4
Oct. 2013	31.5	21.7	88.3	55.9	141.2	9
Nov. 2013	29.8	22.3	88.7	60.3	57.9	5
Dec. 2013	29.2	19.8	88.0	52.0	24.8	3
Jan.2014	30.1	20.0	84.0	42.0	0.0	0
<b>Total</b>					<b>297.7</b>	<b>26</b>

### Sirsa

Month	Temperature (°C)		Rainfall (mm)	No. of rainy days
	Max.	Mini.		
April 2013	39.2	14.5	12.4	2
May 2013	46.6	18.9	0.0	0
June 2013	45.2	22.2	29.6	3
July 2013	40.2	25.0	70.8	8
August 2013	38.0	25.0	168.4	11
September 2013	37.6	22.0	0.0	0
October 2013	36.4	15.2	-	-
November 2013	30.4	18.6	4.0	1
<b>Total</b>			<b>285.8</b>	<b>25</b>

## 10.11 : Cotton Scenario

Details of state-wise cotton area, production and productivity are given below:-

### State-Wise Cotton Area, Production and Productivity

Zone/State	2012-2013 *			2013-2014 *		
	Area (Lakh ha)	Production (Lakh bales)	Productivity (kg/ha)	Area (Lakh ha)	Production (Lakh bales)	Productivity (kg/ha)
Punjab	4.80	21.00	744	5.05	21.00	707
Haryana	6.14	25.00	692	5.57	23.00	702
Rajasthan	4.50	17.00	642	3.03	14.00	785
<b>North Zone</b>	<b>15.44</b>	<b>63.00</b>	<b>694</b>	<b>13.65</b>	<b>58.00</b>	<b>722</b>
Gujarat	24.97	93.00	633	26.91	116.00	733
Maharashtra	41.46	79.00	324	38.72	81.00	356
Madhya Pradesh	6.08	19.00	531	6.21	19.00	520
<b>Central Zone</b>	<b>72.51</b>	<b>191.00</b>	<b>448</b>	<b>71.84</b>	<b>216.00</b>	<b>511</b>
Andhra Pradesh	24.00	84.00	595	21.42	72.00	571
Karnataka	4.85	15.00	526	5.78	18.00	529
Tamil Nadu	1.28	6.00	797	1.17	5.00	726
<b>South Zone</b>	<b>30.13</b>	<b>105.00</b>	<b>592</b>	<b>28.37</b>	<b>95.00</b>	<b>569</b>
Others	1.70	6.00	600	1.67	6.00	611
<b>Grand Total</b>	<b>119.78</b>	<b>365.00</b>	<b>518</b>	<b>115.53</b>	<b>375.00</b>	<b>552</b>

1 bale= 170 kg.

Source: Cotton Advisory Board, Ministry of Textile, Govt. of India. \* - As estimated by CAB in its meeting held on 01.11.2013



Annual (April 1, 2012 to March 31, 2013) Performance Evaluation Report in respect of RFD 2012-2013 of RSCs i.e. Institutes

Annexure-I

Name of the Division: Crop Science Division

Name of the Institution: Central Institute for Cotton Research, Nagpur

RFD Nodal Officer: Dr. M.V. Venugopalan

Objectives	Weight (%)	Actions	Success Indicators	Unit	Weight (%)	Target/ Criteria Value			Achievements	Performance		Reasons for shortfalls or excessive achievements, if applicable
						Excellent	Very Good	Fair		Raw Score	Weighted Score	
						100%	90%	70%				
1. To conduct research for discovering and developing new genetic material for enhancing yield, stress tolerance, input use efficiency and fibre quality of cotton.	47	Augmentation, collection, characterization and utilization of cotton genetic resources	Germplasm accessions maintained	No.	4	100%	90%	70%	1789	100	4	-
						1550	1500	1150	1000			
						100%	80%	70%	50	90	2.7	-
			Germplasm accessions including perennials / land races added to cotton gene bank	No.	3	55	50	39	50	90	2.7	-
			Germplasm lines, varieties and parents of hybrids characterized through DUS	No.	2	111	100	77	100	90	1.8	-
			Genotypes characterized through DNA fingerprinting	No.	2	44	40	31	44	100	2	-
		Evaluation of cotton genetic resources/ improved varieties for suitable crop husbandry practices	Germplasm lines evaluated for adaptability and stress response	No.	5	620	600	570	5020	100	5	One time evaluation for water logging based on IRC Decisions
			Advance breeding material	No.	3	20	19	14	25	100	3	-

Objectives	Weight (%)	Actions	Success Indicators	Unit	Weight (%)	Target/ Criteria Value					Achievements	Performance		Reasons for shortfalls or excessive achievements, if applicable
						Excellent	Very Good	Good	Fair	Poor		Raw Score	Weighted Score	
			evaluated for adaptability and stress response											
		Discovery of novel genes to combat stress and improve fibre quality / production	New genes discovered	No.	4	3	2	1	0	0	3	100	4	-
			New transgenic events developed and registered with RCGM	numbe	6	6	33	30	26	23	20	33	100	6
		Discovery of novel genes to combat stress and improve fibre quality / production	Informative markers identified	No.	2	18	15	13	12	10	15	90	1.8	-
			Validation of association of markers available in public domain with desired traits	No.	2	2	3	2	1	0	0	3	100	2
		Discovery of novel genes to combat stress and improve fibre quality / production	New genes discovered	No.	4	3	2	1	0	0	3	100	4	-
			New transgenic events developed and registered with RCGM	No.	6	6	33	30	26	23	20	33	100	6
		Discovery of novel genes to combat stress and improve fibre quality / production	Informative markers identified	No.	2	18	15	13	12	10	15	90	1.8	-
			Validation of association of markers available in public domain	No.	2	2	3	2	1	0	0	3	100	2

Objectives	Weight (%)	Actions	Success Indicators	Unit	Weight (%)	Target/ Criteria Value				Achievements	Performance		Reasons for shortfalls or excessive achievements, if applicable	
						Excellent	Very Good	Good	Fair		Poor	Raw Score		Weighted Score
			with desired traits											
			Lines developed through marker assisted breeding	No.	1	2	1	0	0	0	0	0	-	
			Advanced cultures developed	No.	2	65	60	55	50	45	100	2	-	
			Development of improved varieties to suit diverse cotton production ecologies / situations	No.	3	37	30	28	27	25	100	3	-	
			Promising cultures sponsored for AICCIP	No.	2	2	1	0	0	0	90	1.8	-	
			Varieties released / proposals submitted	No.	2	3	2	1	0	0	100	2	-	
			Germplasm / genetic stock / breeding lines registered with NBPGR	No.	2	55	50	44	39	33	100	2	-	
			Production of nucleus / breeder's seeds of cotton / formulations	kg	2	550	525	515	505	500	100	2	To revive the seed chain for HDPS trials	
			Quantity of nucleus seed produced	kg	2	550	525	515	505	500	100	2	To revive the seed chain for HDPS trials	
			Quantity of breeder seed produced	kg	2	550	525	515	505	500	100	2	To revive the seed chain for HDPS trials	
2. To develop efficient, eco-friendly crop husbandry tools for improved cotton genotypes for	41	Crop husbandry tools for improved cotton varieties / hybrids	Production technologies developed	No.	5	5	4	3	2	1	90	4.5	-	
			Implemented / designed / fabricated/ tested and validated	No.	4	4	3	2	1	0	90	3.6	-	

Objectives	Weight (%)	Actions	Success Indicators	Unit	Weight (%)	Target/ Criteria Value				Achievements	Performance		Reasons for shortfalls or excessive achievements, if applicable	
						Excellent	Very Good	Good	Fair		Poor	Raw Score		Weighted Score
diverse agro-ecologies		Simulation/ stochastic / prediction / forecasting models	Districts monitored for insect pest / disease infestation	No.	3	100%	90%	80%	70%	60%	90	2.7	-	
						3	2	1	0	0				
						43	41	39	37	35				
		Tools of suppression of stresses due to biotic and abiotic factors	Districts monitored for insect pest / disease infestation	No.	5	43	41	39	37	35	90	4.5	-	
			Populations monitored for insect resistance to insecticides and Bt toxins	No.	6	42	40	38	36	34	100	6	-	
			New crop protection technologies developed	No.	6	6	5	4	3	2	100	6	-	
			Techniques to combat abiotic stresses, drought, water logging, salinity/alkalinity/leaf reddening / high temperature etc.	No.	4	9	8	7	5	4	90	3.6	-	
			Technologies disseminated	No.	4	6	5	3	2	1	90	3.6	-	
		Products / processes disseminated, commercialized and patents filed	Products / processes commercialized	No.	2	3	2	1	0	0	90	1.8	-	
			Patents filed	No.	2	2	1	0	0	0	90	1.8	-	

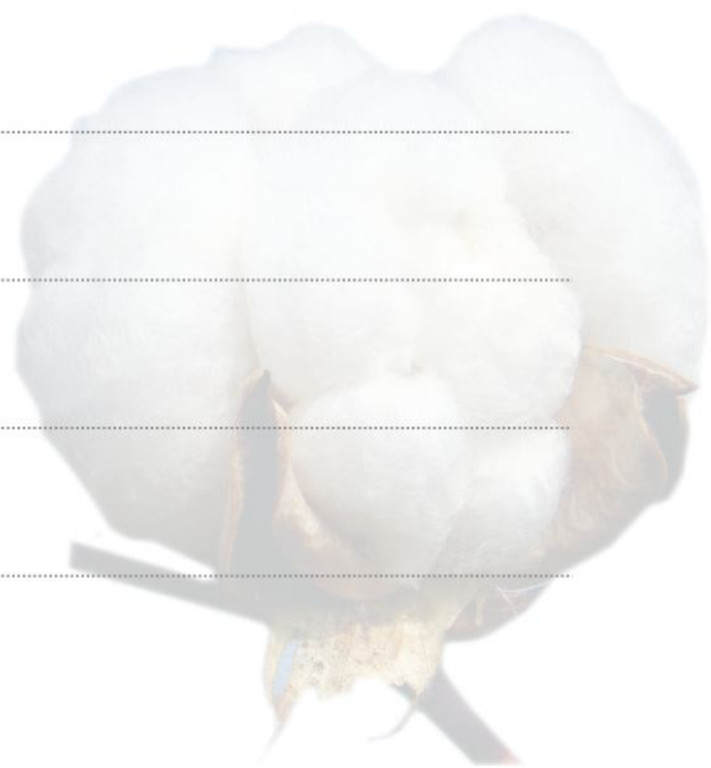
Objectives	Weight (%)	Actions	Success Indicators	Unit	Weight (%)	Target/ Criteria Value				Achievements	Performance		Reasons for shortfalls or excessive achievements, if applicable	
						Excellent	Good	Fair	Poor		Raw Score	Weighted Score		
														100%
*Efficient functioning of the RFD System	3	Timely submission of RFD for 2012-13	On-time submission	date	2	Mar. 23 2012	Mar. 26 2012	Mar. 27 2012	Mar. 28 2012	Mar.29 2012	May 23,2012	0	0	-
						100%	90%	80%	70%	60%				
Administrative Reforms	5	Timely submission of Results	On-time submission	date	1	May-01 2013	May-02 2013	May-03 2013	May-06 2013	May-07 2013	May 01,2013	100	1	-
						June 4 2012	June 5 2012	June 6 2012	June 7 2012	June 8 2012	June 1, 2012	100	1	-
		Implement ISO 9001	Prepare ISO 9001 action plan	date	1	Mar 25 2013	Mar 26 2013	Mar 27 2013	Mar 28 2013	Mar 29 2013	Nil	0	0	-
						100	95	90	85	80	95	90	1.8	-
Improving Internal Efficiency /responsiveness service delivery of Ministry /Department	4	Implementing strategies for reducing potential risk of corruption	% of implementation	%	2	100	95	90	85	80	100	100	2	-
						100	95	90	85	80	100	100	2	-
<b>TOTAL WEIGHT=</b>					<b>100%</b>									

Total Composite Score: 91.0  
Rating : Very Good

Procedure for computing the Weighted and Composite Score

1. Weighted Score of a Success Indicator = Weight of the corresponding Success Indicator x Raw Score / 100
2. Total Composite Score = Sum of Weighted Scores of all the Success Indicator





GLIMPSES OF KRISHI VASANT 9-13 FEB. 2014



Fodder Demonstration Block



Oilseeds Demonstration Block



Vegetables Demonstration Block



Pulses Demonstration Block



Farmers from various states gaining knowledge from the high tech demonstrations & Exhibitions





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