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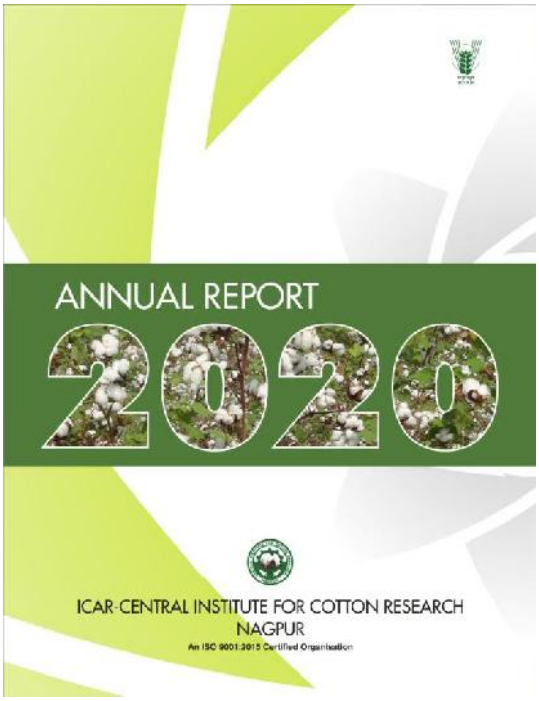

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ICAR- CENTRAL INSTITUTE FOR COTTON RESEARCH, NAGPUR

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PREFACE

Cotton was sown in 133.41 million hectares during 2020-21 season by an estimated 6 million cotton farmers across 11 major cotton growing states despite the COVID-19 pandemic which reiterates the resilience of Indian cotton production sector. The institute coped well with the unfolding pandemic situation and continued its research which led to significant achievements during the year under report.
For the first time, sevenBt cotton varieties were notified for commercial cultivation: two varieties for cultivation in the central zone (CICR SurajBt and CICR 16 Bt), three Bt varieties for cultivation under rainfed conditions in Maharashtra (CICR Rajat Bt, CICR PKV 081 Bt and GJHV 374 Bt), CICR Bt 6 for cultivation in Haryana and CICR 23 Bt for irrigated situations in South zone. CNA 1032, a *G. arboreum* genotype was identified for central zone; CCB-51 an ELS cotton genotype was releasedfor irrigated conditions of South Zone (Andhra Pradesh, Telangana, Karnataka and Tamil Nadu with an yield potential of 1464kg/ha, shorter duration of 165-170 days, fibre length of 37.4 mm andmicronaire of 3.3 and tenacity of 38g/tex.CICR-H Cotton 36 (Suraksha), an extra-long staple hirustumvariety was identified for release for both Central and South Zone States in irrigated conditions. One *G. barbadense* line CCB-12 was identified for registration with ICAR-NBPGR for cleistogamous nature of flower as a unique trait**.** More than 1000 crosses were attempted exploring wild species for increasing genetic diversity and pre-breeding for specific traits. Promising derivates of upland cotton were obtained from crosses with exotic lines (GVS 8 and GVS 9) for breeding resistance to the dreaded leaf curl virus disease (CLCuD) in the north zone.

Thirty-six and forty-two geographical populations of pink bollworm were monitored for resistance against baseline susceptibility to cry toxins, Cry1Ac and Cry2Ab, respectively. Spatial maps depicting the risk of pink bollworm establishment, number of generations and potential population abundance in different geographical locations were prepared by coupling a temperature-based phenology model with geographical information system (GIS). A multi lure pheromone system against major lepidopteran pests of cotton was designed and tested for field efficacy. Using marker assisted selection (CIR-246 marker) and artificial inoculation of BLB resistant plants, 56 BC4-F2 and 38 BC5-F1 BLB resistant plants were selected, screened and grouped.Nine potential endophytes were screened in vivo and were found promising against cotton diseases.For the first time natural infection of reniform nematode eggs by nematode antagonistic fungus, *Pochoniachlamydosporia* was reported from India and mass production protocol standardized.

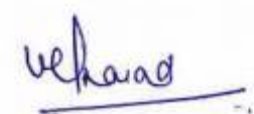
Soils rotated with deep rooted crops - pigeon pea, sunnhemp and *daincha* had less penetration resistance than those without a rotation. The night Net Ecosystem Exchange (NEE) was 5-10 μmol m^{-2} s^{-1} for cotton crop. The total Water footprint (WF)

of rainfed cotton at Nagpur was 16384 m^3/t of seed cotton, of which the green WF was 12187 m^3/t, and the grey water foot print was 4198 m^3/t. The total WF of drip-irrigated cotton was 13310 m^3/t. After two years of continuous cotton–maize and cotton-wheat cropping system under irrigated conditions, SCY increased significantly by 26.5% and 134.6% combined sources of organic (FYM once in two years) and inorganic (NPK + $MgSO_4$ + $ZnSO_4$ + Borax), treatments, respectively over control. At Sirsa, the seed cotton yield (SCY) was significantly higher under Zero tillage - permanent narrow raised bed with residue retention on surface. Among the cropping systems, significantly higher SCY was recorded under Cotton - Chickpea cropping systems.

Under e-Communication programme, cotton technologies were disseminated among farmers through voice message services covering 1.6 lakh farmers. Uploaded 91,54,264 voice messages during the year. Voice messages on cotton production and protection technologies were disseminated in Marathi, Tamil & Hindi.

During the period, a total of 76 research papers of which 30 research papers with >6 NAAS Score and 46 research papers with <6 NAAS Score as well as 30 popular articles were published. Forty-nine training programmes including virtual training programmes were organized. Linkages were fostered with sister ICAR Institutes, SAUs, other public sector Institutes, private companies, NGOs and farmer producer groups to commercialize and upscale varieties and technologies developed. One MTA and six MoUs were inked during January to December 2020

Guidance and constant encouragement received from Dr Trilochan Mohapatra, Secretary, DARE and Director General, ICAR and Dr T.R. Sharma, DDG (Crop Sciences) helped the institute perform well in tough times. I am grateful for the guidance and direction by the Research Advisory Committee Chairman Dr SA Patil and respected members of RAC. I am grateful for the support extended by Dr R,.K. Singh, ADG (CC), Dr AH Prakash. Head, Regional Station, Coimbatore and Project Coordinator, Dr O.P. Tuteja, Head, Regional Station, Sirsa. Heads of Divisions viz., Dr VN Waghmare, HoD Crop Improvement and Director (Acting); Dr Blaise D'Souza, HoD, Crop Production and Dr Nandini Gokte, HoD, Crop Protection and Dr MV Venugopalan, Head, PME at CICR provided support incarrying out the research programmes. Thanks are due to the Editorial Committee members for their unstinted work in bringing out this publication in time.



(Y.G. Prasad)
Director, ICAR-CICR

CONTENTS

1. EXECUTIVE SUMMARY

Crop Improvement Division

- A total of 24 wild species, 15 races of cultivated species and more than 45 synthetic polyploids are conserved in the 'wild species garden' at ICAR-CICR, Nagpur.
- The Gossypium species *G.anomalum*, *G. triphyllum*, *G. capitis viridis*, *G. thuberi*, *G. armourianum*, *G. davidsonii, G. raimondii, G. trilobum, G. stocksii, G. somalense, G. longicalyx*, *G.nelsonii*, *G. barbasonum* received from other sources were confirmed through morphological characterization.
- More than 1000 new crosses were attempted exploring the wild species namely *G. longicalyx, G. somalense*, *G. anomalum, G. capitis viridis, G. australe, G. thurberi, G. raimondii, G. barbosanum, G. triphyllum, G. klotzchianum,* and *G. mexicanum.*
- More than 12,335 accessions of *Gossypium* (*G. hirsutum – 8851, G. barbadense – 536, G. arboreum – 2053, G. herbaceum – 565, Wild Species – 24, interspecific derivatives – 40, Perennials and land races – 254, Races and derivatives of cultivated species – 12*) *are being maintained at ICAR-CICR Cotton Gene Bank.*
- Sixty nine (69) germplasm of *desi* cotton collected from different states of North Eastern Hill Region (NEH Region) were characterized and evaluated. Forty Eight (48) germplasm consisting of G. *hirsutum*, *G. arboreum* and wild species were distributed to breeders/ scientists of CICR, State Agricultural Universities and Private Seed Companies for utilization in their cotton improvement programme.
- One *G. barbadense* line CCB-12 was identified for registration with ICAR-NBPGR, New Delhi for its cleistogamous nature of flower as unique trait**.**
- One inter-specific hybrid (*G. hirsutum* × *G. arboreum*) plant was established at ICAR-CICR, Nagpur through embryo rescue technique.
- CNA 1032, a *G. arboreum* genotype tested in Agronomy trial in Central Zone during 2019-20 was identified for commercial cultivation by Varietal Identification Committee.
- An ELS cotton genotype CCB-51 was released for irrigated conditions of South Zone (Andhra Pradesh, Telangana, Karnataka and Tamil Nadu). It has an yield potential of 1464kg/ha with duration of 165-170 days. It has a fibre length of 37.4 mm, micronaire of 3.3 and tenacity of 38g/tex.
- CICR-H Cotton 36 (Suraksha), an extra long staple variety was identified for release for both Central and South Zone States in irrigated condition with an yield potential of 4019 kg/ha and average values of Upper Half Mean Length (UHML) of 32.4 mm, micronaire of 3.7 and tenacity of 34.3 g/tex in HVI mode in South Zone and UHML of 31.9 mm, micronaire of 4.4 and tenacity of 33.5 g/tex in HVI mode in Central Zone.
- Four GMS based *G. arboreum* hybrids were evaluated for seed cotton yield with two check hybrids. One GMS based hybrid CISAA 19-5 (2802 kg/ha) recorded significantly higher seed cotton yield than both the check hybrids, CICR 2 (2466 kg/ha) and CISAA 19-4 (2659 kg/ha).
- GMS lines (DS5, CISA 2, GAK 413A, CISG-20) and 18 newly identified GMS lines [CISG-1, CISG-2, CISG-4, CISG-8, CISG-9, CISG-10, CISG-11, CISG-13, CISG-14, CISG-15, CISG-16, CISG-17, CISG-18 (narrow leaf), CISG-18 (broad leaf), CISG-19, CISG-21, CISG-22 (narrow leaf) and CISG-22 (broad leaf)] were maintained through sibmating.

- Two F_5 generations of eight and ten parental crosses were raised for developing MAGIC RILs. 1000 lines were evaluated for leaf temperature and chlorophyll content which ranged from 24.1 to 29.5°C and 18.8 to 65.9 µmol/m² respectively while, 250 lines were evaluated for proline content that ranged from 1.4 to 2.18 µmol g^{-1} FW.
- Promising introgression lines were developed through interspecific (*G. hirsutum* × *G.barbadense*) hybridization for specific traits like high ginning outturn percentage (CNH 20378, CNH 20387, CNH 204710, CNH 204910) and cluster boll bearing (CNH 2020-7, CNH 2020-15, CNH 2020-16, CNH 2020-17, CNH 20 SP 2).
- In order to develop mapping population for waterlogging tolerance, four accessions each of tolerant (IC359979, IC359245, IC563998 (INGR 08093), LRA5166) and susceptible (IC357558, IC359242, IC357607, IC356708) group were characterized and molecular diversity was analyzed using SSR markers.
- Twelve F_4 populations of interspecific crosses of *G. herbaceum* × *G. arboreum* were evaluated. The population of cross IC371362 × PA785 had maximum UHML (30.1mm), UI (83%), MIC (3.3µg/inch), bundle tenacity (31.3g/tex) along with good yield potential.
- In order to develop compact desi cotton (*G. arboreum*) genotypes, BC_3F_1, BC_2F_2 and F_4 population of long linted genotypes *viz.,* PA255, PA812, PA740, PA783 and KWAN3crossed with Phule Dhanwantari were evaluated and selections were carried to combine plant architecture and fibre quality.
- A total of 165 single plant selections and 85 progenies were evaluated for earliness, jassid tolerance, compact plant architecture, good boll weight and yield. Eighty one single plant selections and 53 progenies were categorized as tolerant (grade 1) for jassid tolerance. Based on the molecular divergence revealed by 50 polymorphic markers, the jassid tolerant and susceptible upland cotton genotypes were grouped into 3 major clusters.
- Seven male parents (*G. barbadense*) *viz.,* ICB 161 (compact type), CCB 11A (early maturing), CCB 29 (Advance culture for yield), Suvin (fibre quality), ICB 124 (High leaf trichome), CCB 25 (Epicuticular wax content), ICB 46 (High gossypol glands) were selected to develop interspecific hybrids by crossing them with four female parents namely Suraj, Surabhi, MCU5 VT, CCH 15-1. The 50 *G. barbadense* accessions were grouped into seven clusters.
- A total of 24 samples representing 12 male sterile and 12 male fertile plants submitted for SNP genotyping. The seed of 12 CMS and its maintainer lines, 28 GMS and 25 Restorer lines were submitted for medium term storage (MTS).
- Resistance to CLCuD was studied using GVS-8 (EC881780) and GVS-9 (EC881781) and it was confirmed to be governed by a single dominant gene. Selfed and backcrossed populations are being derived to develop upland cotton varieties with better fibre traits and tolerance to CLCuD.
- Under Mega Seed Project, 5.87 q TFL seeds of 4 ICAR-CICR Bt varieties, 7.45 q breeder seeds and 7.16 q TFL seeds of popular non Bt varieties was produced.
- Foliar supplementation of micronutrient mix and neem kernel extract significanlty enhanced the quality seed yield in Non Bt Cv.Suraj. Application of Mepiquat Chloride (Chamatkar) significantly increased the boll weight but did not affect the seed index.
- Maintenance breeding and characterization for 186 extant cotton varieties which includes 141 *G. hirsutum*,

35 *G. arboreum,* 3 *G.herbaceum* and 7 *G.barbadense* varieties has been performed.

- Seeds stored along with Zeolite beads and kept in a refrigerator as well as seeds stored in polylined aluminium packets with modified atmosphere viz., Nitrogen and CO2 revealed higher germiantion than those stored with out zeolite beads and those stored in normal polylined aluminimum foil packets kept in cold as well as ambience.
- More than 100 genotypes are under Bt conversion and evaluation at all three stations of ICAR-CICR. The promising Bt lines are being evaluated in Institute common trial and the promising one are sponsored for AICRP trials. Promising released varieties like LRA 5166, Anjali, MCU 5-VT, Suraj, Surabhi, Supriya, Sumangala, CCH 2623, Subiksha, Sunantha, Suraksha, CCH 19-2, CCH 19-4 etc. are being converted to Bt. Nucleus seed of four Bt varieties *viz.,* 115kg of ICAR-CICR Suraj Bt, 153kg of ICAR-CICR GJHV374 Bt, 187kg of ICAR-CICR Rajat Bt and 156kg of ICAR-CICR PKV081 Bt was producedSeven Bt varieties *viz.,* ICAR-CICR Bt 6, ICAR-CICR PKV Bt, ICAR-CICR Suraj Bt, ICAR-CICR Rajat Bt, ICAR-CICR GJHV Bt, ICAR-CICR Bt 16 and ICAR-CICR Bt 23 were notified in the Gazette *vide* S.O. 3482(E) dated Oct. 7, 2020.
- Introgression of Tg2E13 event (*cry1Ac* gene) and CH12 event (*cry2Ax1* gene) into Suraj, NH615 and CISH3178 is in BC4F2 and BC3F1 stage. Non-deregulated transgenic events viz., Tg2E13 (*cry1Ac*) and CH12 (*cry2Ax1*) were assessed for their bio-efficacy against pink bollworm and American bollworm along with checks [BG II hybrid check (*cry1Ac+cry2Ab*); Suraj Bt variety (Mon531) and non-transgenic (Coker 310)]. For pink bollworm, Tg2E13 was found comparable to single and dual gene Bt checks. The event has also showed good bio-efficacy against American bollworm.
- *Agrobacterium*-mediated genetic transformation of *G.hirsutum* Coker 312 with *CICR- cry2Ab1Ac::chitinase* gene constructs and regeneration through somatic embryogenesis found four putative transgenic plants positive for *npt*-II and *chitinase* gene with PCR analysis using gene specific primers.
- Putative transgenic callus cultures derived from transformation of *wnt 3A* gene cassette in *G hirsutum* cv. Suraj were confirmed through PCR analysis using combination of gene and vector backbone primers.
- Callus cultures derived from Agrobacterium mediated transformation of Coker 312 hypocotyls with four gene targeting vectors *viz.,CRISPR/Cas9::GhPHYA1sgRNA1,CRISPR/Cas9::GhPHYA1sgRNA2, CRISPR/Cas9::GhPHYA1sgRNA3 and CRISPR/Cas9::GhPHYA1sgRNA4* are being maintained through sub culturing for regeneration of putative genome edited plants through somatic embryogenesis.

Crop Protection Division

- Thirty-six and forty-two geographical populations of pink bollworm were monitored for resistance against baseline susceptibility to cry toxins Cry1Ac and Cry2Ab, respectively. Among the populations tested, highest resistance ratios were recorded in population from Kurnool (Andhra Pradesh) to both Cry1Ac (423 fold) and Cry2Ab (3737 fold) compared to susceptible check (1.00 fold).The pink bollworm larvae from the infested green boll samples collected from

various locations of India were found parasitized by *Apanteles angaleti* under field conditions.

- Endosymbiotic gut bacteria belonging to five genera viz., Burkholderia, Pluralibacter, Gergoviae, Enterobacter and Citrobacter were identified as a core microbial community associated with pink bollworm larvae. Twenty-nine haplotypes (from Pb_H1 to Pb_H29) were identified from 38 sequences of pink bollworm larvae collected from 21 different cotton growing locations across India. The most common haplotype was Pb_H1 which was shared by nine populations and Pb_H3 shared with two populations whereas, other 27 haplotypes were found as unique.
- Using marker assisted selection using CIR-246 marker and artificial inoculation of BLB resistant plants, 56 BC4-F2 and 38 BC5-F1 BLB resistant plants were selected, screened and grouped.
- Nine potential endophytes were screened in vivo against cotton diseases using pot culture. The endophytes viz., *Diaporthe longicolla* (CEL 41, CEL 48), *Daldiniae schscholtzii* (M1-4) did not prove pathogenic to cotton cultivars Suraj and Phule dhanwantary. Cross pathogenicity of endophyte *Daldiniae schscholtzii* (M1-4) against wheat, sorghum, red gram, soybean, cowpea and brinjal did not reveal symptoms of pathogenicity or abnormality.
- Symptomatological studies were carried out on boll rot samples collected from cotton fields of Maharashtra, Telangana and Madhya Pradesh states. Twenty-eight bacterial and nine fungal isolates causing inner and external boll rots, respectively in cotton were identified.
- Target leaf spot samples from 35 different cotton growing locations of Maharashtra, Gujrat, Telangana, Andhra Pradesh, Rajasthan and Haryana states were collected and the pathogens were isolated on PDA medium.Pathogenicity of these isolates was tested on susceptible cotton cultivar PKV-081 (*G. hirsutum*).
- Grey mildew disease samples were collected from cotton growing districts of Maharashtra and Telangana states. Different agar media like Richard's, Kirchoff's, leaf decoction and Coon'swere used for isolation of the pathogen, *Ramularia areola*. In all the tested media, pathogen growth was slow with no sporulation even after 30 days of incubation.
- Cotton intercropping systems significantly reduced the thrips population compared to sole cotton crop. Cotton intercropped with marigold had the lowest thrips population. Bt cotton + onion followed by Bt cotton + vegetable cowpea were found as the most profitable cropping systems. Among 10 different insecticides evaluated against thrips under field condition, spinoteram was found the most effective and buprofezin was least effective. *Metarhizium anisopliae* was found as most effective biopesticide whereas neem oil followed by castor oil recorded higher efficacy among botanicals.
- The absorbance value was higher in leaf followed by petiole and squares among the different plant parts used for tobacco streak virus (TSV) detection. The absorbance values obtained from different plant parts were found in decreasing order for germplasm lines ICB 38, ICB 36 and ICB 37. Variation in absorbance in different plant parts revealed that DAS-ELISA can be used for the detection of TSV in cotton.
- Samples of *Alternaria* leaf spot (141) collected from the cotton growing states of India viz., Telangana, Andhra Pradesh, Karnataka, Tamil Nadu, Maharashtra and Gujarat were tested for pathogenicity and virulence on susceptible genotype LRA 5166 under glasshouse conditions. All the

141 isolates were found pathogenic to cotton and Telangana isolates were more virulent (7 to 54 PDI) followed by Karnataka (15 to 45 PDI), Andhra Pradesh (11 to 37 PDI) and Tamil Nadu (4 to 17 PDI)

- For the first time the natural infection of reniform nematode eggs by nematode antagonistic fungus, *Pochonia chlamydosporia* was reported from India. The fungus can parasitize more than 75% of eggs and cause 100% mortality of juveniles in root-knot and reniform nematodes. The mass production protocol for *P. chlamidosporia* under in vitro condition was standardised. Two new nematode antagonistic fungi were isolated from the rhizosphere of cotton. The temperatures between 25-35^{0}C were favourable for multiplication of reniform nematode.
- Bioassays conducted against whitefly red eyed nymphs indicated maximum mortality due to pyriproxyfen (64.00%) and least mortality due to diafenthiuron (48.00%) among tested insecticides. Dislodgement, predation, parasitization and non-viability were recorded as key mortality factors for eggs. Whiteflies deposited fewer eggs and had shorter developmental period (egg-adult) on CLCuV infected plants compared to healthy plants. Ninety-one exotic and indigenous germplasm lines and released cultivars of *G.hirsutum* cotton were screened against whitefly under field and laboratory conditions.Seasonal dynamics of sucking pests viz, whitefly, jassids and thrips were studied on both Bt and non-Bt cotton cultivars.
- Biopesticides viz., *Beauveria bassiana*, *Lecanicillium lecanii*, *Metarhizium anisopliae*,HaNPV, SlNPV with neem oil and chlorpyriphos 20EC as control were evaluated under field conditions. Twelve bacterial and 10 fungal isolates were obtained from infected pink bollworm larvae.
- A technical guidance on pest management was provided to Department of Agriculture based on analysis of weekly pest situation. Mass awareness was created among cotton production stakeholders through print and electronic media, invited talks, press notes, articles in newspaper and magazines, TV and Radio talks and published literature etc.
- IRM-PBW project was implemented in 105 villages of 21 districts covering 1050 acres area of 8 states. Random surveys to assess the level of field infestation of pink bollworm and various outreach activities oriented towards creating mass awareness were carried out.
- Highest whitefly adults were trapped in yellow-daffodil sticky trap followed by yellow-orange appeal sticky trap. Seven different vegetable oils viz., groundnut, sunflower, rice bran, soybean, safflower, sesame and palm oil containing compounds like linoleic acid, palmitic acid, myristic acid and stearic acid exhibiting oviposition deterrent properties were found effective against *Helicoverpa armigera* in cotton and in chickpea. All the tested oils were effective in deterring the oviposition by *H. armigera* at a concentration of 1% and above both in cotton and chickpea crops. Blends of these oils in different combinations were also effective against *H. armigera* in cotton.
- Spatial maps depicting the risk of pink bollworm establishment, number of generations and potential population abundance in different geographical locations were prepared by coupling a temperature-based phenology model with geographical information system (GIS). The indices representing the pest risks were computed using interpolated temperature data from Worldclim

database for current and future climate change scenarios. The risk maps indicated increased pest activity of pink bollworm due to climate change and intensification of yield losses in cotton.

- Based on presence of two fatty acids(oleic and linoleic) in faecal pellets of pink bollworm, six different vegetable oils were identified and evaluated as oviposition deterrents under field conditions. Similarly, based on the presence of α/β pinene, carene, γ terpinene, α copaene, caryophyllene and humulenein square extract of cotton, the cotton twig, square extract and artificial blend of identified compounds were evaluated for oviposition preference of female pink bollworm. Higher proportion of γ terpinene in *Gossypium herbaceum* might attribute to oviposition deterrent effect.Higher quantity of caryophyllene and α/β pinene with low levels (G. arboreum) or absence (*G. hirsutum* and *G. barbadense*) of γ terpinene attracts pink bollworm female for egg laying.
- The bacteria viz., *Bacillus subtilis*, *B. cereus*, *Lysinibacillus sphaericus*, *Brevibacterium epidermidis*, *Providencia vermicola* and *Ochrobactrum pseudogrignonense* induced resistance in cotton plants against reniform nematodes. Spray of formulation of curcumin + cow urine in combination with neem oil reduced nematode population and increased yield in cv PKV081(13.1 q/ha) as compared to control (11.47 q/ha). Short-ter*m* culture collection repository has been established in house at Division of Cop Protection, ICAR-CICR, Nagpur for deposition, preservation and maintenance of microbial cultures.
- Mass production unit for a talc-based formulation of *Trichoderma harzianum* was established at Bio-control laboratory of Division of Cop Protection, ICAR-CICR, Nagpur.
- The information on compatibility and field efficacy of multi lure pheromone system against major lepidopteran pests of cotton was explored. The field experiments provided insight on how different pheromone lures housed in one trap performed in combination in attracting more than one lepidopteran pests in cotton to cater the needs of pest monitoring and management. Nine different cotton genotypes (Bt and non-Bt) were evaluated for tolerance against stem weevil, wherein the infestation varied from 10 to 43%. Affected stems showed hypertrophy and hyperplasia of cells resulting in extensive stem swelling. Higher proportion of phenolic and terpenoids compounds imparted field level tolerance whereas, high soluble sugar content increased susceptibility to stem weevil.
- Entomopathogenic fungal consortia caused significantly higher mortality than any solo entomopathogenic fungus in sucking pests of cotton under in vitro condition. A primary form of bacterial symbiont of entomopathogenic nematode *Xenorhabdus nematophilus* caused significantly higher mortality than that of *X. stockiae* in jassids under in vitro condition. Entomopathogenic nematode, *Steinernema* sp isolated from *S. frugiperda* larvae caused 100% mortality of larvae and pupae. Twenty isolates of endophytic fungi from the cotton roots were isolated. A methodology for the virulent isolates of entomopathogenic nematode and fungi by modified soil baiting method has been standardized.
- About 100 fungal isolates were purified from cotton rhizosphere soil samples collected from different cotton cropping systems in North, Central and South Zones of India. Three liquid bioinsecticide formulations of most virulent Entomopathogenic fungus (EPF) strains compatible with insecticides were

developed and evaluated in large plot field trial at ICAR-CICR Regional Station, Sirsa. The tested EPF formulations provided highest mortality in whitefly nymphs and lowest CLCuD PDI (%) next to the insecticidal treatment of spiromesifen.

Crop Production Division

- Soils rotated with deep rooted crops - pigeon pea, sunnhemp, *daincha* and radish had less penetration resistance than those without a rotation. The least resistance was observed with the deep sub-soiling treatment. However, deep sub-soiling treatment had a high fuel consumption of 9.5 lph compared to 7.2-7.8 lph for the shallow sub-soiling treatments. Sub-soiling in alternate rows reduced fuel consumption by 50%. Seed cotton yields were the highest in the rotation plots, except radish.
- Among six medium long to long linted genotypes of *G. arboreum* L. (PA 812, PA 760, PA 528, PA 402, DLSA 17, CNA 1041) and a short staple check- Phule Dhanwantary were evaluated at two spacing (60 × 10/15 cm – HDPS and 60 × 30 cm-normal) on two dates of sowing (timely with the onset of the monsoon (D1) and late around 14 days after the first (D2) indicated that, genotypes CNA 1041 and PA 528 were the highest yielders, followed by PA 812 and PA 760. Yield was higher at 60x15 cm spacing.
- The night Net Ecosystem Exchange (NEE) was 5-10 µmol m^{-2} s^{-1} for cotton crop. The day time NEE reached its peak during 12:00 to 14:00 hrs depending on the net radiation and clear sky condition. The peak NEE during 1 Aug (nearly 30 DOS) was found to be -10 µmol m^{-2} s^{-1}. It has increased to -20 to -25 µmol m^{-2} s^{-1} during September- November at flowering and peak boll development stage.
- The total Water footprint (WF) of rainfed cotton at Nagpur was 16384 m^3/t of seed cotton, of which the green WF was 12187 m^3/t, and the grey water foot print was 4198 m^3/t. The total WF of drip-irrigated cotton was 13310 m^3/t. The ridge and furrow-irrigated cotton at Coimbatore recorded a WF 26541 m^3/t. Among the agro-techniques evaluated to reduce WF, broad bed and furrow with polymulch intercropped with green gram yielded higher SCY (3288 kg ha^{-1}) with less water requirement.
- Integrated farming system (IFS) model produced 70.2 q/ha cotton equivalent yield with B:C ratio of 1.95. one goat (Usmanabadi) unit gave a net return of Rs.15,812 and a poultry (Giriraja) unit (100 birds in two batches), gave a net return of Rs. 65,614. Fruit and vegetables (custard apple, papaya, french bean, okra, tomato, cucurbits) as a horticulture component in IFS, yielded a net profit of Rs. 29,134 in a year. Overall, one-hectare IFS could generate 492 man-days during the one-year cropping season.
- Under rainfed conditions (Nagpur), cotton intercropped with legumes had higher leaf N compared to sole cotton. Similarly, legume rows had one-fold increase in soil N compared with the sole cotton. Under irrigated conditions (Coimbatore), *Desmanthus virgatus* was the best perennial legume for alley cropping under cotton – maize system.
- Among the Sulphur (S) formulations, micronized S was superior to the grits of bensulf formulations ((Bensulf, FRT-Bensulf) with regard to S release.
- Fifty-one cotton genotypes were screened for *in-gel* oxalate oxidase (OxO) activity under control and drought conditions.

The expression of OxO activity was higher in cotton under drought stress compared to control. Genome–wide identification of the *GLP1* isoforms/oxalate oxidase was performed and 50 such isoforms were identified in *G. arboreum*. These were further characterized for their tissue-specific expression (leaves, squares, ovules and cotyledon).

- Harvested Ankur 3028 BGII and PKV-081 Bt with the modified spindle type Cotton picking head recorded higher trash content (17% and 27%, seed cotton basis), respectively, as compared to 1% in the manually picked cotton.
- A significant difference was observed between the control and bacterial inoculation treatments in enhancing root and shoot traits in cotton at 45 DAI (days after inoculation). Among the six isolates evaluated, *Pseudomonas* sp. (5R) showed better shoot and root traits under drought stress.
- Based on the three-year insect bioassay, five bacterial isolates for each lepidopteran pest were short-listed for management of Pink bollworm, American bollworm, Fall army worm and Cotton leaf worm. Among these, *Pantoea agglomerans*, *Enterobacter cloacae*, *Enterobacter sp.*, *Enterobacter hormaechei* showed higher Pink bollworm ovicidal activity (47%-71%). Field inoculation of selected bacterial isolates as seed treatment showed increased plant growth attributes (plant height, sympodial branches, SPAD values, LAI, boll numbers, yield and fibre quality) compared to the control.
- Bacterial strains were screened for their effectiveness in attracting/repelling the whiteflies and jassids, through the production of microbial volatiles (mVOC). Among the different solvents tested for their mVOC (extraction efficiency), Dichloromethane (DCM) and Diethyl ether (DE extracted more mVOC. Field trap catch using yellow sticky trap swabbed with 48 h broth grown bacterial cultures (10^8 cells/ml) indicated 28%-126% increase in whiteflies and 13%-60% increase in jassids catch compared to control.
- The K solubilization index of selected K solubilizing microorganisms (KSM) on Alexandow media supplemented with bromothymol blue ranged from 1.3 to 4.0. The KSMs also produced Indole-3 acetic acid (IAA) ranging from 10 to 18.7 µg/ml/24h.
- The elevated CO_2 levels enhanced weed and cotton growth. However, there was 108% enhancement in weed dry matter accumulation over its ambient counterpart at 90 days after sowing compared to 40% enhancement in dry matter accumulation in cotton during this period.
- Adoption of soil moisture conservation techniques (ridges and furrows) followed by foliar application of Glycine Betaine @ 100 ppm, 5 days after plant drought experience were found useful to manage drought. Adoption of drainage practice (ridges and furrows) followed by foliar application of salicylic acid (0.5mM) 3 days after water-logging were found useful to manage excess water stress. Water-logging (36 h) reduced germination by 40.5%, 35.0%, 21.0%, 37.6%, 24.5%, and 26.3% respectively, in *arboreum* (PA 528), *barbadense* (Suvin), *hirsutum* (Suraj), *herbaceum* (G Cot 25), H × H (RCH 659 BG II), and H × B (MRC 7918 BGII).
- The application of growth regulators-Mepiquat chloride and Chlormequat chloride at 70 and 100 DAS significantly reduced plant height in Suvin and RCHB 625 BGII at 125 DAS. Planting Suvin at 90 × 45 cm spacing produced significantly higher SCY (1395 kg ha^{-1}) than 90 × 60 cm

(1150 kg ha^{-1}). Planting RCHB 625 BG II hybrid at 90 × 30 cm spacing produced significantly higher SCY (1892 kg ha^{-1}) than 90 × 60 cm (1628 kg ha^{-1}) and 90 × 45 cm (1620 kg ha^{-1}).

- After two years of continuous cotton–maize and cotton-wheat cropping system under irrigated conditions, SCY increased significantly by 26.5% and 134.6% withcombined sources of organic (FYM once in two years) and inorganic (NPK + $MgSO_4$ + $ZnSO_4$ + Borax) treatments, respectively, over control. Under cotton-wheat cropping system, higher SCY was recorded in *Bt* cotton hybrid compared to non-*B*t cotton hybrid, *Bt* and non-*Bt* cotton variety.
- The drought tolerance imparted by epigenetic regulated chemicals (ERCs) through seed treatment, in varieties like Suraj and LRA 5166 was inherited upto fourth generation. This is evident from the fact that the ERCs like 5 azacytidine, sulfamethazine, epigallocatechin gallate and nicotinamide improved the relative water content, SPAD values, proline content, nitrate reductase activity, chlorophyll stability index and total soluble sugars and reduced the excised leaf water loss when compared to untreated control. Among the ERCs, 5 azacytidine improved the key drought tolerant traits in both Suraj and LRA 5166.
- At Sirsa, the seed cotton yield (SCY) was significantly higher under Zero tillage - permanent narrow raised bed with residue retention on surface. Among the cropping systems, significantly higher SCY was recorded under Cotton - Chickpea cropping systems.
- Bt cotton variety (CICR Bt-6) and non-Bt cotton variety (CSH 307) with a combination of early sowing, spacing of 67.5 cm × 45 cm and Mepiquat chloride spray at 60 and 75 DAS were identified as BMPs for high yield. Similarly, for BG II hybrid (SP-7172) a combination of early sowing, spacing of 67.5 cm × 60 cm and Mepiquat chloride spray at 60 and 75 DAS were identified as Best Management PracticesBMPs. When sowing was delayed to the second week of June, planting at closer spacing ie. 67.5 cm × 10 cm for varieties and 67.5 cm × 30 cm for hybrid was a better option.
- Under e-Communication programme, cotton technologies were disseminated among farmers through voice message services covering 1.6 lakh farmers. Uploaded 91,54,264 voice messages during the year. Voice messages on cotton production and protection technologies were disseminated in Marathi, Tamil & Hindi languages.
- Cotton farm profit margin of 35 to 52% over Cost C2 was registered over the years. A unit increase in domestic production of cotton would increase the demand for Indian cotton by 6.02%. TFP growth rate during 2010 to 2016 was in decreasing trend (-6.8%) in all the cotton-growing states except Tamil Nadu. India, to benefit most by concentrating on other potential importers such as Vietnam, Bangladesh, Pakistan, Indonesia, Hong Kong, Thailand and Malaysia.

General

- During the period, a total of 76 research papers of which 30 research papers with >6 NAAS Score and 46 research papers with <6 NAAS Score as well as 30 popular articles were published. 49 training programmes including virtual training programmes were organized where a total of about 5700 beneficiaries including farmers, students, field trainees and extension functionaries participated.

- Linkages were fostered with sister ICAR Institutes, SAUs, other public sector Institutes, private companies, NGOs and farmer producer groups to commercialize and upscale varieties and technologies developed. One MTA and six MoUs were inked during January to December 2020

2. INTRODUCTION

2.1 : Brief History

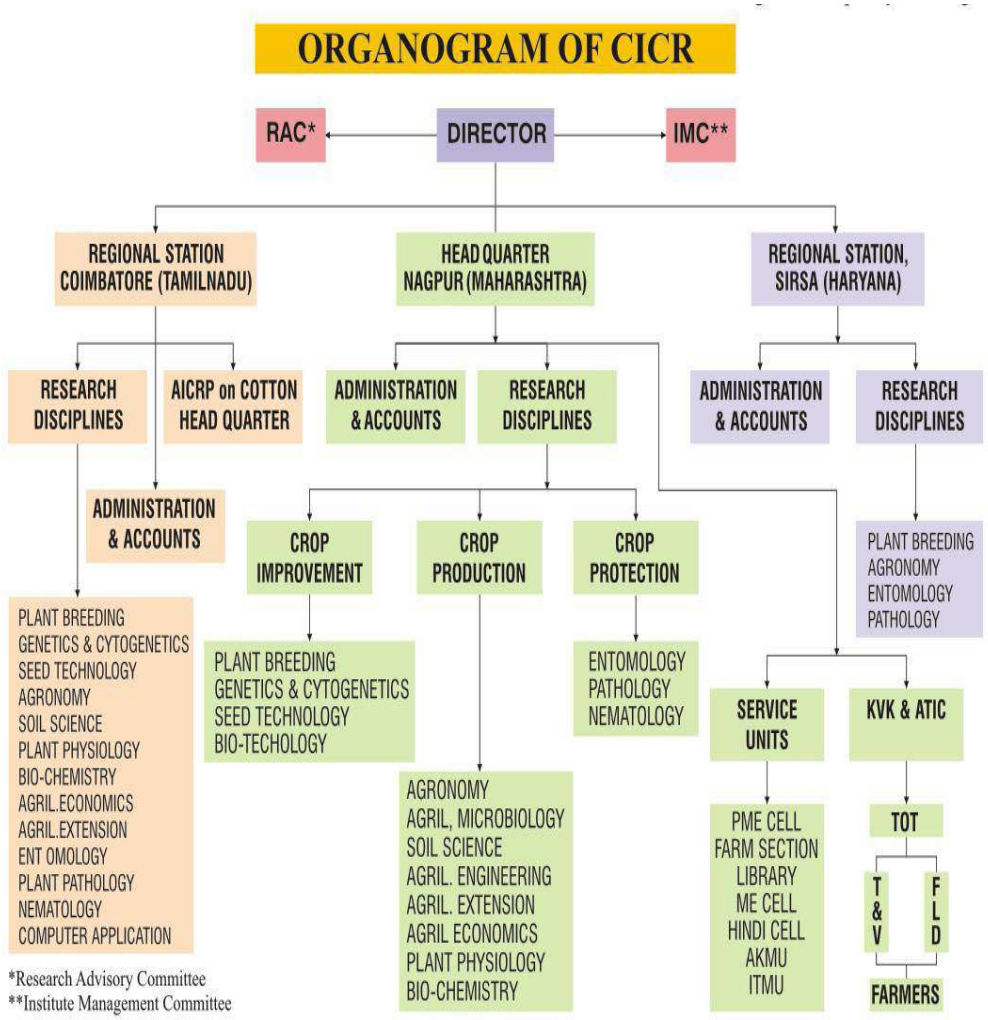
The **ICAR-Central Institute for Cotton Research (CICR)** was established at Nagpur, in 1976. The two regional stations of IARI located at Sirsa (Haryana) and Coimbatore (Tamil Nadu) were transferred to ICAR-CICR to cater needs of north and south India, respectively.

Location of the of ICAR-CICR Institute

Center	Latitude (^{0}N)	Longitude (^{0}E)
ICAR-CICR, Head Quarters, Nagpur,MH	21.037	79.056
ICAR-CICR, Regional Station,Coimbatore,TN	11.014	76.929
ICAR-CICR, Regional Station, Sirsa, Haryana	29.543	75.038

2.2 : Mandate

- Basic, strategic and adaptive research on production, protection, fibre quality and by-products of cotton
- Creation of new genetic variability for location-specific adoption in cotton-based cropping systems.
- Coordination and monitoring of applied research on national and regional issues to develop improved varieties and technologies
- Dissemination of technologies and capacity building



2.3 : Staff Position (as on 31st December, 2020)

Category	Sanctioned Cadre Strength				Post Filled Up			
	NGP	CBE	Sirsa	Total	NGP	CBE	Sirsa	Total
Director (RMP)				**1**	**1**	-	-	**1**
Scientific				**77**	40	20	6	**66**
Technical				**72**	40	14	9	**63**
Administrative				**48**	18	4	5	**27**
Skilled Support Staff				**44**	21	13	8	**42**
Krishi Vigyan Kendra								
Training Organizer	1	-	-	1	-	-	-	-
Technical	11	-	-	11	9	-	-	9
Administrative	2	-	-	2	-	-	-	-
Skilled Support Staff	2	-	-	2	2	-	-	2

NGP – Nagpur; CBE - Coimbatore

2.4 : Financial Statement

The budget grant and actual expenditure for the year 2020 are furnished below:

(Rs. in Lakhs)

Name of Scheme	2019-20		2020-21 (Upto December 2020)	
	Sanction	Expenditure	Sanction (Upto December 2020)	Expenditure (Upto December 2020)
Plan Scheme	1763.16	1758.26	1239.98	1381.83
Deposit Scheme	1202.21	1111.34	1192.27	1002.71
Revolving Fund	22.82	11.40	9.12	9.73
Govt. Grants	4963.19	4738.82	4750.86	3243.87
Total (in lakhs)	**7951.38**	**7619.82**	**7192.23**	**5638.14**
Revenue Generation (Revenue Receipts)	**43.90**		**39.70**	

3. RESEARCH ACHIEVEMENTS

Theme1: Cotton Genetic Resources and Pre-breeding

1.1 Project name: Harnessing the potential of wild and unadapted germplasm for cotton improvement

Dr.Vinita Gotmare (PI); Co-PIs - Dr Santosh HB, Dr M Saravanan, Dr Rachna Pande, Dr Neelkanth Hiremani, Dr Chandrashekhar, Dr S K Verma

Importance of the study: Wild species of *Gossypium* are the reservoir of many useful genes governing different economic traits including lint yield, fibre quality and resistance to biotic and abiotic stress. In view of narrow genetic base of cultivated cotton, the available wild species, races of cultivated species and synthetic polyploids of *Gossypium* are conserved and utilized in introgression breeding to broaden the genetic base and to create newer genetic variations for various traits of interest.

Salient findings

Conservation of wild and unadapted germplasm: A total of 24 wild species, 15 races of cultivated species and more than 45 synthetic polyploids are conserved in the 'wild species garden' at ICAR-CICR, Nagpur. A new species *G. nelsonii* Fryx established through embryo culture was hardened and established in the green house (Fig 1.1.1) for its further utilization in inter-specific hybridization. The plants of *G.anomalum*, *G. triphyllum*, *G. capitis viridis*, *G. thuberi*, *G. armourianum*, *G. davidsonii*, *G. raimondii*, *G. trilobum*, *G. stocksii*, *G. somalense*, *G. longicalyx*, *G.nelsonii* Fryx, *G. barbasonum* established from seeds /cuttings collected from different sources were confirmed through morphological characterization.

Fig 1.1.1: *G. nelsonii* plant established in the greenhouse

Inter-specific hybridization: A total of 1165 new crosses were attempted using wild species namely *G. longicalyx*, *G. somalense*, *G. anomalum*, *G. capitis virides*, *G. australe*, *G. thurberi*, *G. raimondii*, *G. barbosanum*, *G. triphyllum*, *G. klotzchianum*, and *G. mexicanum*.

Evaluation of advanced generations: Plant to row progenies (F_5 generation) of the crosses *viz., G. arboreum* x *G. longicalyx; G. arboreum* race indicum x *G. davidsonii; G. arboreum* x *G. thurberi* and AK 8401 x *G. davidsonii* were evaluated for yield, fibre quality and resistance to pests and diseases.

Confirmation of hybridity of interspecific crosses through SSR markers : The SSR markers polymorphic between parental lines of 26 inter-specific crosses were identified for confirmation of hybridity. These crosses involved following wild and cultivated species of cotton *viz., G. arboreum* (Race Indicum – A_1), *G. arboreum* (Race *Burmanicum* – A_2), *G. arboreum* (Race *Bengalense* – A_3), *G. arboreum* (Race *Cernuum* – A_4), *G. arboreum* (Race *Sinense* – A_5), *G. arboreum* (Race *Soudanense* – A_6), *G. anomolum* (B_1), *G. barbosanum* (B_3), *G. capitis virides* (B_4), *G. aridum* (D_4), *G.stocksii* (E_1), *G. longicalyx* (F_1), *G. hirsutum* cv. H777, *G. arboreum* cv. Jawahar Tapti, *G. hirsutum* cv. JK4, *G. hirsutum* cv. Anjali, *G. hirsutum* cv. MCU5, *G. hirsutum* NISC261, *G. hirsutum* Race Palmeri, *G. arboreum* cv. Roja, PA 255 and *G. herbaceum* cv. Digvijay.

Evaluation of introgressed derivatives for resistance to pests and diseases: Evaluation revealed that the population of *H. armigera*, Whitefly and Aphids was below ETL. For natural enemies of the pests, the average number of lady bird beetle/plant ranged from 0.0-2.0 and average number of spider /plant were ranged from 1.0-3.0. During the crop season, periodical observations were recorded on the incidence of diseases. Grey mildew and Corynespora leaf spot were the major diseases whereas bacterial blight and root rot were negligible on introgressed derivatives. *G. arboreum* race Cernuum (19025) was free from grey mildew disease.

Colour cotton: Naturally brown colour cotton lint samples were analyzed for their colour parameters and fibre properties using standard procedures at ICAR-CIRCOT. Fibre properties of some promising derivatives are listed in Table 1.1.1:

Table 1.1.1: Fibre properties of coloured cotton samples (HVI mode)

S No	Sample No	UHML (mm)	Tenacity (g/tex)	Micronaire (µg/inch)	Elongation %	Uniformity Index
1	CICR-17405 LB	29.6	25.5	3.3	5.3	86
2	CICR-17441 LB	28.9	26.9	4.3	6.3	86
3	CICR-17492 LB	28.8	26.3	3.5	5.8	85
4	CICR-17406 LB	28.3	26.2	3.2	5.3	86
5	CICR-17417 LB	27.5	24.7	3.3	5.6	86
6	CICR-17493 LB	27.4	25.8	3.9	5.4	84
7	CICR-17452 LB	26.6	28.6	4.6	4.5	84
8	CICR-17493 LB	27.4	25.8	3.9	5.4	84
9	CICR-17521 LB Arb	25.9	21.8	4.1	6.5	82
10	CICR-17522 LB Arb	24.9	21.6	4.2	5.8	79

1.2 Project name: Collection, conservation, evaluation, documentation and maintenance of germplasm of cultivated species of Gossypium

Dr. Sunil S. Mahajan (PI); Co-PIs - Dr. Saravanan. M., Dr. Neelkanth Hiremani, Dr. Rachna Pande, Dr. S. Manickam, Dr. K.P.M. Dhamayanthi, Dr. A. H. Prakash, Dr. K.

Rameash, Dr. A. Manivannan, Dr. P. Valarmathi, Dr. Rishi Kumar, Dr. Debashis Paul, Dr. S. K. Sain, Dr. Anjali Kak (ICAR-NBPGR, New Delhi)

Importance of the study: The ICAR-CICR has been entrusted with the responsibility to plan, conduct, promote, coordinate the collection, characterization, evaluation, conservation, exchange, documentation and sustainable management of diverse germplasm of cotton and its storage (ex-situ at 5^0C temp and 35% RH) with a view to ensure its maintenance and making them available to researchers for cotton improvement programmes.

Salient findings

Status of cotton germplasm: ICAR-CICR, Nagpur maintains one of the largest cotton germplasm collections of the world with more than 12,335 accessions covering all the cultivated species,wild species, interspecific derivatives, perennials and landraces of *Gossypium* (Table 1.2.1). The *G. barbadense* germplasm lines (536) are being maintained at ICAR-CICR Regional Station, Coimbatore.

Table 1.2.1: Status of germplasm collections at ICAR-CICR, Nagpur

Species	Base Collection
G. hirsutum	8851
G. barbadense	536
G. arboreum	2053
G. herbaceum	565
Wild Species	24
Interspecific Derivatives	40
Perennials and land races	254
Races and derivatives of cultivated species	12
Total Collection	**12335**

Enrichment and evaluation of cotton genetic stocks: A total of 139 accessions [89 *G. barbadense*, 28 GMS Lines, 2 CMS Lines, 14 Maintainer Lines (B Lines) and 06 Restorer Lines] were deposited in Medium Term Storage (MTS). The harvested seed of imported exotic cotton germplasm shall be further multiplied in the field during coming *kharif* season, whereas *G. barbadense* lines are rejuvenated at ICAR-CICR Regional Station, Coimbatore.

Multiplication and characterization of germplasm: Sixty nine (69) germplasm of *desi* cotton collected from different states of North Eastern Hill Region (NEH Region) were characterized and evaluated. Forty Eight (48) germplasm consisting of G. *hirsutum*, *G. arboreum* and wild species were distributed to breeders/ scientists of CICR, State Agricultural Universities and Private Seed Companies for utilization in their cotton improvement programme. Exotic cotton germplasm was evaluated in glass house for post entry quarantine pest, *Xanthomonas campestris* var. *malvacearum* (Fig.1.2.2).

Characterization of the primitive cultivars of cotton from Sundarbans of West Bengal

ICAR-CICR in collaboration with ICAR-NBPGR, New Delhi explored Sundarban region of West Bengal and collected 39 primitive cultivars and tree cotton of *G. hirsutum* and *G. barbadense*. These lines were characterized using 11 polymorphic SSR markers and were grouped into 7 clusters (Fig 1.2.1) using DARwin statistical package.

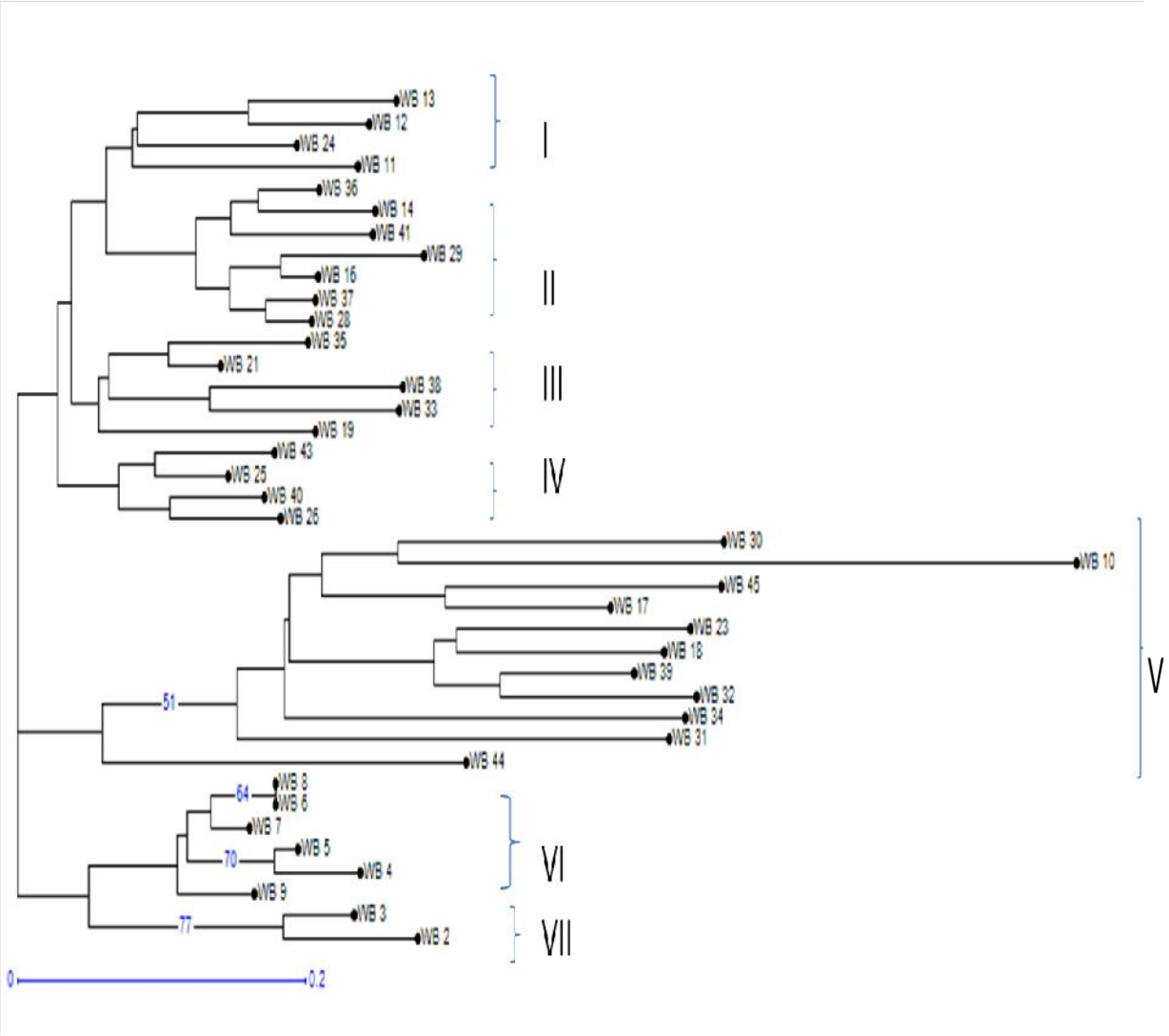


Fig.1.2.1: Molecular characterization of *G. hirsutum* and *G. barbadense* accessions of Sundarban region of West Bengal

Registration of genetic Stocks and Evaluation of cultures under ICAR-AICRP trials: One *G. barbadense* line CCB-12 was identified for the registration with ICAR-NBPGR, New Delhi for its cleistogamous nature of flower as unique trait**.** A field trial was conducted at ICAR-CICR, Nagpur, MPKV, Rahuri and CICR Regional Station, Sirsa for expression of a cleistogamous nature of *G. barbadense* mutant No.CCB-12.It has been proposed for germplasm registration with ICAR-NBPGR, New Delhi.

Evaluation of hairy lines of *Gossypium barbadense*: Among the single plant progenies of ten (H1 to H10) promising cross combination, ICB-124 × Suvin and ICB- 264 × Suvin exhibited high seed cotton yield, which are moderately resistant to jassids.

Evaluation of new exotic collection of *G. barbadense:* A total of 207 exotic collection of *G.barbadense* (Fig.1.2.3) is being evaluated in this crop season.

Fig.1.2.2: Exotic cotton germplasm evaluated in glass house for post entry quarantine pest, *Xanthomonas campestris* var. *malvacearum*

EC-1 **EC-5**

Fig.1.2.3: Evaluation of new *G. barbadense* germplasm entries.

1.3 Project name: Development of cotton leaf curl virus resistant genotypes using G.arboreum / G.herbaceum through introgression

Name of PI & Co-PIs: Dr. S. K. Verma (PI); Co-PI's: Dr. V. N. Waghmare, Dr. S. M. Palve, Mr. Rakesh Kumar

Importance of the study: Cotton leaf curl virus (CLCV) is one of the most important diseases in North India affecting cotton productivity. The cultivated *G. arboreum* is considered immune to CLCV and therefore, it was targeted for introgressing genes for CLCV resistance to *G. hirsutum* to eventually develop high yielding, CLCV resistant and whitefly tolerant *G. hirsutum* genotypes.

Salient findings

One inter-specific hybrid (*G.hirsutum* × *G. arboreum*) plant was established at ICAR-CICR, Nagpur (Fig.1.3.1) through embryo rescue technique. Colchicine treatment (0.5% & 1.0%) of *G. arboreum* was attempted. Crosses attempted between CSH3075, CSH3129 and F2228 with colchicine treated *armourianum*. plants. More than 3000 crosses were attempted using CSH3129 (tetraploid) as female parent and diploid *G. arboreum* genotypes CISA310, CISA614 & LD327 as male parent. Less than 1% seed setting was observed. While, using CSH3075 as female parent and CISA614 as male parent, more than 200 crosses were attempted. *G. hirsutum* lines *viz.*, CSH3129, CSH3075 were crossed with BC1F1 plants of F1861 × *G.*

Fig.1.3.1: Interspecific hybrid (*G.hirsutum* × *G. arboreum*)

Theme2: Accelerating genetic gains for productivity and quality and climate resilience

2.1 Project name: Development of broad based high yielding varieties of diploid and tetraploid cotton through recurrent selection

Dr. V N Waghmare (PI), Co-PIs - Dr. S.K. Verma and Dr. S.K. Sain

Importance of the study: Narrow genetic base is the major limitation for genetic improvement of cotton. Development of cotton varieties with broad genetic base through population improvement approaches such as recurrent selection and intermating is aimed for improving yield, fiber quality and tolerance to biotic and abiotic stresses.

Salient findings

Population Improvement

Evaluation of single plant selection: About 1680 superior single plant selections were planted for evaluation as plant to row progenies. Based on the performance and uniformity/plant progenies were identified for evaluation in replicated trial. Selection of single superior plants from the segregating progenies was carried out for further evaluation.

Evaluation of advance cultures: 174 *G. arboreum* and 52 *G. hirsutum* cultures were evaluated in 9 replicated trials (4 rows plots in 2 replications) during the crop season 2020. In all, 7 trials of *G. arboreum* and 2 of *G. hirsutum* were conducted following spacing of 60 x 45 cm.

Evaluation of sterile plants: Based on evaluation of 3269 single sterile plants from random mating population (1244 of *G. arboreum* and 2054 of *G. hirsutum*), superior progenies for specific traits namely boll weight, GOT and seed cotton yield were identified. By employing selection pressure, about 10-15% superior progenies for specific traits were identified. The remaining seeds of the identified progenies from the previous year in equal quantity bulked together to raise traits-specific population which were evaluated as plant to row progenies to access its superiority for specific trait. All the single plant progenies were monitored for segregation and sterile and fertile plants were tagged. Fertile plants were evaluated for economic and quality traits to identify progenies for specific superior traits.

Evaluation of GMS based *G. arboreum* Hybrids: Four GMS based hybrids were evaluated for seed cotton yield with two check hybrids AAH 1 and CICR 2. One GMS based hybrid CISAA 19-5 (2802.7 kg/ha) could record significantly higher seed cotton yield than the check hybrid CICR 2 (2466.2 kg/ha) and CISAA 19-4 (2659.0 kg/ha). Two GMS based hybrids CISAA 19-5 (2802.7 kg/ha) and CISAA-19-4 (2659.0 kg/ha) could record significantly higher seed cotton yield than another check hybrid AAH1 (2252.0 kg/ha).

Evaluation of Spinnable *G. arboreum* cultures: Fourteen cultures were tested in RBD along with two checks CISA 614 (2344.0 kg/ha) and PA 255 (2350.4 kg/ha). Three genotypes namely CISA 33-3 (3036.2 kg/ha), CISA 33-1 (2899.5 kg/ha) & CISA 33-2 (2854.2 kg/ha) gave significantly higher yield than the checks (PA 255) and (CISA 614). Six genotypes CISA 10, CISA-6-295, CISA-33-8, CISA 33-1, CISA 33-2 and CISA 44-1 were having UHML (mm) >25.0mm and strength ~25.0 g/tex (in HVI mode).

Evaluation of high yielding *G. arboreum* genotypes: Fourteen genotypes were

evaluated in RBD with two check varieties CISA 614 and CISA 310. Three genotypes CISA 33-7 (2782.7 kg/ha), CISA 8 (2708.2 kg/ha) and CISA 33-5 (2704.7 kg/ha) gave significantly higher seed cotton yield than high yielding local checks CISA 614 (2253.0 kg/ha) and CISA 310 (2396.7 kg/ha).

Maintenance of GMS lines: Four GMS lines (DS5, CISA 2, GAK 413A, CISG-20) and 18 newly identified GMS lines [CISG-1, CISG-2, CISG-4, CISG-8, CISG-9, CISG-10, CISG-11, CISG-13, CISG-14, CISG-15, CISG-16, CISG-17, CISG-18 (narrow leaf), CISG-18 (broad leaf), CISG-19, CISG-21, CISG-22 (narrow leaf) and CISG-22 (broad leaf)] were maintained through sibmating. Pigmented GMS lines CISG 4, CISG-8, CISG-10 & CISG-13 had red flower colour with petal spot.

Fig. 2.1.1: *G. arboreum* Variety CNA1032

Crosses with GMS lines: Ten crosses were attempted with the GMS line GMS 16A to introgress CLCuD resistant trait in random mating population. Backcrosses were also attempted involving GVS9 genotype to increase the frequency of CLCuD resistance in the population.

Identification and release of variety: CNA 1032, a *G. arboreum* genotype tested in Agronomy trial in Central Zone during 2019-20 was identified for commercial cultivation by Varietal Identification Committee under the chairmanship of Dr. T.R. Sharma, DDG (CS). Subsequently the variety CNA1032 (Fig. 2.1.1) was released during the 84th CVRC meeting held on 10th July, 2020 and notified in the Gazette vide S.O. 3482(E) dated Oct. 7, 2020. The salient features of the variety are provided in Table 2.1.1.

Table 2.1.1: Features of *G. arboreum* variety CNA 1032

S. No.	Characters	Value
1	Boll weight (g)	2.50
2	Ginning Outturn (%)	34
3	Seed cotton yield (Kg/ha.)	1317
4	Days to maturity (days)	150-160
	Fibre characteristics	
5	Fibre length (at 2.5% SL)	28.7mm
6	Micronaire (µg/inch)	5.7
7	Bundle strength (g/tex)	27.9
8	Zone of cultivation	Central Zone

2.2 Project name: Development of compact plant types with improved quality traits through selective mating system in G. hirsutum L

Dr. Suman Bala Singh (PI), Co-PIs - Dr. Jayant Meshram, Dr. J. Amudha

Importance of the study: Biotic and abiotic stresses represent major production constraints in cotton. Genetic approaches like

selective intermating are considered important in breaking the undesirable linkages and developing superior varieties. Development of stress resilient, compact upland cotton varieties with improved fibre quality is the purpose of the project.

Salient findings

Evaluation of advance generation of crosses for yield and economic characters under rainfed conditions was carried out under replicated trial with three replications and plot size of 14.4 sq. m. Of these, 11 genotypes were at par to the check Suraj which recorded seed cotton yield of 1886.39 kg/ha. Seed cotton yield (SCY) ranged from 1391.65 (DTS 414) to 2884.62 kg/ha (DTS 423). Highest SCY was recorded for DTS 423 followed by DTS 421, DTS 410, DTS 403, DTS 409 and recorded more than 20% increase over the check. Boll weight ranged from 3.2 (DTS 404) to 4.67g (DTS 410) and ginning percentage from 33.85% (DTS 401) to 41.81 % (DTS 423). DTS 420, DTS 401, DTS 406, DTS 412, DTS 408, DTS 405 recorded good boll weight (>4.0 g) while DTS 421, DTS 413, DTS 420 recorded better GOT (>39%).

In F_4 generation of crosses involving compact plant type (Fig. 2.2.1), cluster boll bearing and other important traits were evaluated in replicated trial with plot size of 14.4 sq.m. Twenty five crosses were at par to the check Suraj which recorded SCY of 1847.90 kg/ha. Seed cotton yield ranged from 1488.26 (DTS-CP 103) to 3361.08 kg/ha (DTS-CP 128). DTS-CP 128, DTS-CP 125, DTS-CP 105, DTS-CP 115, DTS-CP 130 recorded more than 50% increase over the check Suraj. Boll weight ranged from 3.2 (DTS-CP 121) to 5.05 g (DTS-CP 113). DTS-CP 101, DTS-CP 105, DTS-CP 129, DTS-CP 124, DTS-CP 114 recorded >4.5g boll weight. GOT ranged from 36 (DTS-CP 106 and DTS-CP 112) to 44 % (DTS-CP 114 and DTS-CP 119). DTS-CP 128, DTS-CP 129, DTS-CP 103, DTS-CP 111, DTS-CP 120 more than 40 % GOT.

Advance generation of seven backcross and six genotypes were tested in replicated trial with three replications and plot size of 21.6 sq. m. Six genotypes were at par to the check Suraj which recorded SCY of 2556.92 kg/ha. Seed cotton yield ranged from 1865.92 (DTS-BC 112) to 2764.22 kg/ha (DTS-BC 102). DTS-BC 101, DTS-BC 113, DTS-BC 109, DTS-BC 114, DTS-BC 108 were other promising entries with performance better than check variety Suraj. Boll weight ranged from 3.3 (DTS-BC 108) to 4.5g (DTS-BC 107). DTS-BC 102, DTS-BC 106 recorded more than 4.0g boll weight. GOT ranged from 39 (DTS-BC 112) to 44 % (DTS-BC 109). DTS-BC 105, DTS-BC 108, DTS-BC 110, DTS-BC 113 > 42 % GOT.

A total of 119 single plant progenies were raised and intermating was carried out between 15 lines showing stability and uniformity for zero monopodia. Around 680 single plant selections were evaluated and promising ones were selected for earliness, fibre quality, plant type and susceptibility to sucking pest. Considerable variation was recorded for different fibre quality traits within crosses. In some of the selections, the fibre strength up to 34.6 g/tex was recorded with fibre length of 32.2 mm.

Two F_5 generations of eight and ten parental crosses were raised for developing MAGIC RILs. Single plant picking was carried out for these two populations. 1000 lines were evaluated for leaf temperature and chlorophyll content which ranged from 24.1 to 29.5^{o}C and 18.8 to 65.9 µmol/m^2 respectively while, 250 lines were evaluated for proline content that ranged from 1.4 to 2.18 µmol g^{-1} FW.

Fig. 2.2.1: Compact plant types

2.3 Project name: Breeding of upland cotton for improved fibre yield, quality and resistance to biotic stress (jassid)

Dr. S. M. Palve (PI); Co-PIs - Dr. (Mrs.) Rachna Pande, Dr. Pradeep Mandhyan (ICAR-CIRCOT, Mumbai)

Importance of the study: The aim of the project is to develop a breeding population with improved seed cotton yield, fibre quality and resistance to jassid. Utilization of interspecific crosses between *G. hirsutum* and *G. barbadense* in the breeding programme would certainly help in releasing additional genetic variability for fibre quality traits in populations generated.

Salient findings

Among 180 entries evaluated for seed cotton yield, fibre properties and jassid resistance, CNH 54-18 recorded highest length of 31.2 mm with fibre strength of 30.4 g/tex. CNH 58-46 recorded length of 32.2 mm and fibre strength of 28.3 g/tex. CNH 121-13, CNH 54-18, CNH 58-46, CNH 24-51, CNH 2SP-11 and CNH 72-35 were identified as tolerant to jassid (Grade I). CNH 09-70, CNH 09-23, CNH 09-12-3, and CNH 09-45 were tolerant to jassid.

Single plant selections (205 F_5) were advanced to F_6 progeny rows for evaluation of yield, earliness and fibre properties. Similarly, promising 292 F_6 and 80 F_7 progenies were evaluated for yield and fibre properties.

In interspecific crosses of *G. hirsutum* × *G.barbadense,* promising introgression lines (ILs) for specific traits like high ginning outturn percentage, cluster bolls and round bolls were developed (Fig. 2.3.1). In case of clustered boll lines, CNH 2020-7, CNH 2020-15, CNH 2020-16, CNH 2020-17, CNH 20 SP 2, CNH 20 SP-4 and CNH 20 SP -5 were promising for seed cotton yield. While in round boll lines, CNH 4822, CNH 4823, CNH 48-46, CNH 48-50, CNH 48-51, CNH 48 SP-1, CNH 48 SP-2, CNH 48 SP-4 and CNH 48 SP-5 were promising. The average fibre length, fibre maturity, micronaire and fibre strength values of the BC_1F_5 progenies were generally closer to the recipient *G. hirsutum* parent Suraj. Amongst ILs, CNH 44-31, CNH 45-31, CNH 47-31 and CNH 48-31 were tolerant to jassid (Grade I). In addition, 10 ILs had dark brown, medium brown and light brown lint colour variation (Fig. 2.3.1).

The average value for ginning out turn percentage and fibre quality traits of 201 backcross inbred lines and released varieties Suraj, NH 615 and Suvin was estimated over two years (2018 and 2019). The ILs CNH 20378, CNH 20387, CNH 204710 and CNH 204910 were identified for higher ginning outurn percentage (Table 2.3.1).

(a) Cluster bolls

(b) Dark Brown Lint

Fig. 2.3.1: Identified introgressed lines with distinct traits.

Table 2.3.1: Mean values of selected progenies for ginning outturn, boll weight and fibre properties

SPS	GOT (%)			Boll wt. (g)			UHML (mm)			MIC (µg/inch)			Strength (g/tex)		
	2018	2019	Mean	2018	2019	Mean	2018	2019	Mean	2018	2019	Mean	2018	2019	Mean
CNH 20378	44.3	43.5	**43.9**	5.9	3.8	**4.8**	28.9	30.0	**29.4**	4.3	3.8	**4.0**	29.1	28.4	**28.7**
CNH 20387	44.8	42.4	**43.6**	4.8	4.7	**4.7**	28.2	29.4	**28.8**	3.9	4.3	**4.1**	28.8	27.2	**28.0**
CNH 204710	45.7	43.3	**44.5**	5.9	4.5	**5.2**	28.7	29.4	**29.0**	3.7	4.2	**3.9**	29.8	23.1	**26.4**
CNH 204910	43.0	44.5	**43.7**	5.8	3.8	**4.8**	28.5	28.1	**28.3**	4.3	4.4	**4.3**	28.6	230	**25.8**
Suraj	36.0	36.4	**36.2**	4.1	4.9	**4.5**	31.3	31.1	**31.2**	4.3	3.0	**3.6**	27.1	27.2	**27.1**
NH 615	37.6	37.0	**37.3**	4.2	3.2	**3.7**	27.5	29.6	**28.5**	3.8	3.5	**3.6**	24.4	25.6	**25.0**
Suvin	31.2	31.6	**31.4**	3.1	2.6	**2.8**	36.8	39.9	**38.3**	3.0	3.6	**3.3**	30.1	32.7	**31.4**

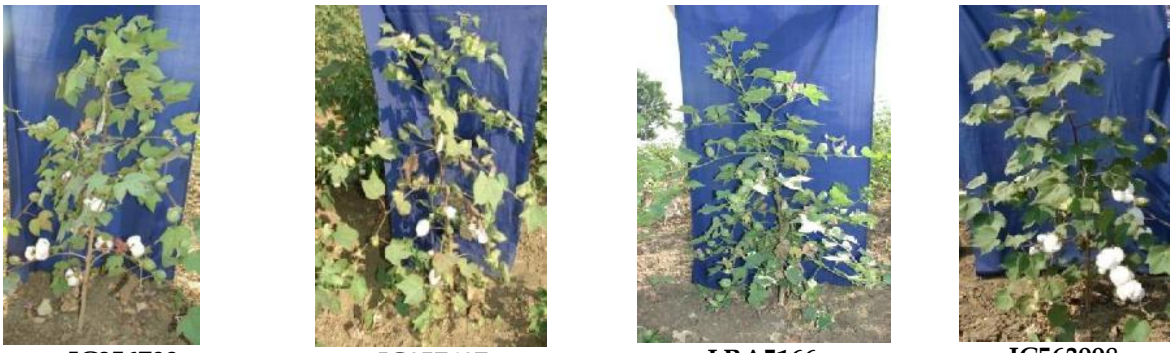
2.4 Project name: MAS/MAB for Waterlogging resistance

Dr Vinita Gotmare (PI); Co-PIs - Dr M Saravanan , Dr Jayant Meshram, Dr Annie Sheeba

Importance of the study: Cotton in India is grown in different agro-climatic conditions and it experiences waterlogging at one or other stages of its life cycle because of recent climate change scenarios. Information on the genetic variation for waterlogging tolerance in cotton is meager. This project is aimed to derive insights on waterlogging tolerance in *G. hirsutum* germplasm.

Salient findings

A total of 7500 *G. hirsutum* germplasm accessions were evaluated under field and pot condition over the years simultaneously at Nagpur and Coimbatore and promising tolerant and susceptible accessions for waterlogging tolerance were identified. Four accessions each of tolerant (IC359979, IC359245, IC563998 (INGR 08093), LRA5166) and susceptible (IC357558, IC359242, IC357607, IC356708) group (Fig. 2.4.1) were characterized and molecular diversity was analyzed using SSR markers. The development of mapping population using these identified accessions is underway.



IC356708 IC357607 LRA5166 IC563998

Fig. 2.4.1: Waterlogging susceptible and tolerant accessions

2.5 Project name: Breeding to improve performance of *Gossypium herbaceum* for adaptation to climate change in Central India

Dr. D.V. Patil (PI)

Importance of the study: One of the major reasons of low cotton productivity in central zone is abiotic and biotic stresses. *Gossypium herbaceum* can grow in difficult weather conditions under low fertile soils with poor management. It has immense inherent of abiotic tolerance. This project aimed to identify genotypes suitable for early maturity traits that escape late season water stress in addition to fitting the crops in available short windows of cropping systems.

Salient findings – 2020

Evaluation of advance generation populations of *G. herbaceum*

Twenty one F_4 populations were evaluated. The population of cross IC371437 × IC371362, IC371437 × GVHV655, Baluchistan 1 × IC371437, Jayadhar × IC371437, Jayadhar × IC371362 and Jayadhar × GVHV655 exhibited higher seed cotton yield compared to checks. The population of cross IC371437 × IC371362

had maximum UHML (27.7mm), UI (80%), MIC (4.5µg/inch), bundle tenacity at 3.2 mm gauge (27.0g/tex) and EI (4.4%) whereas, lowest fibre quality parameters were recorded in cross Jayadhar × GVHV655 (UHML 23.4mm, UI 77%, MIC 4.5µg / inch, bundle tenacity 21.6 g/tex and EI 5.6%).

Evaluation of interspecific population of G. *herbaceum* × *G. arboreum*

Twelve F_4 populations of interspecific crosses of *G. herbaceum* × *G. arboreum* (Fig. 2.5.1) were evaluated. IC371437 × PA785, Baluchistan1 × PA785, GVHV655 × PA785, IC371437 × PA812, Jayadhar × PA812 and IC371362 × PA785 produced higher seed cotton yield. Fibre quality parameters were tested in interspecific crosses. The population of cross IC371362 × PA785 had maximum UHML (30.1mm), UI (83%), MIC (3.3µg/inch), bundle tenacity (31.3g/tex) and EI (6.1. The genetic gain due to back crossing was maximum in the cross PA785 × IC371437 × PA785 (UHML 29.7mm, UI 84%, MIC 3.7µg/inch, bundle tenacity 29.4 g/tex, and EI 5.

Fig. 2.5.1: Interspecific hybridization (G. *herbaceum* × *G. arboreum*) in desi cotton

2.6 Project name: Development of high yielding, early maturing Asiatic cotton (*G. arboreum*) genotypes suitable to south zone

Dr. A.Manivannan (PI); Co-PIs- Dr. M. Saravanan; Dr. V. N. Waghmare

Importance of the study: Desi cotton (*G. arboreum*) resilient to many biotic and abiotic stresses is considered as a sustainable solution for fight against climate change. The demand for short stable cotton is almost double the production which highlights the scope for increasing area and productivity of desi cotton. In order to harness the short window of rainfed regions of central and south zone, this project envisaged to develop early maturing, high yielding *G. arboreum* genotypes.

Salient findings – 2020

Coimbatore

G. arboreum accessions screened for high yield and early maturity, based on Specific Combining Ability (SCA) and Standard heterosis (SH) with *per se* performance. Ten brown linted F_3 progeny families of crosses *viz.*, 1422 × Indicum 12-SP1, Desi 77 × *Arboreum* 12 , G725-SP1 × Indicum12 , H492 × 30839, Desi 56 × Indicum 12-SP1 (Fig. 2.6.1), Indicum12-SP1 × H502, Indicum12-SP1 × H480, H480 × Indicum12-SP1, 30814 × AC 3066 and AC514 × Desi 56, and 14 white linted F_3 progeny families of crosses *viz.*, 4725 SP1 × Indicum 12, NA48 × H 483, H 493 × NH-54-31-32, AC514 × AC 3066, NH-54-31-32 × GMS, Desi 70 × RG18, Desi 77 × AC3066, Desi 56 × AKA 57, Desi 56 × 30810, Malvi × 10 NA 40, 1422 × 19, AC 3066 × 19, Desi70 × AC 3066, and NA 48 × 30839 are being evaluated

Fig. 2.6.1: Field view of F_3 progeny family of brown linted *G.arboreum* Desi 56 × Indicum 12-SP1

Nagpur

BC_3F_1, BC_2F_2 and F_4 population of long linted genotypes *viz*., PA255, PA812, PA740, PA783 and KWAN3 crossed with Phule Dhanwantari were evaluated. Based on plant type and fibre quality traits, superior progenies (Fig. 2.6.2) were identified and used in the backcrossing (BC_4F_1 and BC_3F_2) and generation advancement (F5)

Fig. 2.6.2: Promising progenies and single plant selections of *G. arboreum*

2.7 Project name: Breeding for early maturity, compact plant type and jassid tolerance in cotton

Dr. H. B. Santosh (PI); Co-PIs- Dr. S. Manickam & Dr. K. P. Raghavendra

Importance of the study: High density planting system (HDPS) is recognized for higher productivity of cotton across countries. Availability of cotton cultivars with compact plant architecture is a basic requirement for the success of HDPS. This project envisages to develop cotton varieties which will have the potential to produce higher yield per unit area (under HDPS) and per unit time (due to early maturity) along with inherent resilience to jassids, better yield and fibre quality attributes. Early maturing cotton variety can also help escaping pink bollworm damage.

Salient findings

A total of 165 single plant selections and 85 progenies selected from the segregating populations for earliness, jassid tolerance, compact plant architecture, good boll weight and yield were evaluated. Many single plant selections (Table 2.7.1) and progenies having early maturity along with better fibre quality and yield potential were identified. Crop duration and plant architecture was severely impacted by the incessant rains which also lead to heavy infestation of sucking pests. Taking advantage of pest pressure, material was thoroughly screened for jassid tolerance and promising lines/progenies were identified. Eighty one single plant selections and 53 progenies were categorized as Grade 1 for jassid tolerance. Promising plants from different progenies were intermated and multi-parent crosses were attempted to combine early maturity and fibre quality along with compact plant architecture, jassid tolerance and yield potential. Three non-Bt entries *viz.,* CNH 20-31, CNH 20-32 and CNH 20-33 were sponsored for evaluation under AICRP on Cotton [IET Br 06 (a) trial] during 2020-21. Molecular divergence among jassid tolerant and susceptible upland cotton genotypes was studied using 50 polymorphic markers. Number of alleles detected by the marker ranged between 2 to 5 with a mean of 2.71. Average polymorphism information content (PIC) value ranged from 0.12 to 0.68 with a mean of 0.41. The genotypes were grouped into 3 major clusters which were further divided into sub-clusters (Fig. 2.7.1).

Table 2.7.1: Single plant selections of upland cotton possessing early maturity, jassid tolerance, compact plant architecture along with better yield and fibre quality attributes.

Selections	Plant Height (cm)	Plant width (cm)	Boll opening (%) @150DAS	Boll Weight (g)	Plant Yield (g)	Fibre length (mm)	Micronaire (µg/inch)	Fibre strength (g/tex)
SPS191-068	99	45	100.00	4.33	86	26.1	3.2	23.9
SPS191-048	98	31	100.00	3.67	75	27.8	3.4	27.8
SPS191-070	98	53	100.00	3.00	69	31.1	3.3	32.0
SPS191-049	103	33	97.37	3.00	105	29.4	4.4	31.2
SPS191-033	109	39	97.30	3.33	89	26.7	3.9	28.1
SPS191-036	91	27	93.94	4.33	94	33.0	3.5	29.6
SPS191-066	125	31	93.10	4.33	83	27.8	5.1	26.3
SPS191-069	127	35	88.46	4.00	100	28.5	4.5	25.0
SPS191-023	92	27	88.24	4.67	53	27.5	3.0	26.4
SPS191-067	98	34	86.96	3.33	72	28.2	3.8	28.5
SPS191-042	104	33	84.62	4.33	78	27.1	3.2	26.7
SPS191-024	86	32	82.14	4.67	102	28.5	3.1	26.6
SPS191-035	88	34	81.82	4.67	102	28.3	3.3	29.4
SPS191-027	118	27	78.95	4.33	116	24.4	4.5	26.2
SPS191-026	124	42	75.51	4.00	114	27.7	4.0	29.8
SPS191-037	98	36	74.07	5.00	96	26.6	3.7	27.4

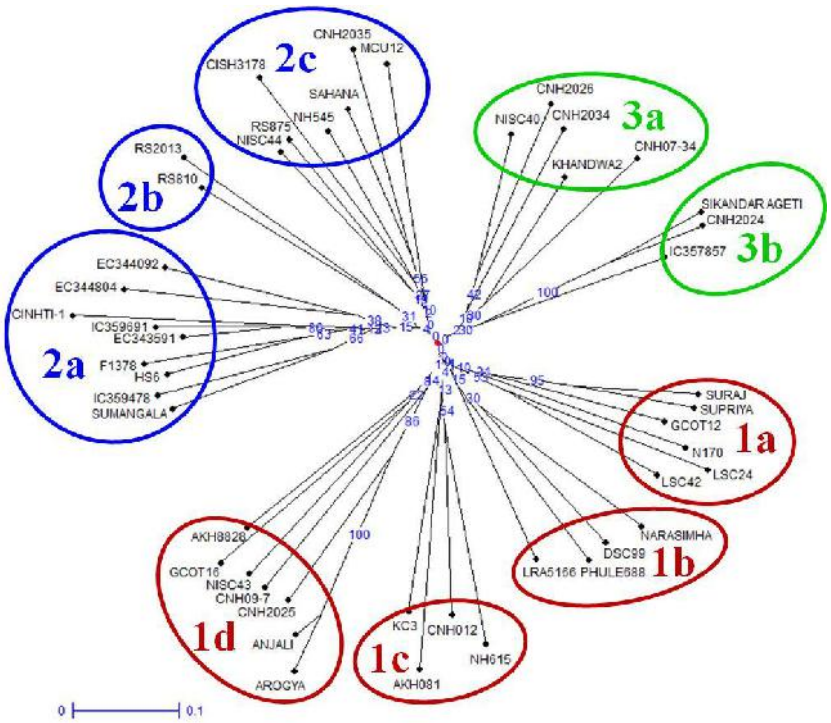


Fig.2.7.1: Clustering of upland cotton genotypes varying for jassid tolerance based on their genetic dissimilarity as revealed by polymorphic SSR markers

2.8 Project name: Breeding for high yielding, early maturing sucking pest tolerant extra-long staple *G. barbadense* genotypes with improved fibre properties

Name of PI & Co-PIs: Dr. KPM Dhamayanthi (PI); Co-PI's: Dr. A. Manivannan, Dr. K. Rameash

Importance of the study: In India, Extra Long Staple (ELS) Cotton (*G. barbadense*) demand is high than current production. The existing *G. barbadense* germplasm has a narrow genetic base and it became a major constraint to sustain progress in the development of ELS cotton cultivars to meet the needs of textile industry requirements. Hence, the project was formulated to improve yield and fiber quality in *G. barbadense* to meet the requirement of the textile industries.

Salient findings – 2020

Release of ELS variety: CCB-51, an ELS cotton genotype (Fig. 2.8.1) was released for irrigated conditions of South Zone (Andhra Pradesh, Telangana, Karnataka and Tamil Nadu). It has an yield potential of 1464kg/ha with duration of 165-170 days. It has a fibre length of 37.4 mm, micronaire of 3.3 and tenacity of 38g/tex. It showed resistance to grey mildew and bacterial leaf blight and showed tolerance to jassids, whiteflies, thrips and aphids.

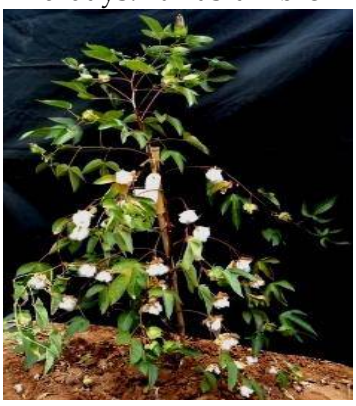


Fig. 2.8.1: CCB 51 *G. barbadense* variety

Seed multiplication of the promising genotypes identified for the Station & AICRP-2020-21 trials.

Seed multiplication of two advance cultures (CCB6 and CCB-15) for initial evaluation trial and CCB-26,CCB-29, CCB-51, CCB-51-2, CCB-64, CCB-64 B, CCB-129, CCB 141, CCB 142, and CCB-143B for various breeding trials was undertaken. Six new promising advanced lines namely CCB3, CCB4, CCB5, CCB7, CCB8, CCB12, CCB13, and CCB28 were multiplied for sponsoring in AICRP next year. Seed for large scale demonstration of newly identified variety CCB 51 was multiplied in large scale.

2.9 Project name: Development of high strength cotton genotypes by reducing short fibre content

Dr. S. Manickam (PI); Co-PIs- Dr. B. Dharajothi; Dr. J. Gulsar Banu; Dr. A. H. Prakash; Dr. K. Rameash; Dr. A. Sampath Kumar

Importance of the study: The long and extra-long staple varieties capable of spinning 60s count yarn occupies a sizeable area in the South Zone but are poor in fibre tenacity which make them unsuitable for spinning to optimum yarn counts. The upgradation of textile mills from ring spinning to open end rotor spinning require high strength cotton fibres to realize their spinning potential. Development of high strength culture will be useful for further breeding programmes.

Salient findings – 2020

- **CICR-H Cotton 36 (Suraksha)**, an extra long staple variety (Fig. 2.9.1) was identified for release in 2020 for both Central and South Zone States in irrigated condition with an yield potential of 4019 kg/ha. The average values of Upper Half Mean Length of 32.4 mm, micronaire of 3.7 and tenacity of 34.3 g/tex in HVI mode in South Zone and Upper Half Mean Length of 31.9 mm, micronaire of 4.4 and tenacity of 33.5 g/tex in HVI mode in Central Zone indicates its superior fibre quality. The variety is resistant to Bacterial Leaf Blight, Grey Mildew, Root rot, Tobacco Streak Virus, Tolerant to Alternaria Leaf Spot and, Rust. The variety is tolerant to Jassids, Whitefly, Thrips, Aphids, and Mirid Bug. It has been listed as Leaf hopper tolerant culture in both the zones.
- The long staple cultures CCH 19-2 and CCH 19-4 showed superior performance in AICRP multi-location trials and were promoted to zonal trials in both Central and South Zone for further evaluation during 2020-21.
- Several big boll progenies having boll weight of more than 5.0 g with good fibre quality has been identified and are being evaluated for further utilization.

a) Plant view b) Green Boll c)Boll opening

Fig. 2.9.1: CICR-H Cotton 36 (Suraksha) – a) plant view; b) green boll; c) boll opening

2.10 Project name: Development and evaluation of ELS interspecific hybrids with better yield and fiber quality

Dr. K. Baghyalakshmi (PI); Co-PIs- Dr. M. Amutha, Dr. A. Sampath Kumar, Dr. A. Manivannan

Importance of the study: In India, the Extra Long Staple (ELS) cotton production is less than the textile mills requirement. In order to meet the demand, the interspecific (H×B) hybrids need with quality sought by modern textile mills need to be developed.

Salient findings

Fifty *G. barbadense* lines were evaluated and based on primary morphological data seven male parents *viz.*, ICB 161 (compact type), CCB 11A (early maturing), CCB 29 (Advance culture for yield), Suvin (fibre quality), ICB 124 (High leaf trichome), CCB 25 (Epicuticular wax content), ICB 46 (High gossypol glands), and four female parents namely Suraj, Surabhi, MCU5 VT, CCH 15-1 were selected. Among the 50 genotypes, genotype with highest boll weight was CCB 143 B (5.35 g), ginning percent ICB 176 (37.5), fiber length CCB 11A (39.4), fiber strength CCB 28 (44.1). The 50 parents were analysed for PCA. About 91.45% of total variability found to be explained by PCA1, PCA2 and PCA3 components. PCA1 explained 39% of the variation for traits like mean length, UHML, fiber strength, boll shape and uniformity index. Diversity analysis (Fig. 2.10.1) grouped the accessions into four major clusters with two sub cluster in group 2, 3 and 4, hence forming seven groups. The minimum distance (0.56) was observed between ICB 176 and CBB 11 while, the maximum distance (3.11) was observed between ICB 174 and ICB 1. The parents ICB 99 for zero branching type, ICB 176 for GOT (37.5%), fibre length (35.4mm), fibre strength (40.7g/tex), ICB 264 for higher trichome density and higher gossypol content, ICB 284 for uniformity index of 87%, ICB 174 for early maturing and higher cuticular wax content, ICB 258 for early maturing with 4.1 micronaire and CCB 143B for higher boll weight of 5.35g were selected for crossing during next season (Table 2.10.1).

Table 2.10.1: Genotypes selected for crossing programme during 2020-2021

Genotype	NS	NM	FPF	BW	TL	GL	CW	GP	UHML	UI	FS	MIC
ICB 99	21	0	76	4.54	31.67	16.67	8.819	34.529	29.2	83.0	32.4	4.4
ICB 176	21	4	73	4.24	45.00	45.00	1.808	37.508	35.4	87.0	40.7	3.9
ICB 264	23	4	67	3.69	111.67	126.67	4.542	31.377	31.8	85.0	31.5	4.6
ICB 284	27	2	84	4.92	90.00	51.67	4.939	35.803	33.3	87.0	35.2	4.7
ICB 174	18	0	65	5.21	63.33	100.00	11.112	31.871	33.7	84.0	35.5	4.8
ICB 258	26	2	67	3.81	60.00	28.33	4.762	31.411	33.0	85.0	35.5	4.1
CCB 143 B	29	4	70	5.35	115.00	76.67	6.438	32.466	39.1	87.0	41.4	4.1

*NS- Number of Sympodia, NM-Number of Monopodia, FPF-50% Flowering, BW-Boll Weight(g), TL-Leaf Trichome numbers (no/sq cm), GL-Leaf Gossypol Glands (no/sq cm), CW-Cuticular wax (µg/sq.cm), GP- Ginning Percent, UHML- Upper Half Mean Length (mm), UI- Uniformity index (%), FS-Fiber Strength (g/tex), MIC- Micronaire

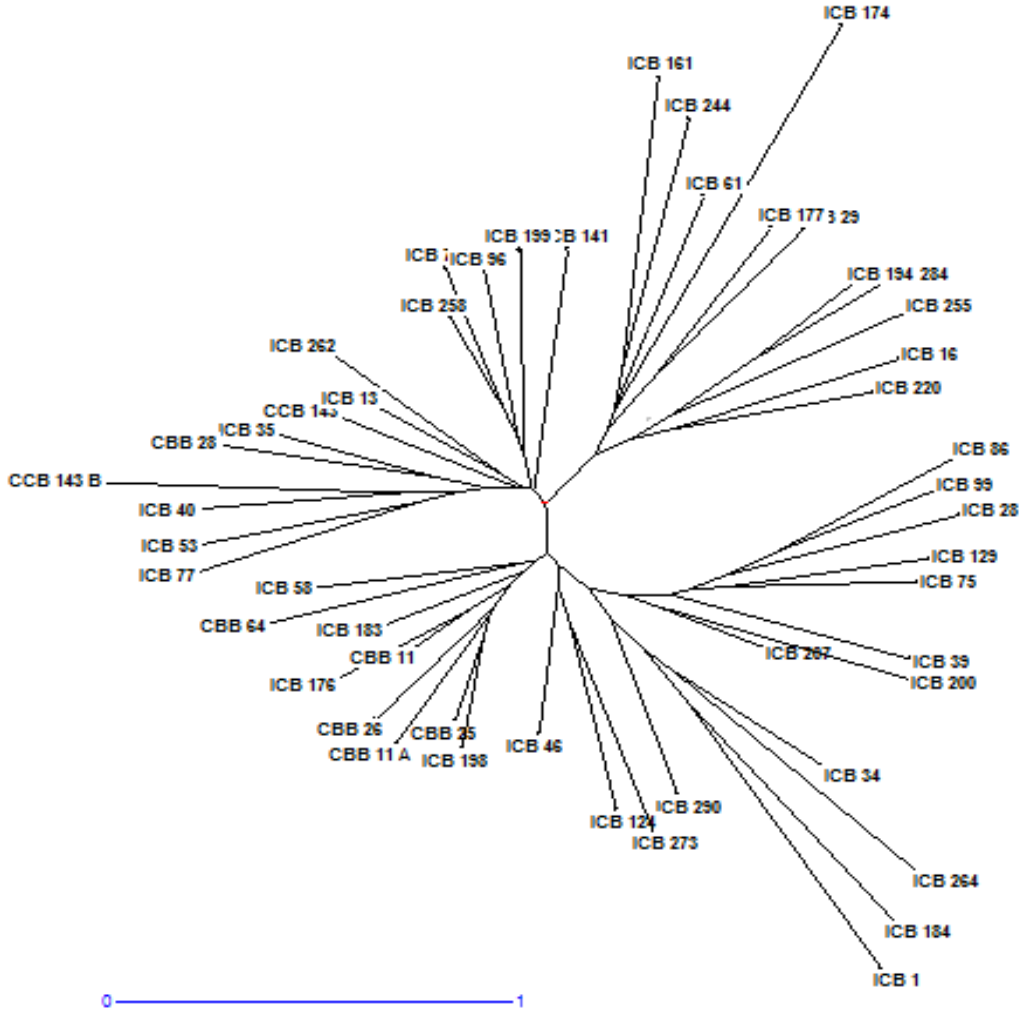


Fig. 2.10.1: Diversity analysis of 50 *barbadense* genotypes

2.11 Project name: Identification of male sterile plants in genetic male sterility (GMS) using molecular markers

Dr. O. P.Tuteja (PI); Co-PIs- Dr. S. B. Singh, Dr. Saravanan, M.

Importance of the study: Hand emasculation and pollination is laborious and the use of male sterility can make hybrid seed much cheaper. Use of GMS for commercial hybrid seed production is a better approach for tetraploid and diploid hybrids. GMS system involving two recessive genes *ms5ms5ms6ms6* found in Gregg MS is the only stable source utilized in India. The seed production plots of GMS female contain 50 percent fertile plants which need to be rouged out during flowering but before pollination. Identification of male sterile plants using molecular markers will help in making GMS based hybrid seed production profitable and sustainable.

Salient findings – 2021 A total of 24 samples representing 12 male sterile and 12 male fertile plants submitted for SNP genotyping. The seed of 12 CMS and its maintainer lines, 28 GMS and 25 Restorer lines were submitted for medium term storage (MTS).

2.12 Project name: Development of varieties of upland cotton having better fibre traits and tolerance to CLCuD

O. P. Tuteja (PI); Co-PIs- Dr. V. N. Waghmare, Dr. S. K. Verma, Dr. D. Monga and Dr. Rishi Kumar

Importance of the study: CLCuD is a major problem for cotton production in north India. As it is a vector transmitted viral disease, its management is very difficult. This project was initiated for development of varieties of upland cotton having good fibre traits and tolerance to CLCuD.

Salient findings

An F_2 population of seven crosses *viz*., CSH-46 × Bhiyani 251, CSH-46 × Bhiyani 251, CSH-27 × CSH-46, CSH-27 × HS 6, CSH-27 × F 846, CSH-46 × F 846 and CSH-538 × HS 6 were evaluated and 21 CLCuV free (0 grade) plants were identified and advanced. Following crosses were attempted involving GVS 9: F1 (GVS-9 × HS-6), BC1 (GVS-9 × HS 6) × GVS 9, BC2 (GVS-9 × HS 6) × HS 6, Selfing of F_1 (GVS-9 XHS-6) to develop F_2 population.

Out of two lines, GVS-8 (EC881780) and GVS-9 (EC881781) (both lines ratooned) showing resistance to CLCuD, the line GVS-9 was crossed with two CLCuD susceptible genotypes, CSH 3129 and F 2228, and F_1 was produced. The F_1 plants were screened for disease reaction which was observed to be resistant (ratooned), also the F1 was selfed for generation advancement. The segregation behavior of disease reaction on F_2 showed a segregation pattern of 3 (resistant): 1 (susceptible) ratio. The chi-square for goodness of fit confirmed that the resistance to CLCuD is governed by a single dominant gene.

Testing of entries in Institute Common Trial of *G hirsutum and G. arboreum*

In *G. hirsutum*, 13 entries and 6 entries in case of *G. arboreum* were evaluated along with checks for seed cotton yield and fibre properties for identifying promising entries for sponsoring in coordinated trials.

Table 2.12.1: The list of entries sponsored in Institute Common Trial 2020-21

Species	Entry
G. hirsutum	CNH 57-12, CNH 58-46, CNH 19276, CNDTS 289, CNH 1144, CNH 57-12, CNH 24-51, CNH 451, CNDTS 290, CNDTS 291, CNDTS 292, CNH 19295, CNH 1145
G. arboreum	CNA 2044, CNH 1077, CNH 1078, CNA 19086, CNA19048, CNA1076

Table 2.12.2: The list of entries sponsored for ICAR-AICRP trials 2020-21.

Trial	Entry
IET of *G. hirsutum* Br 02(a)	CSH 89, CSH 90
IET of *G. hirsutum* Br 02(b)	CNH 18298 , CNDTS 287, CNH 18173, CNH 1137, CNH 2131, CNH 119
IET of *G. hirsutum* Colour cotton trial Br 02 (a/b) CC	CNH 19325, CNH 19480
IET of compact *G. hirsutum* Br 06 (a)	CSH 49, CSH 50, CNH 20-31
IET of compact *G. hirsutum* Br 06 (b)	CNH 1139, CNH 1140, CNDTS 5114, CNDTS 5170, CNH 120, CNH 121, CNH 20-31, CNH 20-32, CNH 20-33
Br 13(a) IET	CCB-6, CCB-15
IET of *G. arboreum* Br 22 (a/b)	CNA 2034, CNA 1071, CNA 1072, CNA 18408, CNA18392, CISA 6-3, CISA 33.5
IET of *G. arboreum*, Long linted Br 22 (a/b) LL	CNA1074, CNA1075
IET of *G. arboreum* Colour cotton Br 22 (a/b) CC	CNA 1092, CNA 19975
Br 25 (a) PHT *G. arboreum*	CISAA 19-3, CISAA 19-4

Table 2.12.3: Entries promoted and retained in ICAR-AICRP on Cotton during 2020-21

Trial code	Entries promoted	Entries retained
Central zone		
Br.03(a) PVT irrigated	CCH 19-2	CNH 17395
Br.03(a) Coloured Cotton	CNH 18528, CNH 18529, CCHC 19-1, CCHC 19-2	
Br.06 (a)	CCH 19-2, CCH 19-4	
Br.13 (a) PVT *G. barbadense*	CCB-141	CCB-64
	CCB 64-B	
Br 13(a) IET	CCB-6, CCB-15	
Br.14(a) CVT *G.*	CCB 51-2, CCB 143-B	

barbadense		
Br.03(b) PVT Rainfed	CNH 1134	
Br.06 (b) CVT compact culture rainfed	CNH09-77, CNH 19-4	
Br.24(b) CVT- *G. arboreum*	CNA2035, CNA2036	
Br.24(b) CVT-Long linted *G. arboreum*	CNA 1069	CNA1065
Br.24(b) CVT- Coloured Cotton trial of *G. arboreum*	CNA 18562, CNA 18563	CNA17522, CNA1091
South zone		
Br.03(a) PVT irrigated	CCH 19-2	
Br.03 a/b (CC) Colour Cotton irrigated	CNH 18529, CNH 18528, CCHC 19-2, CCHC 19-1	CNH 17395
Br.06 (a) CVT Compact culture irrigated	CCH 19-2, CCH 19-4	
Br. 13 (a) PVT *G. barbadense*	CCB 141, CCB 142, CCB 64-B	CCB 51, CCB 29, CCB 64, CCB 26
Br. 14 (a) CVT *G. barbadense*		CCB 51-2, CCB 129
Br.03 (b)	CNH 1134, CNH 09-119	
Br.06(b)	CNH 2046, CCH 19-4, CNH09-77	CNH 11-28
Br. 24 (b) CVT *G. arboreum*	CNA2035	CNA1031,CNA1054
Br. 24 (b) CVT long linted *G. arboreum*	CINA 1069, CINA 1068, CINA 1067	CINA 1065
Br. 24 a/b- CVT *G. arboretum* CC- Rainfed	CNA18562, CNA18563	CNA1091, CNA17522
North zone		
Br 06 (a)	CSH 100	

Table 2.12.4: Bt. entries sponsored for ICAR-AICRP trials 2020-21

Name of the trial	Name of the entry- Sponsored
NORTH ZONE	
IET of Bt cotton varieties	CICR 20 Bt , CICR 44 Bt
CENTRAL ZONE	
Irrigated	
IET of *G. hirsutum* variety	CICR Bt 20-31, CICR 18 Bt, CICR 20 Bt
AET Advanced evaluation trial of *hirsutum* variety	CICR Bt19, CICR Bt 21, CICR Bt 22
Rainfed	
IET of intra-*hirsutum* hybrid	CICRHH 11
IET of *G. hirsutum* varieties	CICR 18 Bt, CICR 19 Bt, CICR Bt 20-31, CICR Bt 1141, CICR Bt 1142

AET Advanced evaluation trial of *hirsutum* variety-I	CICR 24 Bt, CICR Bt 19-32, CICR Bt 19-32, Bt 183059-4
AET Advanced evaluation trial of *hirsutum* variety-II	CICR 20 Bt, CICR 21 Bt, CICR 22 Bt
SOUTH ZONE	
Irrigated	
IET of *G. hirsutum* variety	CICR 20 Bt, CICR 61 Bt, CICR 1002 Bt, CICR Bt 20-31
AET Advanced evaluation trial of hirsutum variety	CICR 25 Bt, CICR 26 Bt
Rainfed	
IET of *hirsutum* variety	CICR Bt 1141, CICR Bt 1142, CICR 20 Bt, CICR Bt 20-31, CICR 61- Bt, CICR 1002 Bt
AET Advanced evaluation trial of *hirsutum* variety	CICR Bt 19-31, Bt 183059-2

Table 2.12.5: Entries developed by ICAR-CICR proposed for Agronomy trial 2020-21

Zone	Species	Variety / Hybrid	Irrigated / Rainfed	Name(s) of the entries
Central Zone	*G. hirsutum*	Variety	Rainfed	CNH 11-11
	G. arboreum	Variety	Rainfed	CNA1054, CNA1031
South Zone	*G. hirsutum*	Variety (Coloured Cotton)	Rainfed	16301 DB
		Compact Variety	Rainfed	CNH 1128
	G. arboreum	Variety (Coloured Cotton)	Rainfed	CNA405
	G. barbadense	Variety	Irrigated	CCB 143B

Theme 3: Maintenance breeding, seed research and quality seed production

3.1 Project Name: ICAR Seed Project Seed Production in Agricultural Crops

Dr. P. R. Vijaya Kumari (PI); Co-PIs- Dr. K. Rathinivel , Dr. Debasis Paul, Dr (Mrs.) V. Santhy

Importance of the study: Supply of quality seed is essential to popularize varieties. The project thus aims to produce sufficient quantity of breeder seeds, foundation seeds, certified seeds and TFL seeds of released, notified crop varieties of cotton as well as other major crops popular in the region.

Salient findings

A total of 156.48 q seeds was produced which includes breeder seed & truthfully labeled seeds of cotton varieties (*tetraploid* and *diploid*), certified seeds of wheat cv. HD 2967, certified seeds of Gram cv. Jaki 9218, certified seeds of Redgram cv. BSMR-736 and foundation seeds of Linseed cv. NL 260 (Table 3.1.1).

Table 3.1.1: Seed production of cotton and other crop varieties

Crop	Variety	Stage	Seed Yield (q)
Cotton	Non Bt Varieties - Parents of CICR-2 hybrid, CISA310 (*G.arboreum*) and CSH3075, CSH 2931 (*G.hirsutum*)	Breeder Seed	7.45
	Bt Varieties namely, ICAR-CICR Suraj Bt, ICAR-CICR PKV-081 Bt, ICAR-CICR PKV Rajat Bt and ICAR-CICR GJHV 374 Bt	Truthfully labeled seeds	5.87
	Stock seed – 89 popular cotton varieties (G. *hirsutum*, *G. arboreum & G. barbadense*)	Truthfully labeled seeds	1.0
	Non Bt varieties released from ICAR-CICR namely, Suraj, Surabhi, CNA 1003 and CNA 1028	Truthfully labeled seeds	6.16
Other Crops			
Wheat	HD 2967	Certified seeds	58
Red gram	BSMR-736	Certified seeds	48.12
Gram	Jaki 9218	Certified seeds	28.40
Linseed	NL 260	Certified seeds	1.48

Study on effect of foliar supplements in enhancing seed yield: An experiment on application of various foliar supplements was taken up in the breeder seed production field of ICAR-CICR for the Suraj variety in RBD design. The data analysis revealed significant difference among the treatments. The boll number per plot was highest for neem kernel foliar treatment (1525 bolls) followed by RPP supplemented with KNO3 (1460). The boll weight was maximum for mepiquat chloride treatment (4.72g) followed by RPP supplemented with KNO3 (4.60g) and micronutrient treatment (4.58g). The seed cotton yield and final delinted seed recovery was also highest for neem kernel extract spray followed by micronutrient and RPP supplemented with KNO3 (Table 3.1.2). There was no significant difference for seed index among the treatments.

Table 3.1.2 Effect of foliar supplements on economic traits of *G hirstutm* Cv Suraj

Treatments	Boll Numbers per plot (area of 21.6m²)	Boll Weight (g)	Seed Cotton Yield (Kg/ plot area of 21.6m²)	Final Seed Yield (Kg/ plot area of 21.6m²)
Recommended Package of Practice (RPP)	1285	4.15	4.41	1.65
RPP + KNO3	1460	4.6	5.14	1.97
RPP+DAP+KNO3	1290	4.33	4.71	1.79
RPP+DAP	1377	4.23	4.95	1.95

Mepiquat Chloride	1337	4.72	5.18	1.82
Micronutrients	1399	4.58	5.25	1.97
Neem kernel extract	1525	4.31	5.40	2.06
Cow Urine	1411	4.33	5.16	1.72
Water treated Control	1249	4.22	4.69	1.18
SEm±	49.6	0.11	0.18	0.07
CV (%)	6.3	4.23	6.36	7.10
CD (0.05)	148.6	0.32	0.55	0.22

3.2 Project Name: Seed characterization based on protein quantification and profiling in Cotton

Dr. V. Santhy (PI), Co-PI- Dr. Pooja Verma

Importance of the study: Seed protein characterization helps in identification of hybrids and genetic purity analysis, diversity analysis of germplasm accessions, and can be used as a genetic marker for seed vigor and viability analysis.

Salient findings

The SDS-PAGE (15%) profiling of tris soluble protein fraction extracted from seeds of four ICAR-CICR released hybrids and their parents was performed. There was no conspicuous difference for the profile among the set of hybrids studied except for parents of CICR-2 F1 hybrid. The female and male parent of CICR-2 F1 hybrid differed with respect to the presence and absence of 29 kDa fragment respectively. However, the hybrid profile was similar to that of the female parent. The artificially aged (40^0 C and 100% RH) seeds along with their fresh counterparts were characterized for seed protein content by Bradford method in 15 varieties. The protein content significantly reduced as seed viability decreased in all the varieties. The comparison of tris soluble seed protein content among four cultivated species revealed *G. hirsutum* varieties to have relatively higher protein content (45 - 50 µg/g seed) than varieties of *G. barbadense, G. arboreum and G. herbaceum* (20-30 µg/g seed).

3.3 Project Name: Strategies to augment quality and storability of cotton seed under different environmental conditions

Dr. Sunil S. Mahajan, (PI); Co-PIs- Dr. V. Santhy, Dr. PR Vijayakumari

Importance of the study: Scientific storage is an essential component for small holder farmers, researchers, gene bank holders and commercial seed industry to supply quality seed. The knowledge of cotton seed storability is essential to avoid loss of valuable genetic stocks, unsold commercial seed stocks, carry over seed stock and unused breeding cultures to be sown in subsequent sowing season.

Salient findings

Freshly harvested seeds (*kharif* 2019) were stored in different packaging materials, different storage conditions and modified gas atmosphere. The results indicated that, after one year of storage, the per cent seed germination of *G. arboreum* was higher than the *G. hirsutum*. Overall, higher seed germination was maintained in cold storage as compared to ambient storage. Seed stored in modified atmospheric gaseous condition or vacuum container exhibited higher seed germination as compared to their non vacuum counter parts. Seed stored in air tight container containing zeolite

beads showed higher seed germination as compared to without zeolite beads.

3.4 Project Name: Implementation of PVP legislation and DUS testing of cotton under ICAR and SAU system

Dr.K.Rathinavel (PI); Co-PI- Dr.V.Santhy

Importance of the study: The project is a centrally sponsored and funded by PPV &FRA with an objective to establish and maintain database of extant cotton varieties, conduct DUS test of new candidate, varieties of common knowledge, farmers varieties and essentially derived varieties, maintenance breeding of reference cotton varieties, morphological characterization of extant cotton varieties and also Registration of extant cotton varieties under this act.

Salient findings

Distinctiveness Uniformity and Stability (DUS) testing of cotton genotypes was done at ICAR-CICR Regional Station, Coimbatore; ICAR- CICR, Nagpur; NSP Unit, UAS Dharwad; Department of Cotton CCSHAU, Hisar; RRS, PAU, Bathinda and Department of Cotton, MPKV, Rahuri. The data base on extant and notified cotton varieties has been updated. Data base of registered tetraploid and diploid cotton varieties was acquired from PPV&FRA, New Delhi. Maintenance breeding and characterization also performed for 186 extant cotton varieties viz. 141 of *G. hirsutum*, 35 of *G. arboreum,* 3 of *G.herbaceum* and 7 of *G.barbadense*. Monitoring of DUS trials at the participating centers have been done through online meetings.

3.5 Project Name: National Seed Project (Crops)

Dr.K.Rathinavel (PI);
Co-PI- Dr.P.R.Vijayakumari

Importance of the study: This project envisages to study the planting values of seeds to examine the prescribed periods of validity of fresh and revalidated certified seed lots of some major field crops. The project also aims at development of priming technologies for enhanced planting value of seed under sub-optimal conditions in field crops

Salient findings

Validity periods of certified seeds of field crops (as per IMSC regulations) have been assessed for fresh and revalidated seed lots of cotton. Fresh seed lots of NH 615 and Roja (CNA1003) varieties were assessed for initial viability and moisture content. They were stored in polythene bag and gunny bag under ambient condition. Bimonthly observations on seed moisture content (ISTA), Germination % (ISTA), Vigor index-I & II (Abdul Baki and Anderson, 1973) and dry matter production of seedlings revealed that the performance of seed lots are well above the minimum seed certification standards. Seeds of NH 615 maintained germination above IMSC regulations beyond 15 months of ambient storage.

An experiment was conducted on priming technologies for enhanced planting value of seeds under sub-optimal conditions using two cotton varieties Surabhi (V_1) and Suraj (V_2) with old(L_1-2018-19) and fresh (L_2 - 2019-20) seed lots. Following treatments were imposed under lab conditions. T_1- Control, T_2-. Hydro-priming (12h @ 25°C), T_3- Seed coating with *Trichoderma harzianum* (15g/kg), T_4- Seed coating (on hydro primed seeds) with Biophos, T_5- Seed coating (on hydro primed seeds) with DAB + BioNPK, T_6- Halo-priming with KH_2PO_4 @ 0.5% and T_7- Halo-priming with KNO_3 @0.3%. Results revealed that seed soaking in KH_2PO_4 @ 0.5%, Seed coating with Biophos, *T. harzianum*, drought alleviating bacteria + BioNPK have enhanced the quality in both varieties. The quality enhancement was more prominent in aged seed lots.

Theme 4: Gene discovery and trait improvement through omics and transgenics

4.1 Project Name: Targeted mutagenesis of *GhPHYA1* through CRISPR/Cas9 in Cotton

Dr. Chandrashekar, N (PI); Co-PI- Dr. Raghavendra, K.P

Importance of the study: Precision in transfer and editing of target gene is of more significance in genetic manipulation of crop plants. The target gene *GhPHYA1* is one of the potential major negative regulators of many genes contributing for cotton fiber quality, boll size, vegetative growth, flowering etc. Therefore targeted mutagenesis of *GhPHYA1* aimed at improvement of useful trait in cotton.

Salient findings

Agrobacterium mediated transformation of Coker 312 hypocotyls with four gene targeting vectors*viz.,CRISPR/Cas9::GhPHYA1sgRNA1, CRISPR/Cas9::GhPHYA1sgRNA2,CRISPR/ Cas9::GhPHYA1sgRNA3 and CRISPR /Cas9::GhPHYA1sgRNA4* has been performed. Callus cultures for all four constructs have been established (Fig. 4.1.1) and are being maintained through sub culturing on MS medium supplemented with 2,4-D (0.1mg/l) and kinetin (0.5mg/l) for regeneration of putative transformants through somatic embryogenesis and further analysis

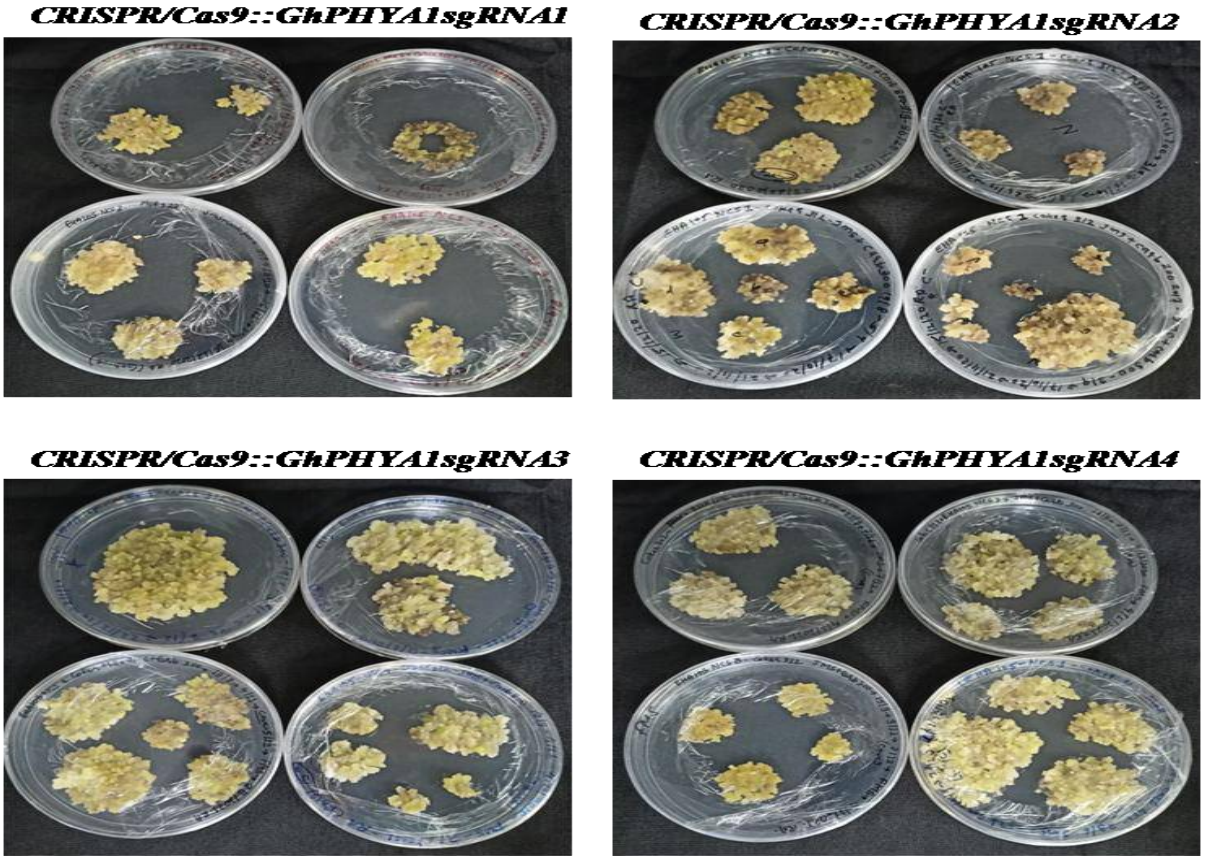


Fig 4.1.1: Representative putative callus cultures harbouring *GhPHYA1* gene targeting cassette

4.2 Project Name: Development of Bt cotton varieties using deregulated and non-deregulated transgenic events

Dr. V.N. Waghmare (PL): Co-PIs- Dr Suman Bala Singh; Dr MV Venugopalan, Dr G Balasubramani, Dr Vinita Gotmare, Dr J Amudha, Dr Raghavendra KP, Dr Rachna Pande, Dr Saravanan M, Dr BB Fand, Dr Santosh HB, Dr Shah Vivek,; Dr N Chandrasekhar, Mr Rakesh Kumar, Dr S. Manickam, Dr. K. Rameash, Dr. A. Sampath Kumar, Dr. OP.Tuteja, Dr. SK. Verma, Dr. Rishi Kumar, Dr. SK. Sain, Dr. Ramkrushna GI, Dr. Bhagyalakshmi

Importance of the study: ICAR-CICR, Nagpur has recently developed Bt cotton varieties containing cry1Ac gene (MON 531) and having tolerance to sucking pests. Public funded Indian Institutions such as CICR-Nagpur, TNAU-Coimbatore, Delhi University, CSIR-NBRI, Lucknow have been able to develop transgenic cotton events using IPR protected novel insecticidal genes. To explore possibilities to use these new events, a comprehensive research programme was initiated with an objective to develop next generation transgenic cotton varieties resistant to insect pests to circumvent production challenges and enhance productivity.

Salient findings

Introgression and Evaluation of non-deregulated transgenic events: Introgression of Tg2E13 (*cry1Ac*) event: The BC4F2 populations of three crosses viz., Suraj × Coker310 (Tg2E13), NH615× Coker310 (Tg2E13) and CISH3178× Coker310 (Tg2E13) were raised under contained facility at ICAR-CICR, Nagpur. The segregating progenies were tested through ELISA at 20-30DAS and non-Bt plants were roughed out. Plants homozygous for Tg2E13 event (cry1Ac gene) in BC4F2 population of three crosses were identified. In CISH3178 background, plants possessing Tg2E13 event (cry1Ac gene), Mon531 event (cry1Ac gene) and their combination (Tg2E13+Mon531 event) were identified for their further evaluation for toxin expression and bio-efficacy.

Introgression of CH12 (*cry2Ax1*) event: BC_2F_1 plants of CH12 event with recurrent parents NH 615 & CISH 3178 were tested using *cry2Ax1* gene specific PCR and identified 23 positive plants. The positive plants are being used for developing advance backcross (BC3) generation.

Effectiveness of different non-deregulated transgenic events against bollworms: Non-deregulated transgenic events viz., Tg2E13 (*cry1Ac*), CH12 (*cry2Ax1*) were assessed for their bio-efficacy against pink bollworm and American bollworm along with checks [BG II hybrid check (*cry1Ac*+*cry2Ab*); Suraj Bt variety (Mon531) and non-transgenic (Coker 310)]. For pink bollworm Tg2E13 was found comparable to single and dual gene Bt checks. The event has also showed good bio-efficacy against American bollworm. Event CH12 (*cry2Ax1*) tested for their bio-efficacy that showed moderate response against American bollworm but found not-effective against pink bollworm.

Development of Bt cotton varieties and hybrids using deregulated transgenic event: A dedicated team of Breeders supported by Entomologists, Pathologists and Agronomists of the Institute are engaged in Bt varietal development programme. More than 100 genotypes are under Bt conversion and evaluation at all three stations of ICAR-CICR. The promising Bt lines are being evaluated in Institute common trial and the promising one are sponsored for AICRP trials.

In order to develop early maturing Bt cotton varieties amenable for HDPS and

mechanical harvesting, the promising single plant selections and progenies carrying *cry1Ac* gene (Mon531 event) were evaluated at spacing of 60x45cm for early maturity, compact plant architecture, jassid tolerance apart from various yield and fibre quality component traits. Taking advantage of severe sucking pest pressure, the material was thoroughly screened for jassid tolerance and promising material was advanced. The genetic gain achieved with stringent selection for early maturity (110-120 days) was found to be accompanied with penalty on fibre quality (specially the fibre length and fibre strength). Therefore, entries possessing early maturity (130-150 days duration) along with better yield and fibre quality were identified (**Table 4.2.1**). Promising plants from different progenies were intermated and multi-parent crosses were attempted to combine early maturity and fibre quality along with compact plant architecture, jassid tolerance and yield potential.

Table 4.2.1. Single plant selections identified for early maturity along with better yield and fibre quality attributes

Selections	PH	PW	Mono	Maturity	BW	PY	FL	Mic	FS
SPS191-257	130	41	1	100.00	6.00	125	24.6	4.9	25.4
SPS191-208	128	37	0	100.00	6.00	115	23.6	4.9	24.3
SPS191-248	139	44	0	100.00	5.67	105	23.8	3.6	23.9
SPS191-298	128	39	2	100.00	5.67	137	27.3	4.5	27.8
SPS191-292	151	54	1	100.00	5.67	217	30.2	3.6	28.0
SPS191-287	107	32	0	100.00	5.33	78	25.2	4.2	27.2
SPS191-187	104	41	0	100.00	5.33	95	28.8	3.5	26.9
SPS191-239	116	28	0	100.00	5.33	115	26.1	4.0	25.4
SPS191-190	98	34	1	100.00	5.00	90	26.7	4.2	27.7
SPS191-206	113	37	0	100.00	5.00	102	24.5	4.6	27.9
SPS191-154	121	36	1	100.00	5.00	108	24.7	4.7	27.6
SPS191-283	108	34	0	100.00	5.00	111	26.1	4.4	29.8
SPS191-297	146	47	0	100.00	5.00	121	27.3	4.5	27.8
SPS191-291	122	31	0	100.00	5.00	140	30.2	3.6	28.0
SPS191-284	107	41	0	100.00	5.00	160	25.9	3.4	27.6
SPS191-295	126	47	1	83.93	5.00	215	29.4	4.2	29.6
SPS191-216	123	30	0	100.00	4.67	90	25.9	4.5	28.5
SPS191-286	103	35	0	100.00	4.67	106	25.3	4.2	27.0
SPS191-013	122	30	1	89.66	4.67	111	25.9	4.5	28.5
SPS191-156	118	32	0	88.46	4.67	140	27.6	4.4	29.3
SPS191-294	118	39	1	80.43	4.67	144	29.40	4.23	29.60

[PH – Plant Height (cm); Plant width (cm); Monopodia (No.); Maturity as per boll opening (%) @150DAS; Boll Weight (g); Plant Yield (g); Fibre length (mm); Micronaire (µg/inch); Fibre strength (g/tex)]

From the project, a total of 10 entries (CICR 18 Bt, CICR 19 Bt, CICR 20 Bt, CICR 44 Bt, CICR 61 Bt, CICR Bt 1141, CICR Bt 1142, CICRHH 11, CICR 1002 Bt, CICR Bt 20-31) were sponsored for testing under ICAR-

AICRP on Cotton trials while 11 entries were promoted to next level.

Bt hybrids development: Using the released Bt varieties as parental lines, 124 cross combinations with Non-Bt lines were made and the F1 combinations, 65 in replicated trial and 59 in non-replicated trials were evaluated. The hybrid combination identified as promising in the previous year and enough hybrid seed produced for the hybrid, CICR HH Bt 11, has been sponsored in Bt hybrid Trial of AICRP.

Institute Common Trial: Twelve Bt hybrids were sponsored for testing in institute common Bt trial. Five of these hybrids were identified as promising and will be tested for second year for their performance.

Development of Bt cotton varieties and hybrids using deregulated transgenic event at Sirsa: the conversion programme is at F4/ F5 stage and 126 single plants confirmed to contain Bt gene through ELISA has been selected for further evaluation for Bt and CLCuD resistance. Promising progenies are being stabilized for promoting in AICRP.

Development of Bt cotton varieties and hybrids using deregulated transgenic event at Coimbatore: 30 BC2F1 population were raised and *cry*1Ac positive plants were back crossed with recurrent parent *viz.*, LRA 5166, Anjali, MCU 5-VT, Suraj, Surabhi, Supriya, Sumangala, CCH 2623, Subiksha, Sunantha, Suraksha, CCH 19-2 and CCH 19-4. Selfing was done in about 75 BC2F1 *cry*1Ac positive plants to produce BC2F2 population. 150 F3 progenies were raised and Cry1Ac positive plants were identified to produce F4 population. Identification of Bt homozygous plants from selected 168 Cry1Ac positive F3 plants for further evaluation and utilization is in progress. The 28 F1 crosses involving four *Bt hirsutum* female parents (Suraj Bt, Rajat Bt, PKV 018 Bt and GJHV 374 Bt) and seven *barbadense* male lines were evaluated for yield performance. The preliminary results indicated that about 5 hybrid combinations had higher number of bolls per plant (>50 nos) while two combinations recorded higher boll weight (>5g/boll) and three combinations recorded higher plant yield.

Agronomic evaluation of Bt (Mon531) varieties and advanced lines

Two Bt varieties *viz.*, Suraj Bt, Rajat Bt and one advanced line CICR Bt 183059-5 was evaluated under two different spacing at ICAR-CICR, Nagpur. It was found that an early maturing, compact, jassid tolerant Bt entry, CICR Bt 183059-5 yielded an average of 3037 kg/ha seed cotton under the high density planting (60×15cm spacing) while both the Bt varieties performed better in the spacing of 60×30cm spacing. Among both the Bt varieties, Rajat Bt had better yield under both the spacings.

Varieties Notified by CVRC: The following 7 Bt varieties (Table 4.2.2) identified for commercial cultivation were considered for release during the 84th CVRC meeting held on 10th July, 2020 under the Chairmanship of Dr. T.R. Sharma DDG (CS), ICAR and notified in the Gazette vide S.O. 3482(E) dated Oct. 7, 2020.

Table 4.2.2: Bt varieties notified in the Gazette vide S.O. 3482(E) dated Oct. 7, 2020

S. No.	Name of Variety	Zone/ State of Cultivation
1	ICAR-CICR Bt 6	Haryana
2	ICAR-CICR PKV Bt	Maharashtra

3	ICAR-CICR Suraj Bt	Maharashtra
4	ICAR-CICR Rajat Bt	Maharashtra
5	ICAR-CICR GJHV Bt	Maharashtra
6	ICAR-CICR Bt 16	Central Zone
7	ICAR-CICR Bt 23	South Zone

Seed production of Bt Varieties: Nucleus seed of four Bt varieties viz., 115kg of ICAR-CICR Suraj Bt, 153kg of ICAR-CICR GJHV374 Bt, 187kg of ICAR-CICR Rajat Bt and 156kg of ICAR-CICR PKV081 Bt was produced.

MoU for seed multiplication and marketing: MoU was signed with Maharashtra State Seed Corporation, Akola for seed multiplication of three Bt varieties *viz;* ICAR-CICR Suraj Bt, ICAR-CICR Rajat Bt and ICAR-CICR PKV081 Bt. Thirty kg of nucleus seed for three varieties was provided and produced 200q of seed. Other seed producing agencies namely TSSDTC Ltd, Hyderabad; M/s., Dhanlaxmi Seeds, M/s. Sahaja Seeds and M/S Vikas Biosciences Pvt. LTD from Hyderabad signed MOU for seed multiplication and Marketing of all the five Bt varieties including ICAR-CICR Bt 6.

4.3 Project Name: Development of consensus genetic linkage map for *Gossypium* L. spp. with SNP markers and QTL analysis for fiber traits

Dr. V.N. Waghmare (PI); Co-PI- Dr. D.V. Patil

Importance of the study: Development of unified consensus genetic linkage map for *Gossypium* L. using stabilized mapping populations (RILs) and SNP markers to be used for mapping & locating trait specific QTLs.

Salient findings

As per the planned activities, five RIL populations provided by the participating centers were evaluated at ICAR-CICR, Nagpur (and also at two more locations UAS, Dharwad and TNAU, Coimbatore) in two replications during 2019-20. The observations were recorded on economic traits i.e. boll number, boll weight, GOT and seed cotton yield. The morphological trait data indicated presence of wide variation for trait values among the RIL progenies (Table 4.3.1) and thus suitability of the data for genetic mapping. The lint samples are under testing at GTC, CIRCOT for fibre quality.

Of the 5 RIL populations, in one of the interspecific population between *G. arboreum* and *G. herbaceum* from Dharwad, we could not get sufficient lint from several RIL progenies for want of sufficient plant stand. The population was again raised during 2020-21 in two replications and morphological data was recorded.

Table 4.3.1: Trait variation in inter- and intra-specific RIL populations

Parents	(*G. arboreum* X *G. herbaceum*) (KWAN-3 x JAYADHAR)	Intra- hirsutum (MCU5 X TCH1218)	Intra- hirsutum (P 56-4 x RS 2013)
No of Population Size	200 RIL progenies	222 RIL progenies	77 RIL progenies
No of	2	2	2

Replication									
Characters	Average	Min	Max	Average	Min	Max	**Average**	**Min**	**Max**
Plant height	121.0	58.0	174.0	103.9	65.0	149.0	105.0	72.0	136.0
No. of Monopodia	1.4	0.0	3.0	0.7	0.0	2.0	0.7	0.0	2.0
No. of Sympodia	17.0	10.0	27.0	17.0	0.0	23.0	16.0	10.0	26.0
No of bolls/ plant	40.0	6.0	43.0	24.5	6.7	66.0	25.0	12.0	56.0
Boll wt	2.7	1.2	3.2	3.7	1.7	5.3	3.5	1.7	4.5
GOT%	42.0	22.0	50.0	34.1	17.0	44.0	40.4	20.0	49.0
Seed Cotton Yield	76.8	27.5	182.7	94.1	30.8	167.8	92.3	29.3	246.3
UHML (mm)	26.9	22.6	33.4	29.3	26.1	34.3	27.2	22.2	30.9
Uniformity Index	81.0	78.0	84.0	82.6	81.0	84.0	81.3	77.0	84.0
MIC ug/inch	5.0	4.5	5.6	3.8	2.9	4.4	4.3	5.0	4.3
Bundle Strength	27.3	25.1	30.8	29.0	25.5	33.4	28.7	22.6	35.6
EL %	6.6	6.6	6.8	6.2	5.9	6.6	6.1	6.0	6.4

4.4 Project Name: An efficient regeneration system for transformation studies with *CICRcry2Ab1Ac* and fiber strength genes in Cotton (*G. hirsutum*).

Dr.G. Balasubramani (PI); Co-PIs- Dr. J. Amudha, Dr. K. P Raghavendra, Dr. N. Chandrashekar

Importance of the study: Pests and diseases are major constraints in cotton production. Development of broad-based resistance against a wide spectrum of pests and diseases and improvement of quality traits is of paramount significance.

Salient findings

Agrobacterium-mediated genetic transformation of *G.hirsutum* Coker 312 with *CICR- cry2Ab1Ac::chitinase* gene constructs and regeneration through somatic embryogenesis resulted in 17 putative transgenic plants (Fig. 4.4.1 & 4.4.2). Screening of putative plants for expression of Cry1Ac & Cry2Ab through ELISA found no detectable expression of Cry protein. However, the four plants out of 17 were positive for *npt*-II and *chitinase* gene with PCR analysis using genes specific primers. Concurrently, transformation was carried out to generate more number of events with *CICR- cry2Ab1Ac::chitinase* gene.

Fig. 4.4.1. Putative transformants in MS selection medium

Fig. 4.4.2 Established putative plants in soilrite condition

4.5 Project Name: Unveiling the potential of cotton WNT-like gene in somatic embryogenesis through genetic engineering

Dr. Chandrashekar, N (PI)

Importance of the study: Characterization of *WNT*-like gene/s in plants and functional validation may leads to unveiling their potential role in somatic embryogenesis of cotton. Such an attempt of basic research not only aids for the generation of reproducible somatic embryogenesis protocol but also may create clues for the signaling cascades of *WNT*-like pathways to uncover other upstream or downstream players in plants.

Salient findings *Agrobacterium* mediated transformation of Suraj hypocotyls was performed with *wnt 3A*::pBI121 gene cassette and putative transgenic callus cultures harboring *wnt3A*::pBI121 gene cassette were established. Transformation of these callus cultures were confirmed through GUS histo-chemical assay. Further, to establish molecular basis of transformation in Suraj genotype, genomic DNA isolated from putative transgenic callus cultures were subjected for polymerase chain reaction using Wnt3A forward:: GUS reverse, Wnt 3A internal forward:: GUS reverse and M13 forward::M13 reverse primer pairs with amplicon sizes of 2614bp, 1425bp and 4590bp respectively (Fig. 4.5.1). Molecular characterization of putative transgenic callus cultures through PCR analysis using combination of gene and vector backbone primers and with proper controls confirms that the Suraj genotype is amenable for transformation.

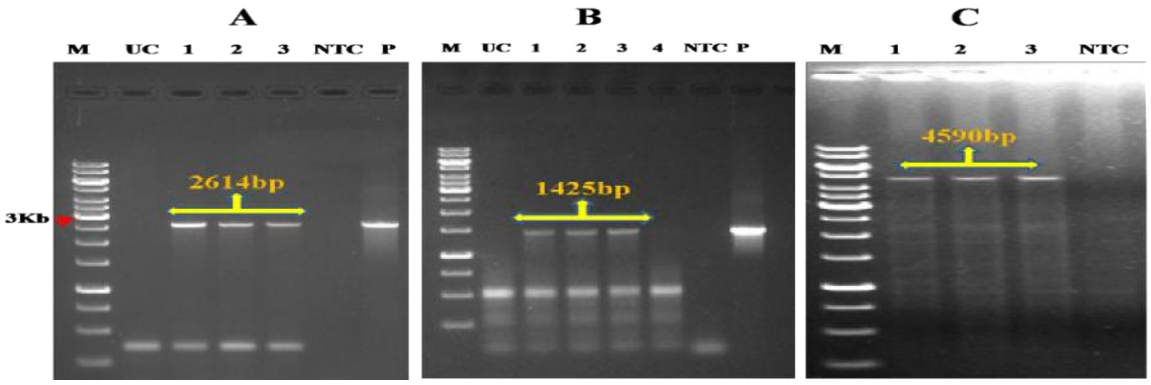


Fig. 4.5.1: Molecular confirmation of putative transgenic callus of *Gossypium hirsutum* Cv Suraj for the presence of *wnt 3A* gene cassette

Note: M: 1Kb Marker, UC: Untransformed callus, 1-4: Putative transgenic callus, NTC: Non template control and P: Recombinant pBI121 plasmid harboring *wnt3A* gene cassette.

Theme 5: Documentation of genetic diversity of cotton insect pests, parasitoids, predators, pathogens and economically important microbial populations in cotton

5.1 Project Name: DST-SERB-EMR: Pink bollworm, *Pectinophora gossypiella* (Saunders): Resistance monitoring, fitness costs, inheritance of resistance to Cry toxins expressed in Bt cotton

Dr V. Chinna Babu Naik (PI)

Importance of the study: Resistance of pink boll worms to Cry toxins had threatened the efficacy of genetically modified Bt cotton. Sound understanding of the extent, mechanisms and genetic basis of resistance to Bt toxins is needed to monitor the buildup of and counter the pest resistance with alternate strategies.

Salient findings

Thirty six and forty two populations of pink bollworm were subjected to bioassays against Cry1Ac and Cry2Ab toxins, respectively for resistance monitoring studies. In the populations from Barwani, Yadgir, Khandwa, Dhar, Aurangabad, Guntur and Kurnool resistance to Cry1Ac over susceptible check were: 120, 123, 138, 165, 170, 185 and 423 fold respectively. Similarly, the folds of resistance to Cry2Ab over susceptible check were: 359, 525, 536, 578, 645, 751, 798, 889, 947, 1428, 2080 and 3737 for Parbhani, Guntur, Barwani, Bellary, Yadgir, Amreli, Khadwa, Aurangabad, Vadodara, Jind, Jalgaon and Kurnool, respectively.

Emergence of parasitoid from dead larvae of pink bollworm (2020-2021):

Pink bollworm infested green bolls were collected from different cotton growing districts of India and these bolls were dissected for pink bollworm larval recovery. The dead larvae were kept for the emergence of parasitoid. Higher parasitization by *Apanteles angaleti* was observed in the samples collected from Amreli, Bhavngar and Jalgaon.

5.2 Project Name: "Genetic diversity in geographical population of pink bollworm *Pectinophora gossypiella* (Saunders) in India"

Dr V. Chinna Babu Naik (PI)

Importance of the study: Pink boll worm populations of south and central zones of India have developed resistance to Cry1Ac and Cry2Ab toxins. Analysis of genetic diversity will improve our understanding of the level of adaptation of a population to environmental conditions and their susceptibility to selection pressure.

Salient findings

Endosymbiotic gut microbiota in pink bollworm populations collected from 12 different districts of India were studied. Populations of pink bollworm were surveyed for infections with various bacterial gut microbes (endosymbionts) that may influence their biology and their interaction with other organisms or the environment. The larval stage of pink bollworm was used for DNA isolation . Endosymbionts in insects were studied based on PCR, cloning, sequencing, and BLAST analyses in NCBI for bacterial 16S rRNA genes. We have identified *Burkholderia* strains as endosymbionts which were further confirmed by using *Burkholderia* specific primer. In some of the sequences *Pluralibacter* strain, *Gergoviae* strain, *Enterobacter* sp. and *Citrobacteryoungae* strains were also found as a core community in insect larvae.

Confirmation of strain was done by ordering *Burkholderia cepacia* (Collection Acc. No. 8719) from catalogue of microbial culture collection laboratory, Chandigarh used as positive control for colony PCR with *Burkholderia* specific primer gyrB forward primer 5′ACCGGTCTGCAYCACCTCGT3′ and reverse primer 5′YTCGTTGWARCTGTCGTTCC ACTGC3′ having annealing temperature of 60°C and amplicon size of 738 base pairs (Fig. 5.2.1).

Analysis was performed for genetic diversity among different populations of pink bollworm using internal transcribed spacer (ITS) region of the ribosomal DNA (rDNA) with the ITS primers (ITS 5 and ITS 4). Twenty nine haplotypes (from Pb_H1 to Pb_H29) were identified in a survey of 38 sequences of PBW from 21 different cotton growing geographical locations all over India. The trimmed sequences were deposited in NCBI gene bank with accession numbers (MT273892-MT273929). The most common haplotype was Pb_H1 which was shared by nine populations and Pb_H3 shared with two populations while other 27 haplotypes were found as unique. Distributions of pair wise differences obtained with ITS gene data from the overall Indian populations are slightly multimodal. Rejection of neutrality test Tajima' D and Fu's Fs with significant negative values supported the theory of demographic expansion and indicated that the population of *Pectinophora gossypiella* underwent rapid expansion (Fig. 5.2.2).

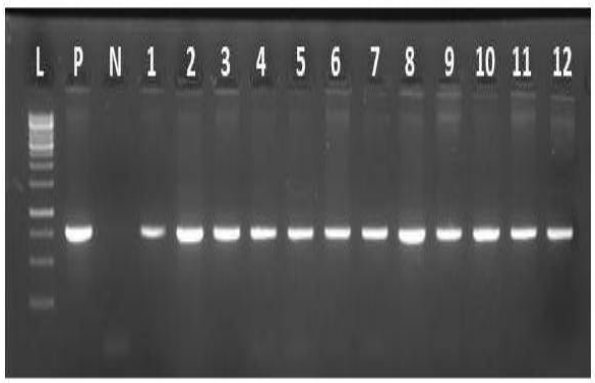


Fig. 5.2.1: Conformation of *Burkholderia sp.* bacteria by species specific primerswith colony PCR for gyrB by amplification at 738bp. L-Ladder (1kb) P- Positive control, N-Negative control, Colonies from different districts 1-12.

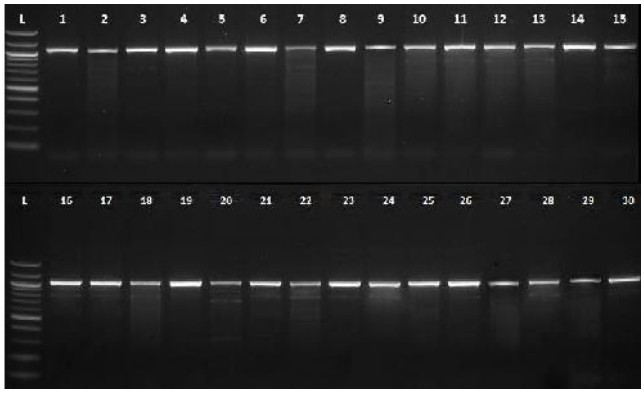


Fig. 5.2.2: DNA of P*ectinophora gossypiella* was amplified with primer pair ITS5 and ITS4 by amplification at 1100bp. L:100bp ladder; lanes 1-30: PCR products

5.3 Project Name: Studies on prevalence of *Xanthomonas* citri pv. *malvacearum* races of cotton and breeding for BLB resistant varieties

Dr. S.P. Gawande (PI), Co-PIs- Dr. V.N. Waghmare, Dr. D.T. Nagrale, Dr. N.S. Hiremani, Dr. S.K. Sain and Dr. Sampathkumar A.

Importance of the study: This study aimed to determine morphometric, biochemical and genetic status of *Xanthomonas* isolates obtained from cotton plants in India. Besides it was also aimed to identify races of the pathogen and to assess the genetic diversity within the pathogen population and to develop BLB resistant variety through marker assisted selection.

Salient findings

- ✓ Collected the isolates of BLB from North, Central and South cotton growing zones of India and biochemical characterization was carried out.
- ✓ Molecular characterization by using SSR and ISSR markers is in progress
- ✓ Race profiling by using 10 differential hosts is being carried out in glass house condition (Fig. 5.3.1 and 5.3.2).
- ✓ Selected, screened and grouped 56 BC4-F_2 and 38 BC5-F_1 BLB resistant plants by marker assisted selection (Through CIR-246 marker) and artificial inoculation of BLB resistant plants (Fig. 5.3.3).

Fig. 5.3.1: Identification of Xcm races by host differentials

Fig. 5.3.2: Oily sunken spots on BLB infected bolls of Cotton

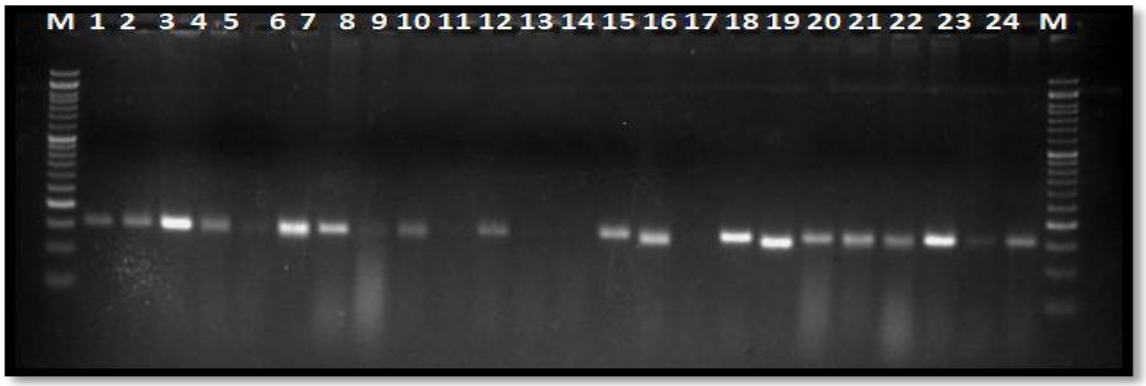


Fig. 5.3.3: Screening and selection of BLB resistant plants by marker assisted selection

5.4 Project Name: Identification of endophytes from cotton with special reference to *desi* cotton and evaluation of biocontrol activity against major diseases

Dr Neelakanth S. Hiremani (PI) ; Co-PIs- Dr S.P. Gawande, Dr Pooja Verma, Dr S.K. Sain

Importance of the study: Endophytes as biological control agents are being widely used nowadays and there is lot of scope to unravel their potential in many of the crops including cotton. This study aims to identify fungal endophytes from cotton and to utilize them as potential biocontrol agents against cotton diseases.

Nine potential endophytes were selected for *in vivo* evaluation and screened against cotton diseases in small pots. Pathogenicity of endophytes *Diaporthe longicolla* (CEL 41, CEL 48), *Daldinia eschscholtzii* (M_1-4) was tested on cotton cultivars viz., Suraj and Phule dhanwantary and none of them was found pathogenic. Cross pathogenicity of endophyte *Daldinia eschscholtzii* (M_1-4) was tested on wheat, sorghum, red gram, soybean, cowpea and brinjal (Fig.5.4.1). No symptoms or abnormality was seen in treated

plants. These endophytes will be further tested for their bio-efficacy against major pathogens.

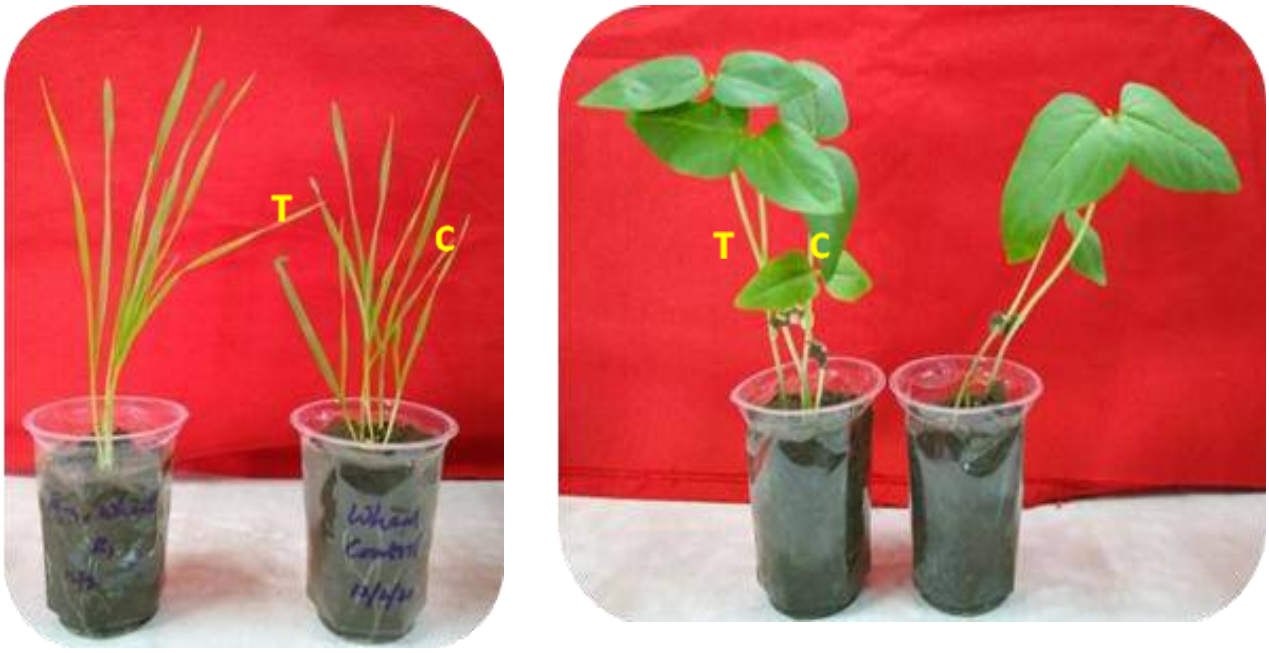


Fig.5.4.1: Cross-pathogenicity test of endophytic *Daldinia eschscholtzii* (M_1-4) on wheat (left) and cowpea (right) plants. T= treated with M_1-4 and C= control

5.5 Project Name: Main Project: Prevalence, distribution and integrated management of emerging diseases and plant parasitic nematodes of cotton

5.5.1 Sub Project A: Studies on inner boll rot of cotton caused by *Pantoea* spp. and other pathogens

Dr Dipak T. Nagrale (PI), Co-PI -Dr Babasaheb B. Fand

Importance of the study: Boll rot disease is emerging in recent years, as a major challenge to cotton production. Boll rot is an important disease because it not only reduces the yield but also affects the quality of lint and seed. Very less is known about this newly emerging disease with respect to its epidemiology and management, therefore present study will address all these issues for developing holistic management strategies.

Salient findings

- ✓ Survey, collection and symptomatological studies of boll rot samples from different cotton growing states of India *viz.*, Maharashtra, Telangana and Madhya Pradesh.
- ✓ Isolations and purification of 28 bacterial isolates causing inner boll rot and 9 distinct fungal isolates causing external boll rot were done using nutrient agar and potato dextrose agar media
- ✓ Fungal isolates were purified on SDA medium PetriplatesMorphological, biochemical and molecular characterization of isolates and evaluation of their pathogenicity are in progress (Fig. 5.5.1.1)

Fig. 5.5.1.1. Symptomatology, morphological characterization and isolation of boll rot pathogens

5.5.2 Sub project B: Studies on target leaf spot of cotton caused by *Corynespora cassiicola*

Dr. S.P. Gawande (PI), Co-PIs - Dr. S.K. Sain and Dr. N. Chandrashekhar

Importance of the study: Present investigation proposed to study target leaf spot of cotton, an emerging disease to facilitate formulation of location specific management. The project aims to generate extensive information on disease onset, diversity and distribution across Indian cotton growing areas to understand disease development and its potential impact on cotton yield.

- ✓ Collected 35 samples resembling target leaf spot symptoms from different cotton growing districts of Maharashtra, Gujrat Telangana, Andhra Pradesh, Rajasthan and Haryana states.
- ✓ Isolation of collected disease samples on PDA (**Fig. 5.5.2.1**)
- ✓ Pathogenicity of isolates on identified susceptible cotton (*G. hirsutum*) cultivar PKV-081 Morphological and molecular characterization by ITS sequencing of collected isolates is in progress (**Fig. 5.5.2.2**).
- ✓ In vitro efficacy of label claim fungicides is being studied.

Salient findings

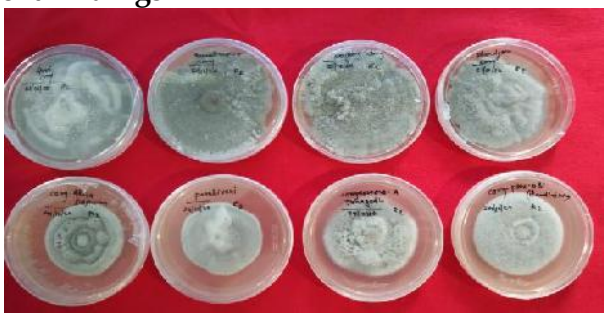


Fig. 5.5.2.1 Growth of *Corynespora cassicola* fungal isolates on potato dextrose agar medium collected from different cotton growing zones of India.

Fig. 5.5.2.2 Symptoms of target leaf spot on leaf and bract of cotton (*G. hirsutum*).

5.5.3 Sub project C: Studies on grey mildew disease of cotton caused by *Ramularia areola*

Name of PI & Co-PIs: Dr Neelakanth S Hiremani (PI) Co-PI- Dr P Valarmathi

Importance of the study: Grey mildew disease was first reported on upland cotton, and later it has spread to all the cultivated cotton species. The constant shift in this disease over the years may be due to the variability existing among the pathogen. These studies were taken up as there is very limited information available on the pathogenic and genetic variability of *R. areola* making it difficult to manage the disease either through resistant cultivars or through fungicides.

Grey mildew disease samples were collected from Wardha, Yavatmal, Nagpur and Chandrapur districts of Maharashtra state and Adilabad district of Telangana state (**Fig. 5.5.3.1**). For the isolation of pathogen, different growth media like Richard's agar, Kirchoff's agar, leaf decoction agar, Coon's agar, *etc* were utilized and are being standardized for the growth and sporulation of *R. areola*. The growth of *R. areola* in all the media tested was found to be slow and no sporulation was seen even after 30 days of incubation period.

Fig. 5.5.3.1 Symptoms of grey mildew disease on *G. hirsutum* (left) and *G. arboreum* (right)

5.6 Project Name: Diversity, ecology and improvement of eco-compatible management of thrips in cotton ecosystem.

Dr M. Amutha (PI); Co-PIs - Dr K. Sankaranarayanan, Dr S. P. Gawande, Dr Rishi Kumar

Importance of the study: Thrips have emerged as important sucking pests of cotton. The project aims to generate the information on pest status, population dynamics, and insecticide resistance in thrips for development of ecofriendly and sustainable management strategies.

Salient findings

Cotton grown with different intercrops *viz*., marigold, vegetable cowpea, onion, french bean and groundnut was evaluated against thrips. The results revealed that, all the intercropping systems significantly reduced the thrips population compared to sole cotton crop. Cotton + marigold intercropping system had the lowest mean number of thrips. The order of efficacy of intercropping system in management of thrips were as follows, Cotton + marigold >cotton + ground nut > cotton+ onion ~ cotton + vegetable cowpea > cotton + French bean (Table 5.6.1) . The study suggested that Bt cotton intercropped with onion followed by vegetable cowpea was most profitable.

ii. Evaluation of different group of insecticides, biopesticides and essential oils against thrips in cotton

Different insecticides (10), biopesticides (3) and essential oils (5) were evaluated against thrips under field condition. The order of efficacy of insecticides were as follows spinoteram> fipronil > flonicamid > clothianidin >thiacloprid >thiamethoxam >diafenthiuron> imidacloprid > profenophos>buprofezin. Among biopesticides, *Metarhizium anisopliae*and among botanical oils, neem oil followed by castor oil recorded higher efficacy against thrips.

Table 5.6.1: Effect of intercrops on the incidence of thrips in cotton

Cropping system	Mean population (Three years)		
	Thrips in cotton (Nos./Leaf)	Thrips in intercrop (Nos./Leaf)	Predators (Nos./Plant)
T1- Bt cotton	10.27±0.46	-	1.57±0.30
T2- Bt cotton+ marigold	7.59±0.38	3.58±0.48	1.56±0.30
T3- Bt cotton+ vegetable cowpea	7.93±0.41	8.48±0.53	1.84±0.29
T4- Bt cotton+ French bean	8.09±0.40	4.27±0.53	1.72±0.32
T5- Bt cotton+ small onion	7.94±0.40	9.05±0.52	1.64±0.29
T6- Bt cotton+ groundnut	7.88±0.39	8.96±0.53	1.65±0.31
S.E. (d)	0.031	0.050	0.008
C.D. (5%)	0.067	0.111	0.017

5.7 Project Name: Studies on symptom expression, host range, transmission and spread of Tobacco streak virus (TSV) infecting cotton

Dr. P.Valarmathi (PI), Co-PIs - Dr. M. Amutha, Dr. S. P. Gawande, Dr. S. K. Sain

Importance of the study: Tobacco streak virus has emerged as important disease in cotton growing areas. The studies aimed at investigations on symptom expression, host range and transmission of TSV infecting cotton.

Salient findings

The different plant parts used for TSV detection include root, stem, petiole, leaf, squares and pollen grains. It was observed that the absorbance value was more in leaf followed by petiole and squares **(Table 5.7.1).** Among the germplasm, ICB 38 was found to be with more absorbance value for leaf 3.332 (0.09), petiole 2.195 (0.08), squares 2.352 (0.05), stem 1.678 (0.08), root 1.206 (0.08) and pollen grains 1.119 (0.05). Among the germplasm, next higher absorbance value was observed in ICB 36 and 37. In the control (Suvin), the absorbance values observed were as follows with leaf 3.865 (0.09), petiole 2.285 (0.08), squares 2.221 (0.04), stem 1.880 (0.05), root 1.238 (0.05) and pollen grains 1.118 (0.08). Hence DAS-ELISA can be used for the detection of TSV in different plant parts of cotton.

Table 5.7.1: Serological detection of TSV in the different plant parts of germplasm of *Gossypium barbadense* by DAS-ELISA {A405nm (1 h)}

S. No	Germplasm	Leaf	Petiole	Squares
1.	ICB 38	3.332 (0.09)	2.195 (0.08)	2.352 (0.05)
2.	ICB 36, ICB 37	3.878 (0.09)	2.189 (0.08)	2.226 (0.04)

3.	ICB 1	3.235 (0.09)	2.145 (0.08)	2.119 (0.03)
4.	ICB 2	2.124 (0.05)	2.114 (0.05)	2.113 (0.09)
5.	ICB 3	3.131 (0.04)	2.125 (0.02)	2.118 (0.05)
6.	ICB 4	2.521 (0.03)	2.142 (0.06)	2.119 (0.08)
7.	ICB 6, ICB 11	2.124 (0.09)	2.365 (0.08)	2.002 (0.02)
8.	ICB 13, ICB 16	2.312 (0.09)	2.114 (0.07)	2.006 (0.04)
9.	ICB 18, ICB 23	2.325 (0.09)	2.045 (0.07)	2.007 (0.05)
10.	ICB 24	2.452 (0.08)	2.140 (0.08)	2.008 (0.06)

5.8 Project Name: Molecular characterization, virulence and genetic diversity analysis of *Alternaria* leaf spot disease of cotton

Dr A. Sampathkumar (PI)

Importance of the study: *Alternaria* leaf spot causes 20-30% seed cotton yield loss in India. Under favourable environmental conditions *Alternaria* leaf spot can cause yield losses up to 26.59- 38.23%. It is mainly caused by two *Alternaria* species *viz. A. macrospora* and *A. alternata.* Morphological and molecular characterization of isolates from south zone will precisely identify the predominant species prevailing in the area along with genetic diversity among the isolates. Molecular characterization will help to identify highly virulent isolates by correlating it with virulence of the isolates.

Salient findings

Pathogenicity and virulence characterization of *Alternaria* isolates:

- One hundred and fortyone *Alternaria* leaf spot samples were collected from the cotton growing states of India *viz*., Telangana, Andhra Pradesh, Karnataka, Tamil Nadu, Maharashtra and Gujarat.
- Out of these, one hundred and six isolates of *Alternaria* pathogen were isolated through tissue segment method using PDA medium. Based on the cultural, morphological and conidial characters, the isolates were identified as genus *Alternaria*.
- Pathogenicity and virulence characterization of *Alternaria* isolates were performed on susceptible genotype LRA 5166 under glasshouse conditions.
- The isolates were mass multiplied using potato dextrose broth for 10 days. The mass multiplied pathogen (conidia and mycelia bits) was spray inoculated on one-month old LRA 5166 seedlings and plants were covered with poly bag for 24 hours to create humidity to facilitate the entry of the pathogen.
- Mild pinpricking of leaves was performed before inoculation of the pathogen. Symptom expression was started 9 days after inoculation and maximum at 30 days after inoculation showing variation in virulence among the isolates.
- Initially water soaked lesions were appeared on upper surface of leaves. Later the lesions were expanded in size and produced circular to irregular spots with greyish center surrounded by dark brown rings or yellow halo. All the isolates were pathogenic to cotton.

Results revealed that Telangana isolates were more virulent (7 to 54 PDI) followed by Karnataka (15 to 45 PDI), Andhra Pradesh (11 to 37 PDI), Tamil Nadu (4 to 17 PDI) (**Fig. 5.8.1)**.

Cotton (LRA 5166) seedlings raised in pots

Cotton (LRA 5166) seedlings raised in pots

Polybag covering after spray inoculation of pathogen

Initiation of symptom expression 9 days after pathogen inoculation

Initiation of symptom expression 9 days after pathogen inoculation

Severe leaf spot symptoms observed 25 days after pathogen inoculation

Petiole blight symptoms observed 30 days after pathogen inoculation

Leaf blight symptoms observed 30 days after pathogen inoculation

Fig. 5.8.1 Pathogenicity and virulence characterization of *Alternaria* isolates

5.9 Project Name: Studies on plant parasitic nematodes of cotton

Dr. J. Gulsar Banu (PI) Co-PI -Dr. Nandini Gokte-Narkhedkar

Importance of the study: Plant parasitic nematodes belonging to 22 species are reported to be associated with cotton in India. In recent years involvement of plant parasitic nematodes in cotton malady has been reported specially in irrigated cotton. This project was initiated to investigate role of nematodes as biotic limiting factors especially in irrigated cotton and formulating sustainable strategy for nematode management.

Salient findings

- For the first time the natural infection of reniform nematode eggs by nematode antagonistic fungus, *Pochonia chlamydosporia* was reported from India. This fungus is able to parasitize more than 75% of root-knot and reniform nematode eggs and causes 100% mortality of juveniles.
- Standardized mass production protocol for *P. chlamydosporia* under *in vitro* condition. A maximum of 6.9 x 10^6 chlamydospores/gm of rice grains was produced at 30 days after inoculation.
- Two new nematode antagonistic fungi were isolated from the rhizosphere of cotton. Morphological and molecular characterization and DNA barcoding of different isolates collected from cotton and other crops are being carried out.
- Life table study of reniform nematode at different temperatures indicated that 25-35^{o}C is favourable for multiplication.
- Comparison of life cycle of reniform nematode on tolerant cultivar indicated that the reduction in penetration, longer life cycle duration and malformation of adult and decrease in egg mass and number of eggs per egg mass was recorded.
- Two nematode antagonistic fungi were isolated from soil samples.

Plant products are being tested against reniform nematode under *in vitro* condition.

5.10 Project name: Whitefly: Studies on ecology and host plant resistance

Dr. Rishi Kumar (PI), Co-PIs- Dr. S.K. Sain, Mr. T. Prabhulinga

Importance of the study: Data on life table analysis of whitefly, *Bemisia tabaci* (Gennadius) in cotton ecosystem, host plant preferences among available cotton genotypes and susceptibility status to commonly used and label claimed insecticides required to be evaluated for IPM in cotton

Salient findings

- Insecticide resistance monitoring bioassays conducted against commonly used and label claimed insecticides indicated maximum mortality due to pyriproxyfen (64.00%) followed by dinotefuran (61.33%), buprofezin (58.67%), spiromesifen (57.33%), ethion (49.33%), diafenthiuron (48.00%) in whitefly red eyed nymphs (Fig. 5.10.1).
- Life table analysis for egg stage indicated dislodgement & predation, parasitization and nonviability of eggs as key mortality factors.
- Life history parameters of were compared on CLCuV infected and healthy cotton plants to determine the effect of virus on its vector. Whiteflies deposited fewer eggs on virus infected plants compared to healthy plants. The developmental time of whiteflies from egg to adulthood was reduced on CLCuV infected plants with shorter nymphal and pupal duration. Male and female whiteflies also had shorter longevity on CLCuV infected plants compared with healthy plants (Fig. 5.10.2).
- Ninety one exotic and indigenous germplasm lines and released cultures of *G. hirsutum* cotton were screened against whitefly under field and laboratory conditions. The settling preference was also studied under choice conditions.

Fig. 5.10.1. Whitefly nymphal bioassay

Fig. 5.10.2. Whitefly biology on healthy and CLCuV infected host

Seasonal dynamics of insect pests

Peak activity of whitefly was recorded during 36th-38th SMW in all genotypes (Fig. 5.10.3 and 5.10.4), thrips during 31st SMW whereas leafhopper peak activity was observed between in 32nd and 33rd SMW

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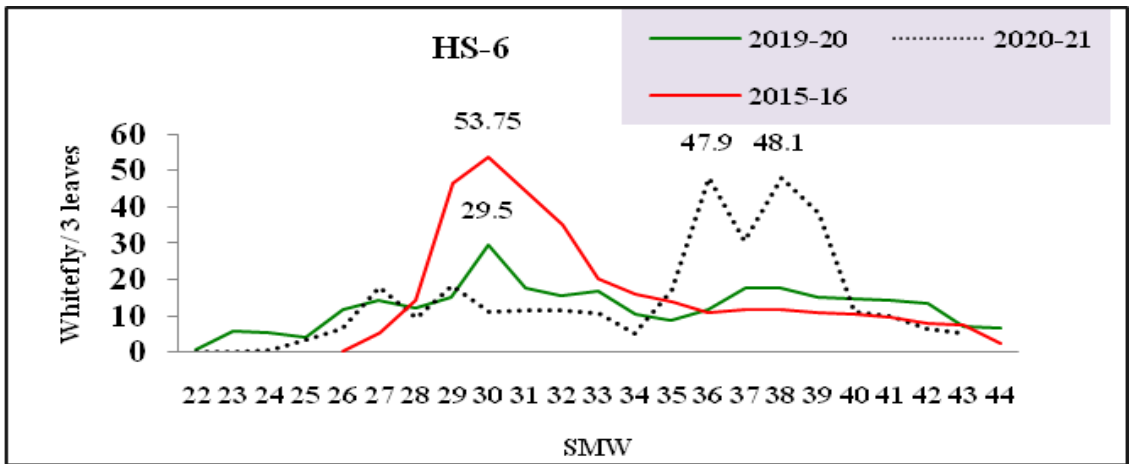


Fig. 5.10.3 : Seasonal dynamics of whitefly on non-Bt cotton, cultivar HS-6

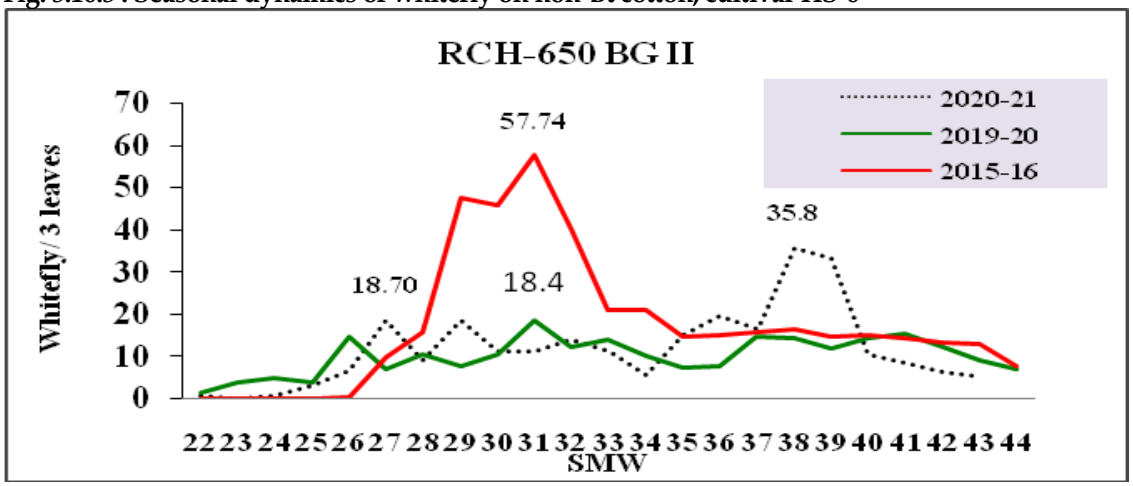


Fig. 5.10.4 : Seasonal dynamics of whitefly on Bt cotton, cultivar RCH-650

Monitoring of pink bollworm incidence in North Zone

- In case of pink bollworm 4.0-22.0 percent larval recovery from green bolls of non-Bt cotton at 160 DAS was recorded.
- In BG-II cotton, though no larval recovery was recorded in North zone locations but at few locations like Jind (Haryana) and Bathinda (Punjab) larval recovery from BG-II cotton was also recorded adjoining to ginneries during 2018-19, 2019-20 and 2020-21. In 2020-21 damage away from ginning and oil extraction mills in BG-II cotton has also been recorded in Hisar (Haryana)

Table 5.10.1. Pink bollworm larval recovery (%) from green bolls in non-Bt cotton

Locations	Larval recovery (%) from green bolls in non-Bt cotton				
	2016-17	2017-18	2018-19	2019-20	2020-21
Bathinda, Punjab	17.7	7.1	5.0-11.3	10.0-31.0	6.0-22.0
Faridkot, Punjab	18.0	8.2	6.0-8.3	4.0-8.0	4.0-8.6
Sri Ganganagar, Rajasthan	22.5	7.6	6.0-6.3	6.0-14.0	4.0-14.0
ICAR-CICR, RS, Sirsa, Haryana	13.6	6.9	4.7-6.7	4.0-16.0	4.0-12.0
HAU, Hisar, Haryana	18.6	9.6	6.3-8.7	4.0-14	5.6-14.0

Mortality of *Helicoverpa armigera* on Bt-cotton hybrids and varieties

Bioassays were conducted under laboratory conditions against *H. armigera* in Bt cotton hybrids and varietal trials of 2020-21. The leaf bioassays conducted at 60, 80, 100, 120 and 140 DAS recorded 100% mortality in case of hybrid after 7 days of larval exposure. In case of square, flower, and boll bioassays of Bt hybrids mortality recorded was 100% at 80-100 days after sowing. In laboratory leaf bioassay of Bt varieties, the mortality ranged between 53.33-100.00% whereas in squares, flowers and bolls the mortality ranged between 66.67-100 % after 7 days of larval exposure.

Efficacy of insecticides against pink bollworm under laboratory conditions through diet incorporation method during 2020-21: Bioassay against pink bollworm on different insecticides belonging to synthetic pyrethroid, diamide, carbamate, organophosphate and bio-insecticide groups through diet incorporation method was conducted under laboratory conditions. The highest mortality was recorded in profenophos 50 EC (82.91%) followed by thiodicarb 75 WP and spinosad 45 SC after 7 days of treatment. Among synthetic pyrethroid the highest mortality was recorded in bifenthrin 10 EC followed by cypermethrin 25 EC at label claim dosages.

Theme 6: Consolidating ecologically compatible and sustainable insect pest management strategies for conventional, transgenic and organic cotton

6.1 Project Name: Investigations on bioefficacy of entomopathogens against cotton pink bollworm, *Pectinophora gossypiella* (Saunders)

Name of PI & Co-PIs: Dr. V. S. Nagrare (PI), CO-PIs - Dr. Chinna Babu Naik, Dr. S.P. Gawande, Dr. Dipak T. Nagrale, Dr. K. Velmourougane , Dr. J. Gulzar Banu

Importance of the study: In recent years, he pink bollworm (PBW), *Pectinophora gossypiella* (Saunders) has re-emerged as a serious pest of cotton in India. The chemical control for PBW is very difficult as the larvae are internal feeders live inside the green bolls. Entomologists are exploring the possibility of using entomopathogens as biological control agents, and the researchers are working towards possible expoitation of entomopathogens (bacteria, fungi, virus, EPN and protozoa) for the control of many insect pests. The project aims to explore potential of entomopathogens for management of pink bollworm in field conditions.

Salient findings

Efficacy of entomopathogens against pink bollworm under field conditions

Biopesticides *viz*., *Beauveria bassiana* (Source: Raichur, Dharwad, Rahuri), *Lecanicillium lecanii* (Source: Raichur, Rahuri), *Metarhizium anisopliae* (Source: Raichur, Dharwad, Rahuri), HaNPV (Source: Rahuri), SlNPV (Source: Rahuri), Neem oil along with chlorpyriphos 20EC as control were evaluated under field conditions.

Characterization of entomopathogens associated with larval infections of *P. gossypiella* collected from different geographic locations

- Isolations of entomopathogens were carried out from dead infected larvae of *P. gossypiella* collected from the different field locations.
- Isolated 12 bacterial and 10 fungal isolates from infected larvae.
- Bioassay studies are being carried to screen the isolates for their bioefficacy against *P. gossypiella* larvae.

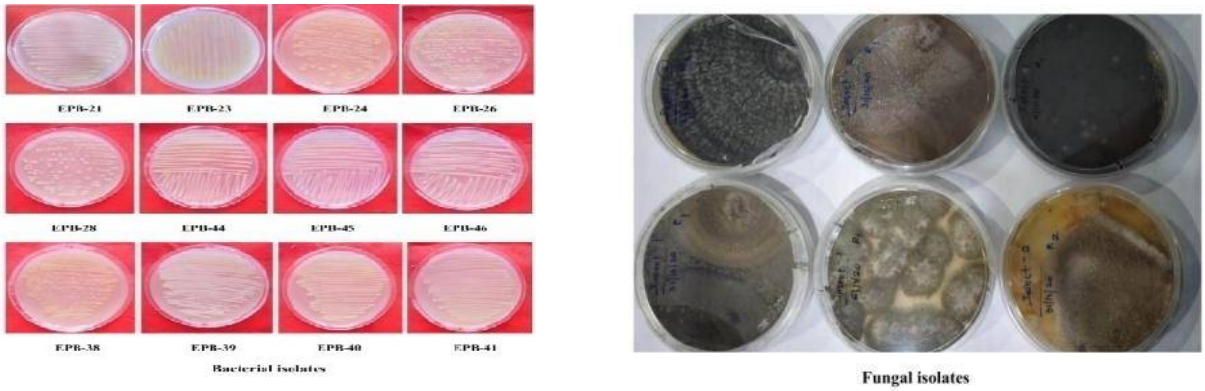


Fig. 6.1.1 Bacterial and fungal isolates obtained from dead larvae of pink bollworm

6.2 Project Name: Crop pest surveillance and advisory project (CROPSAP) in Maharashtra

Dr. V. S. Nagrare (PI)

Importance of the study: Government of Maharashtra has formulated and implemented an innovative project based on Information and Communication Technology (ICT) in the field of plant protection from 2009-10. It's an e-pest surveillance and advisory project. It has helped immensely to protect soybean, cotton, rice, tur and gram crops from pest damage. Consistent pest monitoring and adoption of appropriate pest management strategies at proper crop growth stages of the crop have been implemented. The work assigned to ICAR-CICR was i) to formulate IPM strategies for cotton, ii) to develop pest specific advisory capsules, iii) to visit hot-spots for guidance to farmers and field functionaries and iv) to get feedback for future research and developing IPM Strategies.

Salient findings

- Disseminated cotton pest management strategies through ICT tools
- Updated pest management strategies for target pests, monitored online pest situation through real time pest data uploaded on website.
- Analyzed pest situation weekly and issued advisory accordingly.
- Provided technical guidance to Agri. Department on pest management aspects as and when required.
- Since 2017-18, played proactive role in devising and dissemination of pink bollworm management strategies along with action plan to be executed by the cotton production stakeholders.
- Created mass awareness among cotton production stakeholders through print and electronic media, talks, press notes, articles in newspaper and magazines, TV, Radio, literature etc.

Other research works carried out at the institute level under CROPSAP

Population dynamics of sucking pests

Population of sucking pests *viz.*, jassid, whitefly and thrips were slightly higher in number during initial period of season however, decreased over the season and below ETL (Fig 6.2.1). Aphid population started increasing from 44 SW (6-12 Nov) and peak was recorded at 46 SW (20-26 Nov) (Fig 6.2.2).

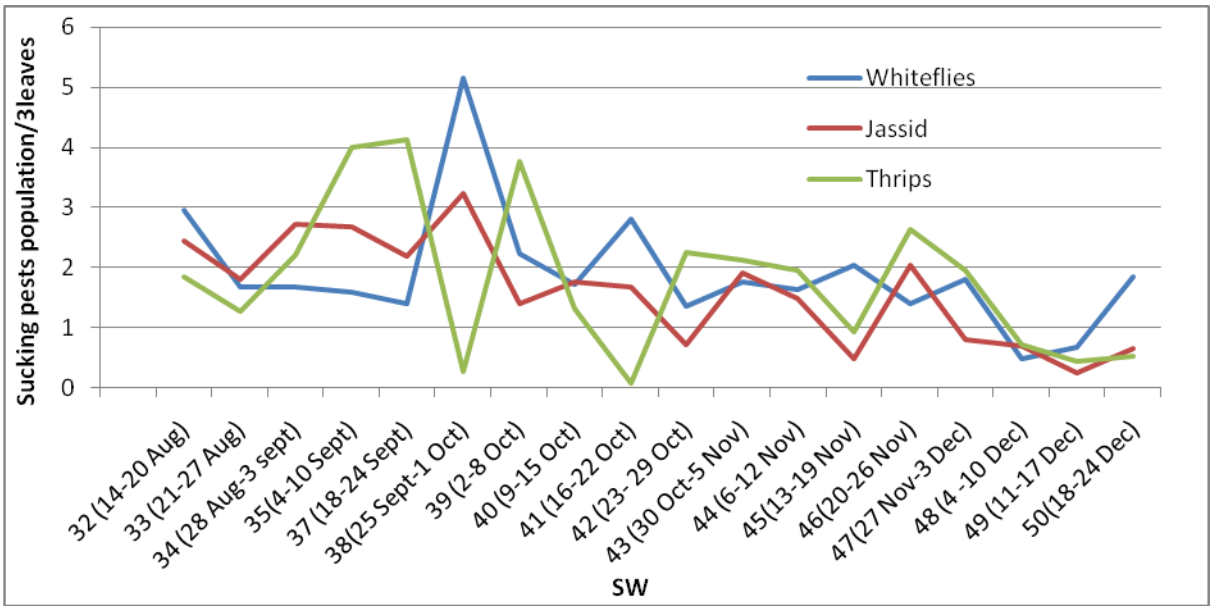


Fig.6.2.1: Population dynamics of sucking pests over the season in RCH 2 during 2020

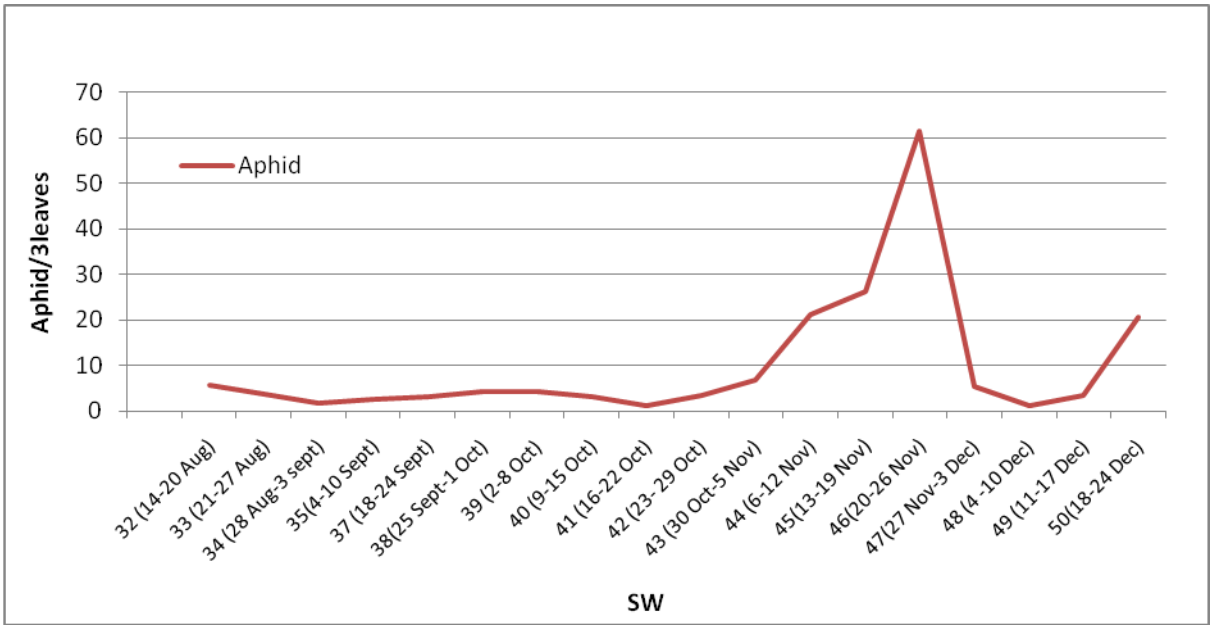


Fig.6.2.2: Population dynamics of aphid over the season in RCH 2 during 2020

Pink bollworm infestation in non-Bt and Bt cotton

In non Bt cotton (Suraj) pink bollworm infestation was recorded above ETL (>10% green boll infestation) starting from 37 SW (18-24 Sept) and subsequently remained above ETL till end of the season except during 39 SW (2-8 Oct) infestation ranged close to ETL (10% green boll infestation). While in Bt cotton (RCH 2 BGII) pink bollworm infestation started during 44 SW (6-12 Nov) and increased with the progress of season. Both Bt and non Bt cotton were found infested by pink bollworm with higher infestation recorded in non-Bt cotton. (Fig 6.2.3).

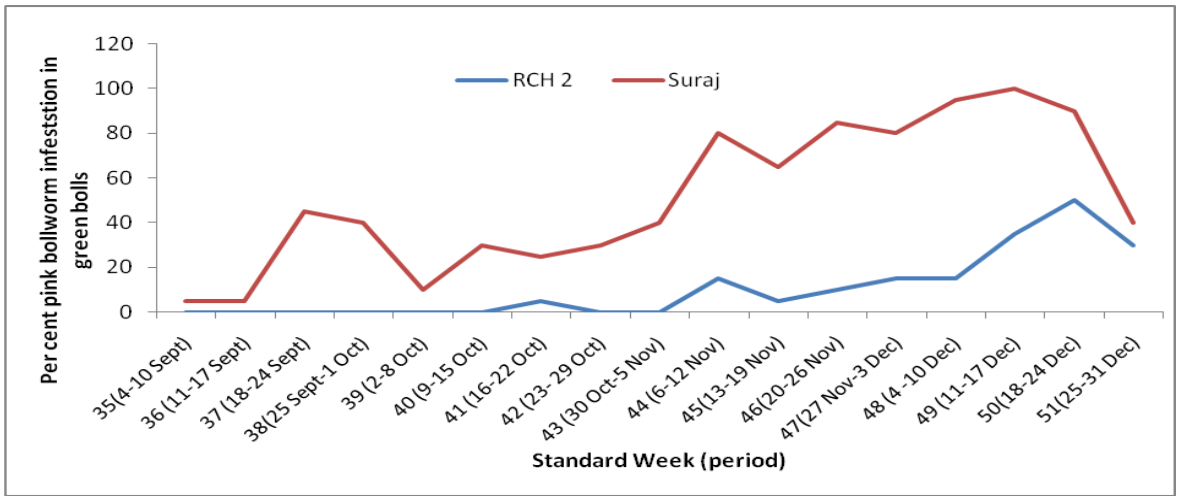


Fig 6.2.3: Pink bollworm infestation in Bt and non-Bt cotton during 2020

Pheromone trap catches

During 2020, moth catches of American bollworm and spotted bollworm were recorded to be negligible. Maximum moth catches (4 moths /trap/week) of American bollworm was recorded at 46 SW (20-26 Nov) while spotted bollworm moth catches were negligible (<1 moth /trap/week) over the season. Pink bollworm moth activity was seen starting from 38 SW (25 Sept-1 Oct) remained low till 42 SW (23- 29 Oct) and again started increasing from 43 SW (30 Oct-5 Nov), peak was recorded (45.6 moths/ trap/ week) at 48 SW (4 -10 Dec) and thereafter started decreasing. Though higher number of moth catches of tobacco caterpillar was recorded, however, infestation in the field was negligible (Fig 6.2.4).

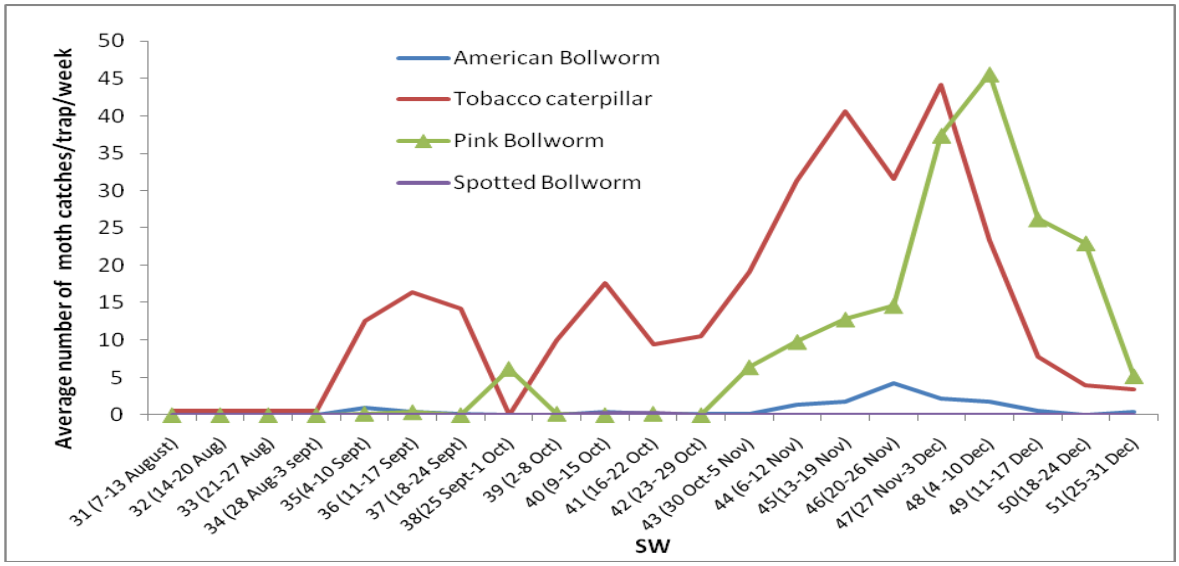


Fig 6.2.4: Pheromone trap catches during 2020 (Nagpur)

Yellow sticky trap catches

Jassid population was initially high (236 jassid/trap/week) on 35 SW (4-10 Sept), decreased with the progress of the season but again started increasing (298 Jassid/trap/week) at the end of the season 48 SW (4 -10 Dec). Populations of whitefly were fluctuated over the season, peak (219 whitefly/trap/week) was recorded at 49 SW (11-17 Dec) (Fig 6.2.5).

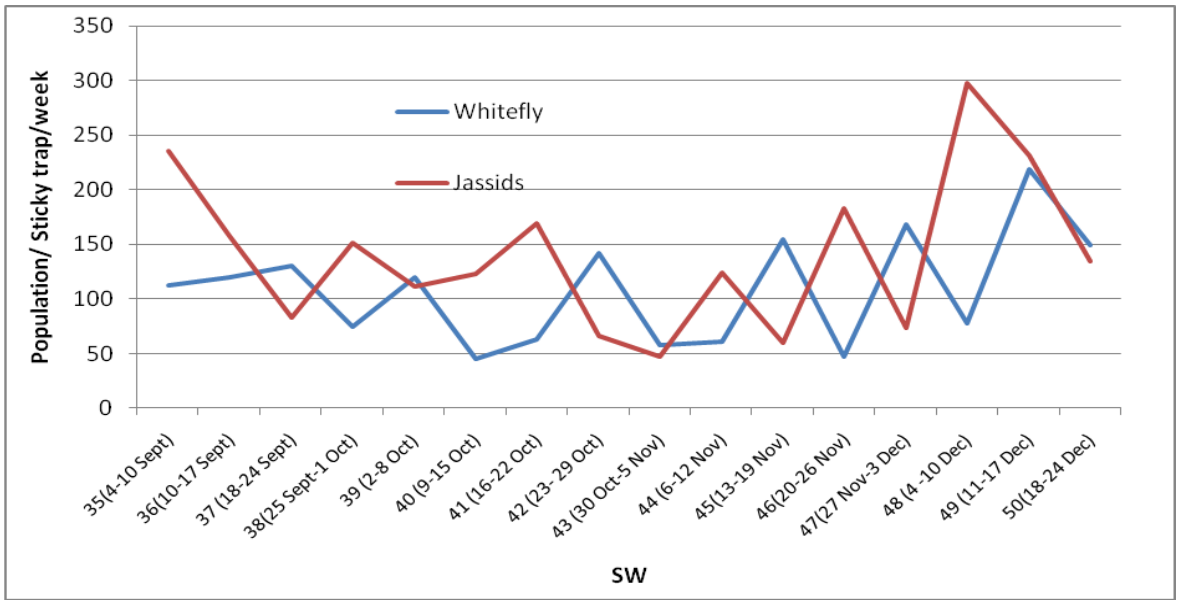


Fig 6.2.5: Sticky trap catches of Jassid and whitefly during 2020 (Nagpur)

6.3 Project Name: Insecticide resistance management: Dissemination of pink bollworm management strategies

Dr. V. S. Nagrare (PI), Co-PIs- Dr. V. Chinna Babu Naik, Dr. S.P. Gawande, Dr. S. M. Wasnik, Dr. B.B. Fand, Dr. D.T. Nagrale, Dr. S.S. Patil, Dr. K. Rameash, Dr. Rishi Kumar

Importance of the study: Pink bollworm, *Pectinophora gossypiella* (Saunders) has emerged as a serious threat to the cotton in all the three cotton growing regions of India. The project was approved during 2018-19, continued during 2019-20 and 2020-21 with the major objective of disseminating pink bollworm management strategies in Bt cotton in eight major cotton producing states (Maharashtra, Gujarat, Madhya Pradesh, Andhra Pradesh, Telangana, Karnataka, Tamil Nadu and Haryana). A project is funded by Department of Agriculture, Cooperation and Farmers' Welfare (Crops Division), Ministry of Agriculture and Farmers' Welfare, Govt. of India.

Salient findings

The project was implemented by ICAR-CICR as a nodal agency and the collaborating SAUs were: Dr PDKV, Akola; VNMKV, Parbhani; MPKV, Rahuri; NAU, Navsari; JAU, Junagadh; RVSKVV, Gwalior; UAS, Dharwad; UAS, Raichur; PITSAU, Hyderabad and ANGRAU, Guntur. It was implemented in 105 villages of 21 districts covering 1050 acres area of 8 states. IRM strategies implemented through the project comprised of management measures like cultural (timely sowing and timely termination of crop), behavioural (pheromone trap), biopesticides (Neem formulation), bio control agents (parasitoid *Trichogramma bactrae*), need based pesticides application (chemical insecticides), etc. During crop season various outreach activities carried out were field visits,

farmers' meetings, field days, farmers' field trainings, sensitization workshop for ginning mill owners/input dealers, broadcasting voice messages, TV talks, radio talks, lectures etc. Random surveys were also conducted during the crop season.

Scenario of pink bollworm infestation in cotton based on random surveys

Random surveys were conducted in IRM implemented 13 districts in the month of October. The district wise pink bollworm infestation recorded in different states was **Maharashtra** (9 districts): Akola 12-76%, Buldana 40-45%, Yavatmal 44-48%, Nanded 11-83%, Parbhani 58-75%, Jalna 3-69%, Nagpur 9-56%, Wardha 4-64%, Amravati 9-42%; **Gujarat** (1 district): Bharuch 5-40%, **Madhya Pradesh** (1 district): Khandwa 18-68%, **Karnataka** (1 district): Raichur 0-40%, **Andhra Pradesh** (1 district): Guntur 0-85%. At the time of roving survey 1-2 pickings were completed.

6.4 Project Name: Elucidating eco-toxicity and resistance development in sucking pests against newer insecticides used in cotton

Dr.V. S. Nagrare (PI), Co-PIs- Dr. V. China Babu Naik, Dr. B. B. Fand

Importance of the study: Sucking pests have assumed serious proportions in cotton especially in the era of post Bt-cotton phase. Exposure of insects to sub lethal dose of insecticides may enhance the development of resistance and reproductive fitness of insect pests. Certain insecticides exhibit stimulating effects in the plants *e.g.* acephate, monocrotophos application shows greening effect in cotton. Similarly, insecticidal enhancement of fecundity under temperature stress has been reported in few insects. Very

scanty information is available on these aspects and the same was seriously lacking for the sucking pests of cotton. Present work was conducted to understand the ecotoxicological aspects of sucking pests of cotton in the context of changing pest scenario and predicted climatic changes.

Salient findings

Phytotoxicity and growth stimulating effects on cotton crop and yield

An experiment was conducted to understand phytotoxicity and growth stimulating effect on cotton plants and crop yield with five insecticides *viz.*, clothianidin 50%WDG, spiromesifen 22.9%SC, dinotefuran 20% SG, flonicamid 50% WG, thiacloprid 21.7% SC along with control. The dosages of insecticides taken were at X, 2X and 4X. The treatments were imposed at 60, 75 and 90 DAS. No noticeable phytotoxicity and growth stimulating effects were observed with the imposed insecticidal treatments. Differences with the different dosage of insecticides on pests and natural enemies' species composition were minor. Yields did not vary significantly among the treatments.

Monitoring of resistance development in sucking pests against newer insecticide

Monitoring of resistance development in leafhopper against newer insecticides *viz.*, acetamiprid, clothianidin, dinotefuran, flonicamid, imidacloprid, spiromesifen, thiamethoxam and monocrotophos was taken up with population of Nagpur, Wardha and Yavatmal. It was observed that leafhopper populations of these districts are still susceptible to the tested insecticides.

Changes in species composition with newer insecticides

There was no distinct change in species composition with insecticides clothianidin 50%WDG, spiromesifen 22.9%SC, dinotefuran 20% SG, flonicamid 50% WG, thiacloprid 21.7% SC with three concentrations (X, 2X, 4X).

Toxicity of newer insecticides to natural enemies

Toxicity of above insecticides with three concentrations (X, 2X, 4X) on the population of natural enemies *viz*, coccinellids, chrysopa and spiders was assessed. Analyzed data indicated insignificant difference in the population of natural enemies among insecticides with chosen concentrations.

Influence of insecticides on survival and fecundity in cotton aphids under thermal stress

Development time and survival of aphids under different temperatures was assessed for insecticides flonicamid and imidacloprid at five different concentrations. Mortality enhancement with temperature increase was observed in flonicamid and imidacloprid. We could not assess the fecundity of aphids because of very low survival due to insecticide treatments.

Relative efficacy of different coloured sticky traps against whitefly

An experiment was conducted by taking 10 different coloured sticky traps to evaluate their relative performance in attracting whiteflies. It was observed that highest whitefly adults were trapped in yellow-daffodil sticky trap followed by Yellow-orange appeal sticky trap. Remaining colors were least effective in attracting whiteflies.

6.5 Project Name: Identification of oviposition deterrents for ethological management of cotton boll worm *Helicoverpa armigera* (Hübner)

Dr. Rachna Pande(PI), Co-PI- Dr. Vivek Shah

Importance of the study: Semiochemicals are the acceptable alternatives for the management of insects as they alter the behaviour of insect. In recent years, among the semiochemicals, oviposition deterrent was the most explored field. In the present study the oils containing the fatty acids as a component were evaluated both under laboratory and field conditions. Selection of oils was based on the oviposition deterrent compounds identified in previous year through GC-MS.

Salient findings

- Seven different vegetable oils *viz*., groundnut, sunflower, rice bran, soybean, safflower, sesame and palm oil were evaluated against *H. armigera* at different concentrations (1, 2, 4 and 8 %) for cotton and (0.5, 1 and 2 %) for chickpea.
- Selection of oil was based on the presence of oviposition deterrent compounds which were identified earlier *viz*., linoleic acid, palmitic acid, myristic acid and stearic acid.
- Performance of all the oils was significant in comparison to control.
- In cotton, at the concentrations of 2% and above, the population was reduced below ETL up to 15 days after spraying, whereas at lower concentrations of 1%, the population was below ETL upto 10 days only.
- In case of chickpea, oils were effective at concentrations of 1% and 2%.
- Blend of these oils was also evaluated in cotton field and it was found that all the blends were effective against *H. armigera* in comparison to control.

6.6 Project Name: Investigations into exacerbation of pest status of cotton pink bollworm *Pectinophora gossypiella* (Saunders) in the context of climate change through development of phenology model.

Dr. Babasaheb B. Fand (PI), CoPI- Dr.V.S. Nagrare, Dr.V. Chinna Babu Naik

Importance of the study: *Pectinophora gossypiella* has recently emerged as a major concern for cotton especially in central and southern parts of India, due to development of resistance in this pest against the Bt-toxins. The problem of pink bollworm damage in

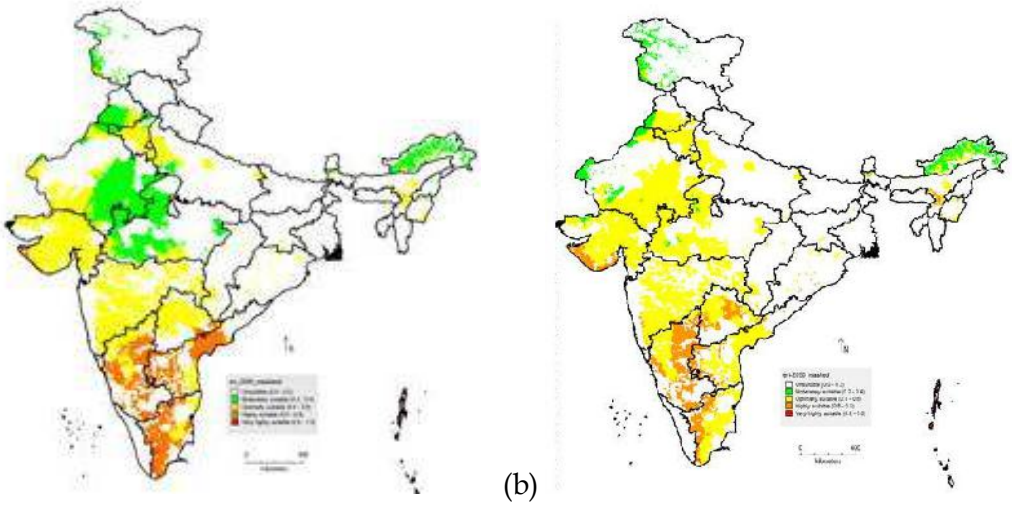
cotton is likely to worsen in future due potential climate change. Hence, the detailed knowledge on various aspects of *P. gossypiella* bio-ecology e.g. temperature – dependent population growth potential, thermo tolerance limits, initiation and peaks of infestation in a seasonal cycle, reproductive fitness and resistance to insecticides under thermal stress, etc. is of paramount importance to know how the pest will respond to predicted climatic changes.

Salient findings

Predicting the impact of climate change on abundance of pink bollworm through phenology modeling and GIS-based risk mapping

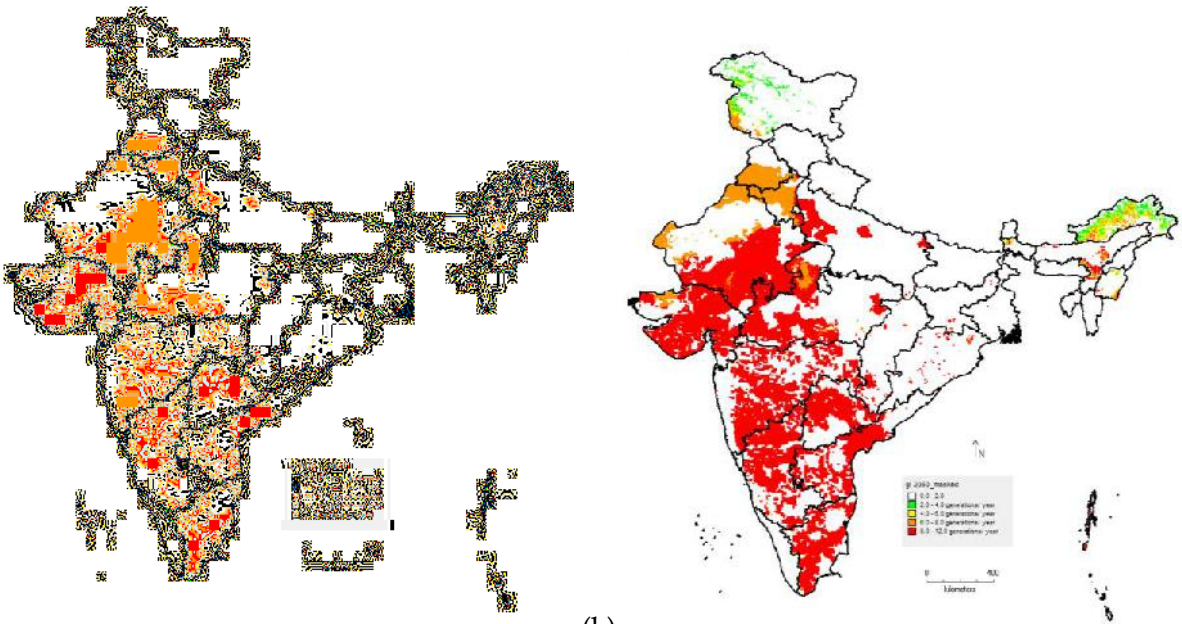
The analysis was carried out to study the hypothesis that the temperature variations due to global climate change may affect the future distribution and abundance of *P. gossypiella* and aggravate the cotton yield losses. A temperature-based phenology

model of *P. gossypiella* was coupled with a geographic information system (GIS) for mapping its population growth potentials in different cotton growing areas of India. The three risk indices *viz*., establishment risk index, generation index and activity index were computed using interpolated temperature data from Worldclim database projecting the climatic conditions for the base year 2000 and future scenario of the year 2050. Results indicated that, approximately 60% cotton growing areas of India are optimally suitable for pink bollworm establishment and survival throughout the year (Fig. 6.6.1a), which are predicted to increase upto >90% by the year 2050 (Fig. 6.6.1b). Under base temperature conditions of year 2000 pink bollworm is expected to complete > 6.0 generations per year on ~ 80% of the cotton production areas. However, economic losses are likely to occur only in areas where at least 8.0 generations can develop in a year; under current climate ~ 60 % areas fall under this category (Fig. 6.6.2a) which may rise upto 80% by the year 2050 (Fig. 6.6.2b). The increased pest activity of pink bollworm due to climate change may intensify the yield losses in cotton.



(a) (b)

Fig 6.6.1: Change in establishment and future distribution of pink bollworm in cotton production areas of India, based on establishment risk index (ERI) for current (a) and future (b) climatic conditions. Geographical regions having ERI values > 0.6 are associated with the risk of permanent establishment of pink bollworm.



(a) (b)

Fig 6.6.2: Change in number of generations per year of pink bollworm in cotton production areas of India based on generation index (GI) for current (a) and future (b) climatic conditions. Economic damage may occur in the regions with generation index values > 6.0.

6.7 Project Name: Studies on chemical cues mediating natural enemy and sucking pest interactions in cotton eco-system

Dr. Shah Vivek (PI), Co-PI- Dr. K. Shankarganesh, Dr.Rishi Kumar, Dr.K Rameash, Mr. Madhu T.N.

Importance of the study: Whitefly and jassids are the major sucking pests of cotton in India. At least 2-3 sprays are directed for their management adding to pesticide load in the ecosystem. Semiochemicals play a vital role in tritrophic interactions between crop plants, insects and their natural enemies. Present study aims at identifying volatiles emitting from the sucking pests that deploy natural enemies, so as to use them in ecofriendly pest management practices.

Salient findings

- Volatiles identified from jassids and whitefly *viz*., 9-octadecenoic acid, 9,12-octadecadienoic acid hexadecanoic acid were identified using GC-MS.
- Field evaluation of vegetable oils containing above mentioned compounds for their attractiveness to natural enemies was done.
- No significant difference was observed in population establishment as presence of natural enemies was only for brief period of 14-21 days

6.8 Project Name: Push-Pull strategy for management of pink bollworm in cotton

Dr. Shah Vivek (PI), Co-PIs- Dr. Pooja Verma, Dr. Rachna Pande

Importance of the study: Push-pull essentially employs behavior modifying stimuli from insects and its host plants to restrict the insects from damaging the host crop. Oviposition deterring pheromones (ODPs) (referred herein as 'Push component') are spacing pheromones that enable

conspecific female insects to avoid egg laying on previously exploited hosts, thereby reducing intra specific competition among the individuals of the population. Plants emit volatile compounds that attract insects (referred herein as 'Pull component') for foraging and oviposition. Insects perceive these compounds primarily by olfaction (smell). Identification of potential semiochemical compounds to repel pink bollworm from cotton and attract to the refuge of same host maintained within the same field has a potential for development of sustainable and eco-friendly management strategy.

Salient findings

- Oleic and linoleic acids from larval faecal pellets of pink bollworm exhibited oviposition deterrent properties
- Six different vegetable oils containing oleic and linoleic acid as major components identified using GC-MS profile, as a cheaper alternatives for field application were: groundnut oil, sunflower oil, rice bran oil, soybean oil, sesame oil and safflower oil.
- The compounds namely α/β pinene, carene, γ terpinene, α copaene, caryophyllene and humulene identified from four cultivated species of cotton were evaluated under choice and no-choice experiments using square extract, artificial blend and natural cotton twig to know the preference of female moth for egg laying.
- *Gossypium herbaceum* was found to be least preferred species under both choice and no-choice experiments using square extract, artificial blend and/or natural cotton twig.
- Higher proportion of γ terpinene in *G. herbaceum* might attribute to deterrent effect.
- Higher quantity of caryophyllene and α/β pinene with low levels (*G. arboreum*) or absence (*G. hirsutum* and *G. barbadense*) of γ terpinene attracts pink bollworm female for egg laying.

6.9 Project Name: Standardization and integration of strategies for sustainable nematode management

Dr. Nandini Gokte-Narkhedkar (PI)

Importance of the study: Losses due to plant parasitic nematodes have been pegged at 8-10%. Reniform nematode *Rotylenchulus reniformis* is the most prevalent and frequent nematode species in central and southern cotton growing areas. For management of nematodes no effective and environmentally sustainable management strategy is available. The project envisaged evaluation of bio-entities for their possible nematoxic effect. The project aimed at development of nematode management module by integration of all available and effective nematode management strategies.

Salient findings

Out of forty bacterial species evaluated, *Bacillus subtilis, B. cereus, Lysinibacillus sphaericus, Brevibacterium epidermidis, Providencia vermicola* and *Ochrobactrum pseudogrignonense* were found to induce resistance in cotton plants against reniform nematodes.

Lysinibacillus sphaericus used as seed treatment was found to reduce nematode population and induce resistance against nematodes as evidenced by split root experiment.

Field trial for evaluation of bio formulations as elicitors for induction of plant resistance against nematodes was taken up for confirmation with cotton cv. PKV081 and effect of bio formulations on nematode population in field and on final cotton yield

was evaluated. Formulation with curcumin + cow urine + neem oil spray in combination reduced nematode population and increased yield in cv PKV081(13.1 q/ha) as compared to control (11.47 q/ha). Aspirin and curcumin combination as well as neem oil with curcumin were second best giving yield of 12.77 and 12.40 q/ha respectively.

6.10 Project Name: Main Project: Exploration of beneficial microorganisms for biotic stress management in cotton

6.10.1 Sub project: Establishment of in-house short-term culture collection repository

Dr.D.T. Nagrale (PI), Co-PIs-
Dr.S.P. Gawande, Dr.N.S. Hiremani, Dr. S.K. Sain, Dr. Sampath Kumar, A.

Importance of the study: Microbial inoculants, bioinoculants can be used as biofertilizers and biopesticides. Several fungal and bacterial pathogens infect the cotton crop and lead to heavy damage in cotton, thereby reducing quality of fibre and total cotton yield. Hence, there is need to study these phytopathogens, biofertilizers and biopesticides in details with establishment of in-house microbial culture collection repository and to utilize these microbial inoculants for meeting e requirement for various experiments by the researchers in the institute and regional stations.

Salient findings

- ✓ Basic facilities of -20ºC, -80ºC and 4ºC refrigerator have been established at Division of Cop Protection, ICAR-CICR, Nagpur for deposition, preservation and maintenance of microbial cultures (Fig. 6.10.1.1)
- ✓ Glycerol stocks at -80ºC have been prepared for the preservation of characterized bacterial cultures
- ✓ Establishment of mineral oil storage facility for preservation of fungal cultures is in progress
- ✓ Polyphasic characterization of isolates are in progress

Fig. 6.10.1.1 In-house short-term culture collection repository established at Division of Cop Protection, ICAR-CICR, Nagpur

6.10.2 Sub Project: Mass multiplication of CICR-Trichocash (*Trichoderma harzianum*) and validation of its efficacy

Dr. S.P. Gawande (PI), Co-PIs- Dr. D.T. Nagrale and Dr. N.S. Hiremani

Importance of the study: *Trichoderma* spp. is the bio control agent widely used in management of diseases of crop plants. India has rich biodiversity pool of antagonists that can be explored as natural, eco-friendly and renewable resources for successful utilization as integrated management approaches of diseases. Therefore, the present proposal has been planned to utilize and validate native strains of antagonist CICR-Trichocash (*Trichoderma harzianum)* in the cotton based cropping system.

Salient findings

- ✓ Established mass multiplication unit at Bio control laboratory of ICAR-CICR, Nagpur.
- ✓ Evaluation of field efficacy of CICR-Trichocash (*T. harzianum*) in comparison with commercial seed dressers is being carried out.
- ✓ Mass multiplication of talc-based formulation of *T. harzianum* has been initiated (Fig.6.10.2.1) and 200 packets (500gms each) distributed as a critical input to farmers under MGMG and SCSP (Fig.6.10.2.2).

Fig. 6.10.2.1. Mass multiplication of *Trichoderma* on PDA

Fig. 6.10.2.2. Distribution of CICR-Trichocash packets to the farmers under MGMG and SCSP

6.11 Project Name: Development of wireless smart trap for automated monitoring of lepidopterous pests in cotton

Dr K. Rameash (PI), Co-PI- Dr K. Shankarganesh

Importance of the study: The study is aimed at developing an automated trap with image sensors for providing real time surveillance for multi species lepidopterous pests in cotton for efficient pest monitoring. By integrating the traditional trapping method with modern information communication technology (ICT), the trap system would provide a real-time information on the field conditions and the dynamics of the pest population at different monitoring sites.

Salient findings

The pheromone compounds 7,11-Hexadecadienyl acetate, (*Pectinophora gossypiella*); (Z,E)-9,11-Tetradecadienyl acetate, (*Spodoptera litura*); (Z)-9-Hexadecenal,

(*Helicoverpa armigera*); (E,E)-10,12-Hexadecadienyl, (*Earias vittella*) were evaluated as single septa (@ 2 mg pheromone loaded per septa) in individual pheromone traps as well as combined traps (1+2+3+4 as separate traps together in a treatment); combined lures (1+2+3+4 as four individual septa in single trap); mixed lure (1+2+3+4 as blend in a single septa - single trap) (Fig. 6.11.1). The study was conducted in a randomized block design (RBD) with eight treatments and three replications at two locations. The traps were placed with a distance of 15 m from each other and at 30 cm height above the crop canopy. Observations on trap catches of adult males of four lepidopteran pests were recorded at weekly intervals.

The trap catches of *P. gossypiella* and *S. litura* were found to be identical in individual traps, combined traps and combined lures. However, in mixed lure trap a significant reduction in trap catches was noticed. Trap catches of *H. armigera* and *E. vittella* were recorded at a lower rate throughout the season. The information on compatibility and field efficacy of multi lure pheromone system against major lepidopteran pests of cotton was explored in the present study. The field experiments provided insight on how different pheromone compounds would perform in combination in attracting more than one lepidopteran pests in cotton to cater the needs of pest monitoring and management. Based on the results of the two field studies, the combined lure setup would be carried forward as an integral part in fabrication of wireless trap (Fig. 6.11.2 and 6.11.3).

Combined traps (a) | **Combined lures: external view (b)** | **Combined lures: internal lure arrangement (c)**

Fig. 6.11.1. Arrangement of different traps and lures

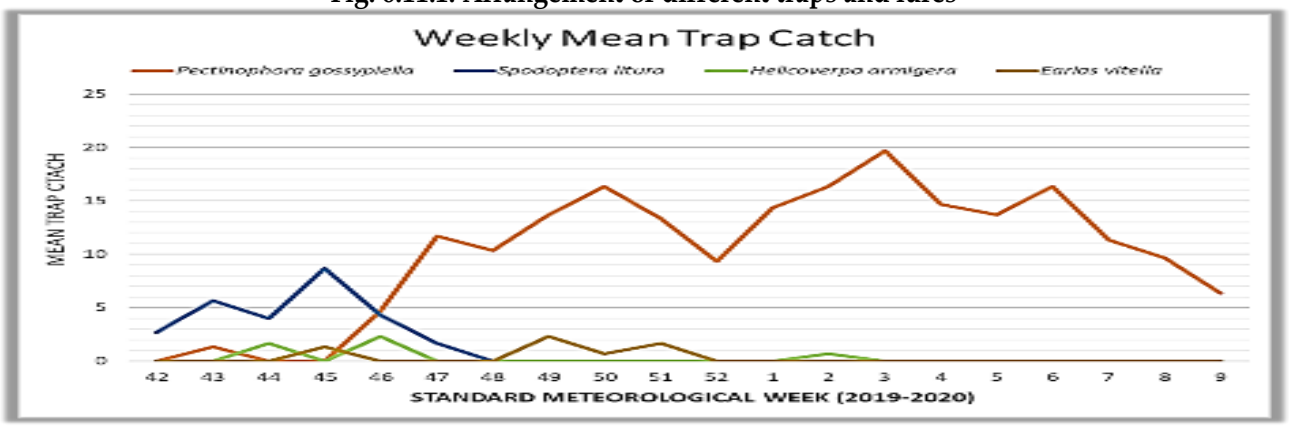
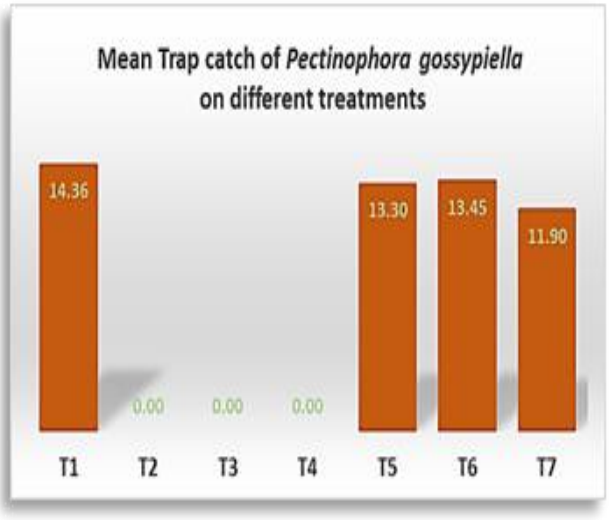


Fig. 6.11.2: Weekly mean male moth trap catches of lepidopteran pests of cotton



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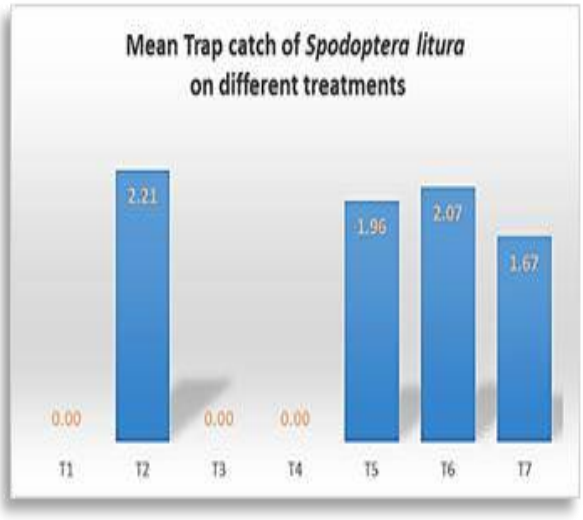

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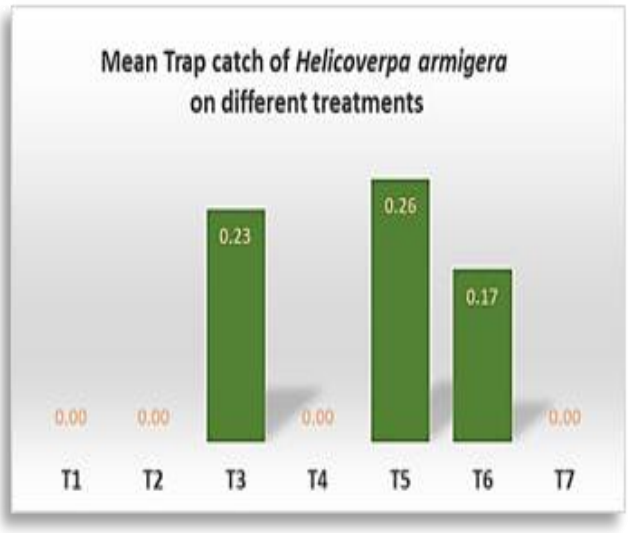

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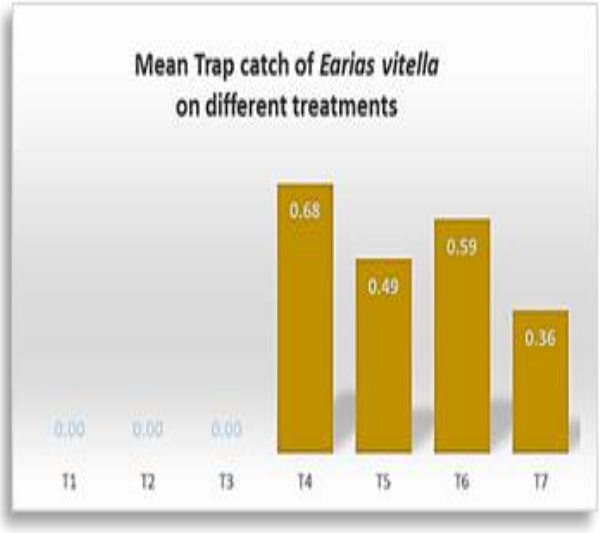


d

Fig. 6.11.3. Mean male moth trap catches of lepidopteran pests of cotton in different combinations of treatments

6.12 Project Name: Identification of semiochemicals associated with host plant cotton and insect pest stem weevil *Pempheres affinis*

Dr. K. Shankarganesh (PI),Co-PI- Dr. J. Annie Sheeba, Dr. A. Manivannan

Importance of the study: The project aims at screening for source of tolerance against stem weevil in cotton under field condition.

Salient findings

Screening for tolerance of cotton varieties / hybrids against stem weevil

- Out of the nine genotypes, Mallika Bt hybrid and MCU5VT were found to be more susceptible to stem weevil.
- The infestation varied from 10 to 43%. The maximum incidence was observed in Mallika Bt and MCU 5 VT and it was

comparatively less in Surabhi, LRA 5166, MCU 3, RCHB 625 BGII.

Morphology of stem galls:

- Cells in affected stems underwent hypertrophy and hyperplasia, resulting in extensive stem swelling. The diameters of stems with galls ranged from 1.6 to 3.4 mm.
- In affected stems, the periderm was split and pushed away from the stem by galls.
- The phloem ring was disrupted, and it appeared that phloem cells might have differentiated into cells of gall tissue.
- Most of the samples showed phenolic deposition in the pith region (Fig. 6.12.1).

Fig. 6.12.1. Cross section of stem weevil infested plants with stem gall: a microscopic view (a) and general view (b)

Biochemical difference in susceptible and tolerance varieties

- Plant phytochemicals contributing to host plant resistance/susceptibility to stem weevil such as phenols, sugars and terpenoids were estimated from leaves and collar regions of different varieties of cotton plants chosen for the study.
- Among the varieties, MCU3 and Bahubali showed field level tolerance to stem weevil.
- MCU3 recorded higher phenolic content from 16th to 19th day old seedlings in the collar region which may be one of the reasons of tolerance of these varieties.
- Soluble sugars were high in leaves of Mallika followed by Bahubali.
- Higher terpenoid content is recorded in the collar region of MCU 3 on 15th, 16th, 21-23rd days and on 25th day.
- Bahubali too recorded higher terpenoid values on 15th and 16th in the collar region

6.13 Project Name: Development of biocontrol consortia with multifaceted fungi for the management of important pests and nematodes of cotton

Dr. J. Gulsar Banu(PI); Co-PI- Dr. M. Amutha

Importance of the study: Fungal biopesticides and nematicides are used for the eco-friendly management of pests and nematodes, respectively. Field application is hampered as some of them lack virulence under field condition. Each biopesticide is having different mode of action and target pests. Identification of fungi with different mode of action and unique capacity which are compatible with each other will be required in future. Hence there is a need to develop biocontrol consortia with multifaceted fungi for the management of

important insect pests and nematodes of cotton

Salient findings

- Bioefficacy of four entomopathogenic fungi *viz., Lecanicillium lecanii, Metarhizium anisopliae, Beauveria bassiana* (BB and MB) and *Cladosporium cladosporioides* alone and in combination were tested against jassids, aphids and mealybug, *Phenococcus solenopsis* under *in vitro* condition. Entomopathogenic fungal consortia could cause significant mortality of target pests than fungus alone.
- Twenty isolates of endophytic fungi from the cotton roots were isolated.
- Two bacterial symbionts of entomopathogenic nematode, *Xenorhabdus nematophilus* and *X. stockiae* (primary and secondary forms) were tested against jassids under *in vitro* condition. Among two bacteria, *X. nematophilus* primary form could cause significantly higher mortality than *X. stockiae*.
- Mode of action of these two bacteria against 16 fungi (11 plant parasitic and 5 entomopathogenic fungi) was tested by dual culture assay. Six isolates of entomopathogenic fungi were isolated from *S. litura.*
- Standardised a methodology for the virulent isolates of entomopathogenic nematode and fungi by modified soil baiting method. By this method most virulent isolate against target pests alone will be isolated there by reducing time in collection and screening of several isolates against target pests.
- One entomopathogenic fungus and nematode was isolated from *S. frugiperda* larvae. This entomopathogenic nematode, *Steinernema* sp could cause 100% mortality of larvae and pupae within 24 hours after inoculation at an initial inoculum of 10 IJ/ larva or pupa.
- Maximum production of infective juveniles of *Steinernema* sp was recorded at an initial inoculum of 10 IJ/ larva.

6.14 Project Name: Exploration of beneficial microorganisms for biotic stress management in cotton

Sub project 1: Collection, characterization and evaluation of beneficial fungal microorganisms from North, Central and South cotton growing zones

Dr.S.K. Sain (PI); Co-PIs- Dr. S.P. Gawande , Dr.Amarpreet Singh, Dr.P. Valarmathi, Dr. Nandini Gokte Narkhedkar

Importance of the study: Soil microorganisms play a key role in the agricultural ecosystem for plant growth and health. They act as phyto stimulators, produce phytohormones, promote plant development through altering root architecture and induce biotic stress tolerance in plants. Until now, studies on isolation and characterization of the rhizosphere fungi from cultivated cotton in India arelacking. The identified beneficial fungal strains can further be used for developing bioformulation or consortia for improving the plant health, and ultimately the productivity of the cotton cropping system.

Salient findings

- Survey and collection of rhizosphere soil samples from different cotton cropping systems in North, Central and South Zones of India was undertaken and more than 80 cotton rhizosphere soil samples were collected (Table 6.14.1).
- Fungal colony in the sample ranged from 1-16 with an average of 5.5 c.f.u. $x10^{-4}$.
- About 100 fungal isolates including the genus *Aspergillus, Trichoderma, Sclerotome, Mortierella, Metarhizium, Macrophomina, Rhizopus, Penicillium, Curvularia, Bipolaris, Colletotrichum, Paecilomyces, Fusarium, Nigrospora, Acremonium* and some

unidentified fungi were purified and are being further characterized (Fig. 6.14.1).

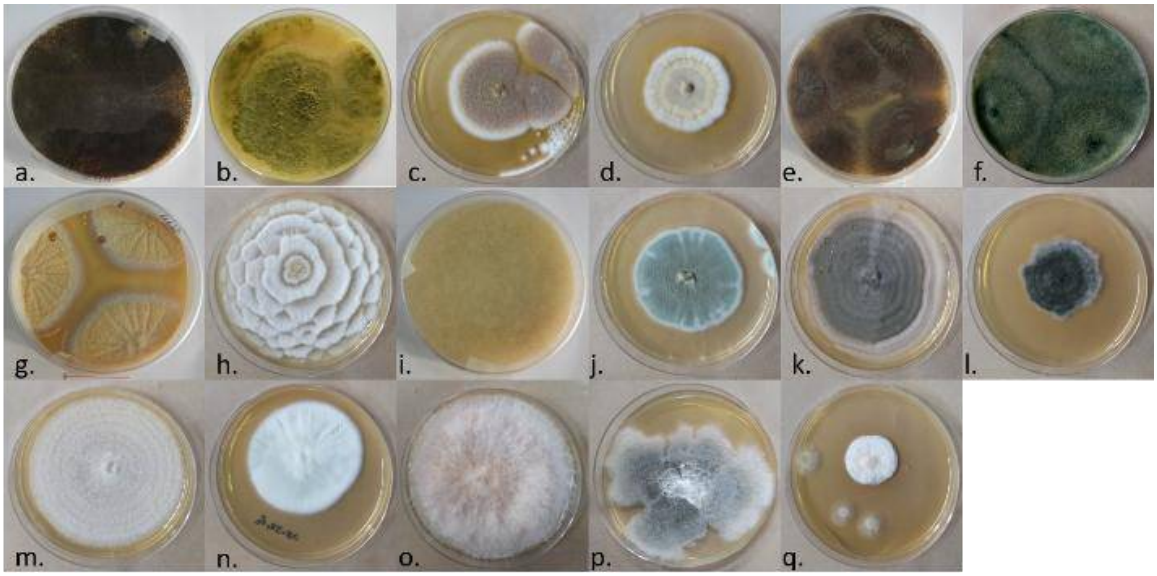


Fig. 6.14.1 Fungal genera recorded in different soil samples: a. *Aspergillus niger,* **b.** *Aspergillus flavus*, **c.** *Aspergillus terreus,* **d.** *Aspergillus fumigatus* **e.** *Aspergillus foetidus,* **f.** *Trichoderma* spp., **g.** *Sclerotium rolfsii,* **h.** *Mortierella* spp., **i.** *Rhizopus stolonifer,* **j.** *Penicillium* spp., **k.** *Curvularia* spp., **l.** *Bipolaris* spp., **m.** *Colletotrichum* spp., **n.** *Paecilomyces* spp., **o.** *Fusarium spp.,* **p.** *Nigrospora* spp., **q.** *Acremonium* spp.

Table 6.14.1: Number of different fungal genus isolated and purified from North, Central and South cotton growing zones

Zone	Soil samples	Fungal colonies (purified)	Fungal genera recorded
North	63	**345 (61)**	*Aspergillus (88), Fusarium (35), Bipolaris (1), Curvularia (2), Rhizopus (6), Sclerotomerolfsii (2), Trichoderma (7), Mortierella (20), Nigrospora (2),Penicillium (32), Acremonium, Colletotrichum, Paecilomyces,*and non-sporulation
Central	10	25 (15)	*Aspergillus, Macrophomina, Fusarium, Rhizopus, Trichoderma, Penicillium, Metarhizium.*
South	21	65 (25)	*Aspergillus (40), Penicillium (2), Fusarium (14), Bipolaris (4)* and *Rhizopus (5)*

6.15 Project Name: Studies to identify the most virulent strains of entomopthogenic fungi for whitefly control (2016-2020)

Dr.S. K. Sain (PI); Co-PIs- Dr. D. Monga, Dr.S. Kranthi, Dr.Rishi Kumar, Mr. Prabhulinga T., Dr.Dipak Nagrale, Dr. Neelakanth Hiremani

Importance of the study: Entomopathogenic fungi (EPF) are ecofriendly alternative to chemical insecticides for the management of whitefly. The scanty availability of effective bioinsecticide is making farmers dependent

on chemicals, resulting in insecticide resistance and environmental pollution. The top most virulent EPF strains found compatible with chemical insecticides under polyhouse conditions and laboratory were evaluated under field conditions

Salient findings

- Three liquid bioinsecticide formulations developed using the most virulent EPF strains compatible with insecticides (CICRRS *Cordyceps javanica*-102, CICRRS *Metarhizium anisopliae*-1299 and CICRRS *Beauveria bassiana*-4511).
- These three bioinsecticides @ 0.5%, commercial formulations of *Lecanicillium lecanii* @ 0.5%, spiromesifen @ 0.1% along with control treatment were evaluated in large plot field trial at ICAR- CICR Regional Station Sirsa.
- The results of three consecutive sprays of individual treatments indicated that the highest area under nymph mortality progress curve (AUMPC) was observed with spiromesifen, followed by CICRRS Cj-102, CICRRS Ma-1299 and CICRRS Bb-4511.
- Compared to other treatments, lower CLCuD PDI (%) was observed in spiromesifen, Cj-102, Ma-1299, Bb-4511 and the higher seed cotton yield (q/ha) was recorded in Bb-4511, Cj-102, Ma-1299 and spiromes ifen (Fig 6.15.1)

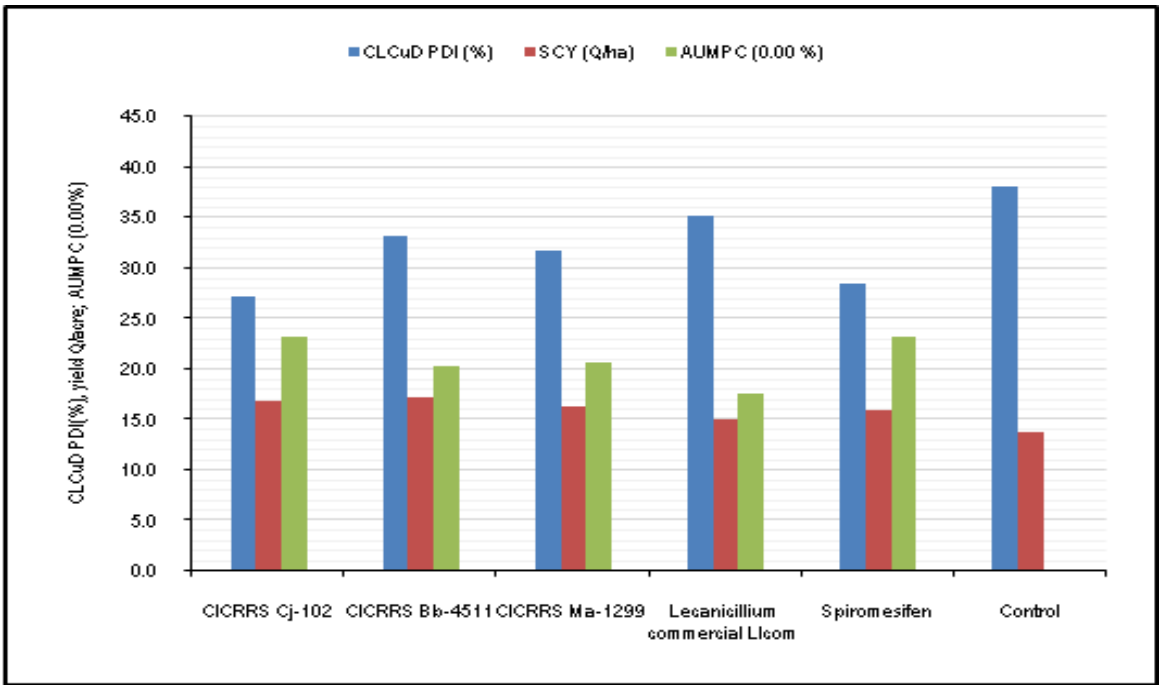


Fig 6.15.1: Comparative effect of bioinsecticide formulations, chemical insecticide on whitefly nymph mortality, CLCuD, and seed cotton yield

Theme 7: Precision based cotton farming with mechanical harvesting

7.1 Project Name: Evaluation and refinement of spindle type header prototype and development of a cotton picker

Er. G. Majumdar (PI); Co-PIs- Ramakrishna G.I, Jayant Meshram, Blaise DesouzaCSIR-CMERI, Durgapur, WB. Mr. E.Chandrasekar, Mr. Sanjay Hansdah

Importance of the study:Manual picking accounts for 30% of cost of cultivation in India. While, in most of the western countries, machine harvest is followed. Limitations exist for the commercialization of cotton pickers available in western markets, due to theirmassive size and power requirements. Additionally, operation of cotton harvester needs trained workforce,and repair and maintenance facilities at the village level. Hence, there is an urgent need to develop a small-scale cotton harvester to cater the needs of small farms in India.

Salient findings

A spindle type cotton picking head earlier developed under a DST funded project in collaboration with ICAR-CICR and CSIR-CMERI-MERADO is now being modified in collaboration with CSIR-CMERI, Durgapur. Preliminary trials of the header were taken up at CICR, Nagpur with BGII hybrid (Ankur 3028) and BG cultivar (PKV-081Bt). The cottonwas planted at 90×60cm and the tractor was operated in reverse direction. In general, the trash content of machine-picked cotton was significantly higher than manually picked cotton. Ankur 3028 BGII and PKV-081 Bthad trash content of 17% and 27% (seed cotton basis), respectively, as compared to 1% in the manually picked cotton. High trash in PKV-081Bt was due to non-defoliation of the crop and a high percentage of non-separable lint with trash constituents found in machine-harvested cotton(**Table 7.1.1)**.

Spindle head trial at ICAR-CICR

Table 7.1.1:Trash constituents of machine picked cotton

	Hybrid	Bracts (%)	Leaves (%)	Sticks (%)	Inseparable Lint from trash (%)	Fine Trash(%)	Total Trash (%)
Machine Picked	PKV 081 Bt	3.07	1.88	1.37	20.67	0.37	27.36
	Ankur 3028	5.45	0.97	1.0	9.08	0.84	17.37
Manual	Ankur 3028	-	0.17	0.01	0.67	-	0.85

Theme 8: Enhancing the productivity, diversity and sustainability of cotton-based production systems through efficient resource management

8.1Project Name: Alleviating soil compaction – a production constraint in cotton

D. Blaise (PI); Co-PIs- Dr.A. Manikandan, Er. G. Majumdar and Dr. Savitha Santosh

Importance of the study: Soil compaction is one of the factors that leads to land degradation. A better understanding of the causes and effects of soil compaction in cotton-based systems, will lead to strategies and management practices to alleviate compaction.

Salient findings

Field trials were conducted to study the effect of sub-soiling and crop rotation todevise a suitable plan for ameliorating soil compaction. Deep rooted crops such as pigeonpea, sunnhemp, *daincha* and radish had less penetration resistance than those without a rotation. The least resistance was observed with the deep sub-soiling treatment. However, deep sub-soiling treatment had a high fuel consumption of 9.5 lph compared to 7.2-7.8 lph for the shallow sub-soiling treatments. Sub-soiling in alternate rows brought down the fuel consumption by approx. 50%. Seed cotton yields were the highest in the rotation plots, except the radish that had the least seed cotton yield.

Sub-soiling with tractor drawn sub-soiler to manage soil compaction in vertisols

8.2Project Name: Integrated farming system to double income of cotton farmer

Dr. Ramkrushna G.I (PI); Dr. RachnaPande, Dr. A. Manikandan, Dr. U.V. Galkate

Importance of the study: Single or sole crop systems are risk prone. Diversification of cropping systems is needed to better utilize natural resources and improve farm income of small farmers.

Salient findings

Out of one-hectare Integrated farming system (IFS)model, pigeon pea was intercropped in cotton (2:6 ratio) in one-acre area, in which, seed cotton yield was 823 kg and pigeon pea was 152 kg. In another one-acre area, soybean was grown in *kharif*, followed by chickpea + mustard in *rabi*. During the *kharif*, 864 kg

soybean was harvested, while, in *rabi* 1060 kg chickpea and 75 kg mustard were harvested. A goat (Usmanabadi) unit was established at KVK farm, and a net return of₹15,812 wasrealized from the goat unit with the generation of 120man-days. A poultry (Giriraja) unit (100 birds in two batches) was established atthe farmer field, which gave a net profit of ₹65,614. Fruit and vegetables (custard apple, papaya, french bean, okra, tomato, cucurbits, etc.) is taken as a horticulture component in IFS, yielded a net profit of ₹29,134 in a year. Overall, the IFS model produced 70.2 q/ha cotton equivalent yield with B:C ratio of 1.95. During the year (2019-20), 3020 kg feed, 1590 kg fodder, and 2.50 t manure were produced in the system and were used as input for different enterprises. Water harvested in 20 x20 m^2 pond was used for life-saving irrigation in *rabi* and vegetable crops. Overall, one-hectare IFS could generate 492 man-days during the one-year cropping season.

Components of IFS

8.3 Project Name: Efficient nitrogen fixing legumes for cotton based cropping systems

Dr. A. Manikandan(PI); Co-PIs- Dr. D. Blaise, Dr. P. Nalayini, Dr. VS. Nagrare

Importance of the study:

Legumes fix atmospheric nitrogen,and intercropping of legumes with cotton will help in rural livelihood and food security. The prime objective of our study was to evaluate the best legume-intercropping system for rainfed and irrigated cotton.

Salient findings

Under rainfed conditions (Nagpur), cotton intercropped with legumes had higher leaf N compared to sole cotton. Similarly, legume rows had one-fold increase in soil nitrogen content (kg ha^{-1}) compared with the sole cotton (Table 8.3.1). The higher soil nitrogen is attributed to the nitrogen fixation by legumes intercropped. Under irrigated conditions (Coimbatore), *Desmanthusvirgatus*was found to be the most suitable perennial legume for alley cropping under cotton – maize system.

Table 8.3.1:Soil nitrogen contentin the legume and cotton rows under rainfed conditions

Intercrop	Cotton row	Legume row
Black gram	118.3	287.0
Cluster bean	121.0	294.3
Green gram	126.7	275.7

Cowpea	129.7	275.7
Groundnut	125.7	282.3
Soybean	129.7	277.3
Cotton	125.0	

8.4Project Name: Studies on sorption of sulphur formulations and commercial nitro phosphate fertilizers to different soils

Dr. A.Manikandan (PI); Co-PI- Dr. D. Blaise

Importance of the study: Sulphur (S) is the fourth major nutrient for cotton, and specifically S is involved in cotton seed quality. To understand the role of slow release S bentonite formulations (Bensulf, FRT-Bensulf and micronized sulphur),we examined the S mobility and sorption in five soil types of cotton-growing areas (Bhandara, Ludhiana, Sindhudurg, Nagpur, and Wardha). We also conducted pot study to determine the effects of four nitrophosphatefertilizers on cotton growth and nutrient uptake with the above-mentioned soils.

Salient findings

Among theS formulations, micronized S had an advantage over the grits of bensulf formulations ((Bensulf, FRT- Bensulf) with regard to maximum S releaseon all the five soils (Fig.8.4.1).In pot culture studies, application of Nitrophosphate as basal dose improved cotton (Mallika BGII), no significant differences were observed between the nitrophosphate treatments. In Bhandarasoils, the boll numbers ranged from 10.5 to 13.6 bolls per plant as compared to 5.8 in the control. For the Nagpur, Ludhiana and Wardha soils, the boll numbers ranged 4.9 to 8.6, 3.1 to 5.6 and 4.3 to 6.3 bolls per plant. The Sindhudurg soil types had the least boll numbers per plant (1.5 to 1.9).

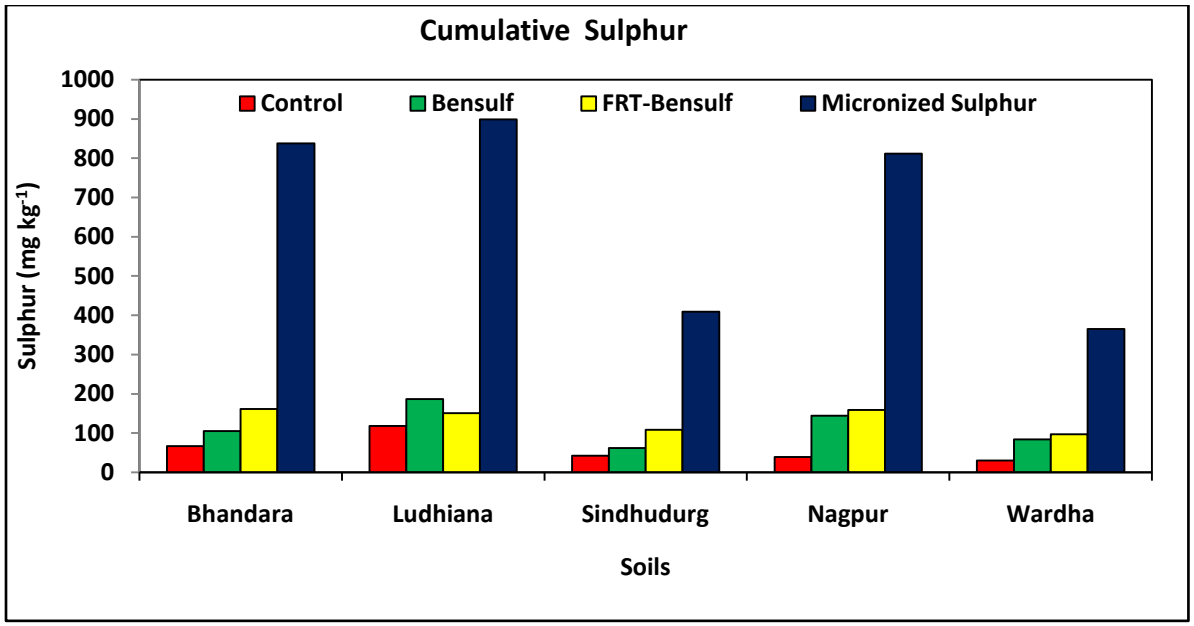


Fig 8.4.1: Sulphur release (mg kg^{-1}) from different Sformulations

8.5Project Name: Evaluation of PGPR and microbial inoculants to alleviate drought stress in cotton (G.hirsutumL.)

Dr. J.H.Meshram (PI); Co-PIs- Dr. S. Gawande, Dr. D. Nagrale, Dr. K. Velmourougane, Dr. P.Verma

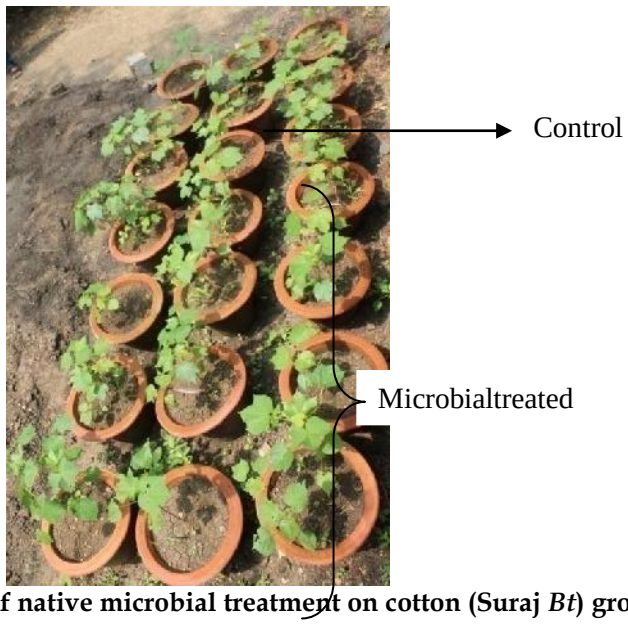
Importance of the study: Microbial inoculants play an important role in imparting drought tolerance in several crop plants. The study investigates the potential of PGPR and microbial inoculants for alleviating drought stress in cotton.The output could provide another sustainable strategy to mitigate the effects of drought in cotton.

Salient findings

A significant difference was observed between the control and identified bacterial isolates in enhancing root and shoot traits in cotton after 45 DAI (days after inoculation). Of the six bacterial isolates evaluated, *Pseudomonas* sp. (5R) showed better shoot and root traits under drought stress conditions.

Table 8.5.1: Morpho-physiological parameters response after inoculated with native microbial strains in *G.hirsutum*

Bacterial Name	Plant Ht (cm)	Root Length cm)	Leaf Temp.(°C)	Leaf Chl SPAD	Shoot FW (g)	Shoot DW (g)	Root FW (g)	Root Dry Wt(g)	Leaf Area (cm²)
Not identified 1	13.6	11.2	29.1	49.6	1.10	0.05	0.18	0.03	13.47
Not identified 2	14.3	9.8	28.8	49.3	0.79	0.04	0.12	0.03	8.82
Not identified 3	15.4	10.3	28.9	35.8	0.79	0.04	0.14	0.02	8.62
Solibacillusisronensis (1R)	15.8	13.1	28.6	40.8	1.28	0.05	0.20	0.04	13.86
Pseudomonas Sp.(5R)	16.0	13.5	29.2	42.1	1.43	0.05	0.26	0.06	18.48
*Sphingomonas*Sp. (6R)	13.9	10.9	29.1	45.7	1.13	0.04	0.22	0.04	12.01
Control	12.3	9.5	29.4	42.4	0.82	0.04	0.16	0.03	8.32
SD	1.34	1.56	0.26	4.92	0.256	0.005	0.050	0.014	3.71
SEM	0.507	0.590	0.10	1.85	0.096	0.001	0.018	0.005	1.40



Effect of native microbial treatment on cotton (Suraj *Bt*) grown in pots

8.6 Project Name: Development of microbial biofilm formulations for cotton: effects on yield, pests, diseases and soil health

Dr. K. Velmourougane (PI); Co-PI - Dr. Savitha Santosh, Dr. Rachana Pande, Dr. Dipak Nagrale

Importance of the study: This project aims to develop multi-species microbial biofilm formulation to enhance cotton root colonization, thereby expected to enhance plant innate immunity against pests and diseases, apart from enhancing plant and soil health attributes.

Salient findings

Based on the three-year insect bioassay, five bacterial isolates for each lepidopteran pest were short-listed for management of Pink bollworm (*Pectinophoragossypiella*), American bollworm (*Helicoverpaarmigera*), Fall army worm (*Spodopterafrugiperda*), and Cotton leaf worm (*Spodopteralitura*). Among the short-listed bacterial isolates *Pantoeaagglomerans*, *Enterobacter cloacae*, *Enterobacter sp.*, *Enterobacter hormaechei*showed higher PBW ovicidal activity (47%-71%). The short-listed bacteria will be used for development of multi-species biofilm formulations using well-known fungal biocontrol agents such as *Trichoderma*, *Beauveria* and *Metarhizium*.Native bacterial isolates (*Pseudomonas sp., Enterobacter hormaechei, Pseudomonas putida, Sinomonas sp., Delftiaacidovorans, Enterobacter ludwigii*) were also short-listed for their biocontrol potential against the major cotton pathogens (*Fusarium, Alternaria, Macrophomina, Myrothecium, Corynespora and Xanthomonas*). The field trail with short-listed bacterial isolates as seed treatment option in Bt-cotton showed increased plant growth attributes (plant height, sympodial branches, SPAD values, LAI, boll numbers, yield and fibre quality) compared to the control.

Table 8.6.1: Effect of native bacterial isolates on major lepidopteron pests of cotton

Pink bollworm (*Pectinophoragossypiella*)		American bollworm (*Helicoverpaarmigera*)		Fall army worm (*Spodopterafrugiperda*)		Cotton leaf worm (*Spodopteralitura*)	
Bacterium	% Mortality	Bacterium	% Mortality	Bacterium	% Mortality	Bacterium	% Mortality
Pantoeaagglomerans	94	*Enterobacter ludwigii*	85	*Enterobacter hormaechei*	91	*Enterobacter hormaechei*	76
Providencia rettgeri	89	*Bacillus subtilis*	80	*Enterobacter hormaechei*	86	*Enterobacter aerogenes*	76
Enterobacter sp.	89	*Providencia rettgeri*	75	*Clostridium sporogenes*	81	*Eubacteriumuniforme*	62
Enterobacter cloacae	83	*Aeromonas hydrophila*	75	*Aeromonas caviae*	81	*Enterobacter hormaechei*	62
Enterobacter sp.	83	*Enterobacter sp.*	75	*Aeromonas finlandiensis*	81	*Providencia rettgeri*	58

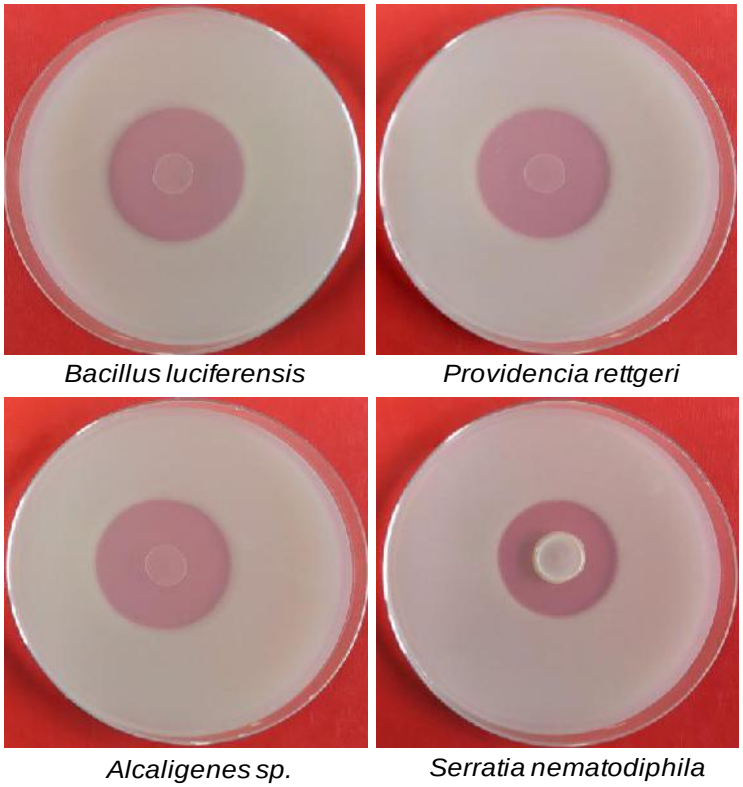
8.7Project Name: Microbial dissolution of carbonate to ameliorate soil sodicity in Black Soil Regions of Maharashtra

Dr. K. Velmourougane (PI); Co-PI - Dr. A. Manikandan, Dr. D. Vasu (NBSS & LUP)

Importance of the study: Pedogenic formation of calcium carbonate ($CaCO_3$) induces soil sodicity, which affects soil properties (drainage, infiltration rate, nutrient availability) and crop productivity. Hence, there is an urgent need for the reclamation of calcareous soils, as it affects soil physical and chemical properties. Though plenty of literature is available on microbial formation of $CaCO_3$, few studies reported microbial weathering of $CaCO_3$. This study aimed to isolate calcium-dissolving bacteria, and to develop consortia of calcium dissolving bacteria for dissolution of pedogenic $CaCO_3$ in soils throughexogenous application.

Salient findings

Two hundred isolates were tested for $CaCO_3$ dissolution potential using DB (Devenze-Bruni) medium @ 0.5, 1.0 & 1.5% pure $CaCO_3$for 5, 10, 20 days. The bacterial isolates were short-listed based on the following parameters: growth rate (OD_{600}), $CaCO_3$ solubilisation index, pH, carbohydrate and protein content (µg/ml), extra cellular polysaccharide production (µg/L), water-soluble calcium (mg/kg), exchangeable calcium (mg/kg), CO_3 bound calcium (mg/kg). Based on the above attributes, eight $CaCO_3$ solubilizing bacteria (CSB) has been short-listed and taken forward for further studies



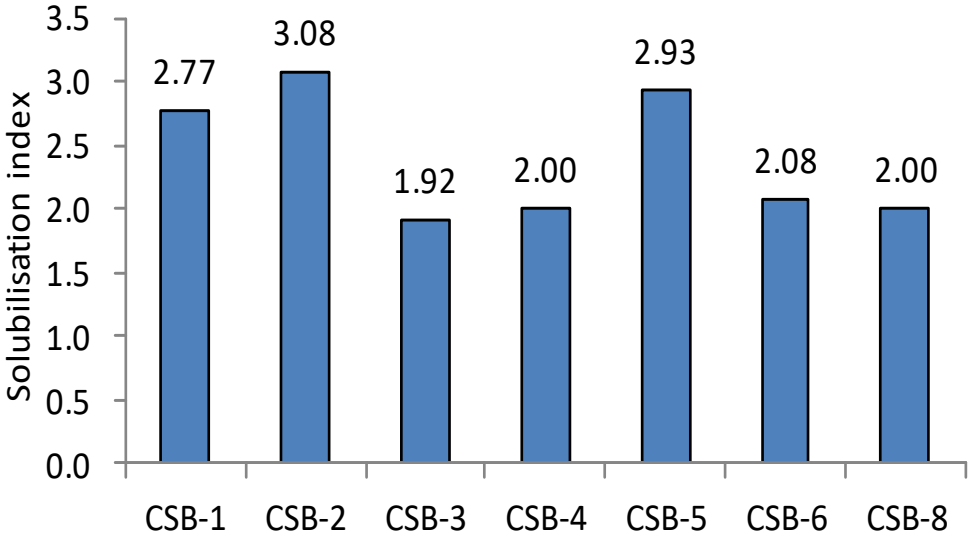


Fig. 8.7.1: $CaCO_3$ solubilisation potential of native bacterial isolates

8.8Project Name: Bioprospecting microbial volatiles for plant growth promotion and sucking pest (Whitefly and Jassids) management in Bt cotton (SERB-DST Project)

Dr. K. Velmourougane (PI)

Importance of the study: Among the sucking pests, whitefly (*Bemisiatabaci*) and green leafhopper (jassids) (*Amrascabiguttulabiguttula*) are deadly and spread throughout the growing season, causing significant yield loss in *Bt* cotton. Microbial volatile organic compounds (mVOCs) are semiochemicals that can attract or repel insects, stimulate oviposition, mimic plant hormones, and induce plant resistance. The aim of this project was to develop ecofriendly and cost-effective microbial volatile formulation for field application to enhance plant growth promotion and management of whiteflies and jassids in *Bt* cotton

Salient findings

Bacterial strains have been screened for their effectiveness in attracting or repelling the whiteflies and jassids, through the production of microbial volatiles (mVOC). Different solvents (Dichloromethane (DCM), Diethyl ether (DE), Ethyl acetate (EA) and Hexane (Hx) were tested for their mVOC extraction efficiency singly and combinations. From the analysis, we found DCM and DE to extract more mVOC (Fig. 8.8.1). In the first batch of experimentation, we tested 25 microbial cultures under field conditions for trap catch of whiteflies and jassids using yellow sticky trap swabbed with 48 h broth grown bacterial cultures (10^8 cells/ml). From the field data, we short-listed top ten potential isolates for further testing (Table 8.8.1). The top ten microbial isolates, which proved better trap catch of whiteflies and jassids under field conditions have been identified through 16S rRNA sequencing

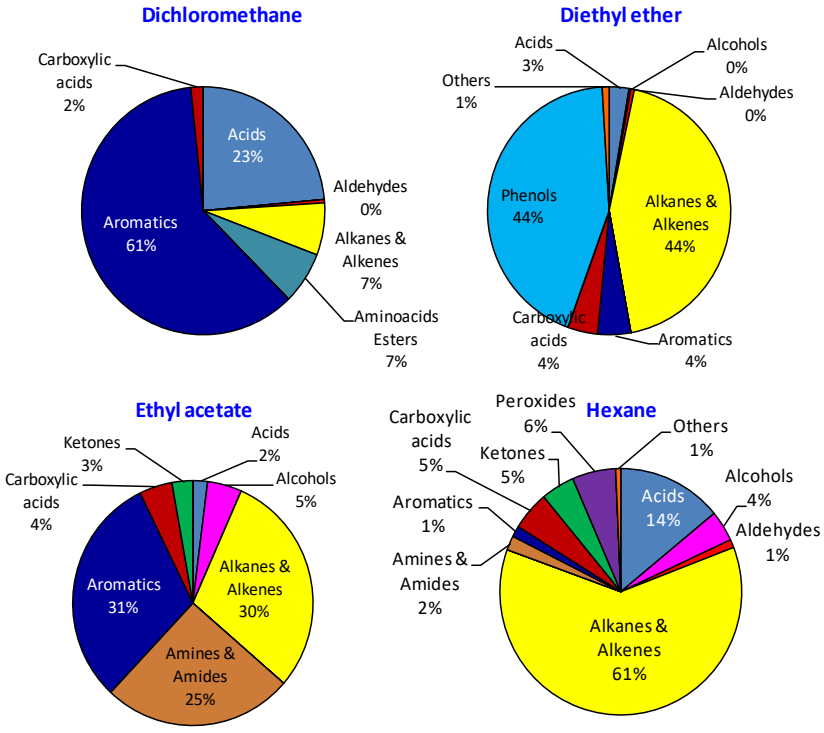


Fig. 8.8.1: Efficiency of solvents in microbial volatiles extraction

Table 8.8.1: Field trap catch data of whiteflies and jassids

	Whiteflies		Jassids	
Bacterium	Total catch	% increase	Total catch	% increase
Clostridium sporogenes	508	125.7	72	60.0
Enterobacter aerogenes	374	66.2	59	31.1
Eubacteriumuniforme	352	56.4	80	77.7
Aeromonas caviae	352	56.4	83	84.4
Aeromonas finlandiensis	350	55.5	101	124.
Enterobacter hormaechei	331	47.1	72	60.0
Providencia rettgeri	325	44.4	65	44.4
Providencia rettgeri	301	33.7	89	97.7
Enterobacter hormaechei	290	28.8	51	13.3
Control	225		45	

8.9Project Name: Microbial interventions for potassium nutrition in cotton

Dr. SavithaSantosh (PI); Co-PIs-Dr. Ramkrushna, G.I, Dr. A. Manikandan

Importance of the study: Though Indian soils have medium to high levels of potassium (K), most of the K stocks are reported to be in plant unavailable form. Exogenous application of K solubilizing microorganisms (KSM) was shown to enhance K availability in several crop plants. However, such studies are scarce in cotton. In this study, our aim was to identify efficient KSMs for solubilization of soil-bound K in cotton-grown soils.

Salient findings

The K solubilization index of selected KSMs on Alexandow media supplemented with bromothymol blue ranged from 1.3 to 4.0. The KSMs are also found to produce plant growth-promoting hormone, Indole-3 acetic acid (IAA) ranging from 10 to 18.7 µg/ml/24h. These isolates were further studied for their efficiency of potassium solubilization under pot culture and field conditions.

Table 8.9.1: K solubilisation index of on Alexandrow media+ BTB

Isolate Code	Zone of Solubilization (mm)	Colony size (mm)	Solubilization Index
KSM1	03^{e}	10^{c}	1.30^{e}
KSM2	07^{d}	12^{a}	1.58^{d}
KSM3	10^{c}	10^{c}	2.00^{c}
KSM4	03^{e}	10^{c}	1.30^{e}
KSM5	17^{b}	11^{b}	2.54^{b}
KSM6	30^{a}	10^{c}	4.00^{a}
CD (0.05)	0.4	0.2	0.05

K solubilization by KSM 6 isolate

8.10Project Name: Metabolite Exploration of Drought stress in Cotton

Dr. PoojaVerma (PI); Co-PI - Dr. Ramkrushna G I

Importance of the study: Droughtis the major abiotic stress, which affects cotton productivity. Recently, a calcium oxalate (CaOx) crystal has been explored for its functional role in supplying carbon (CO_2) for photosynthesis under drought stress conditions. Based on it, a hypothesis is put forward that CaOx could be used as a biochemical pump to collect C from the organ interior under drought stress conditions in cotton as well. Alternatively, metabolic changes under drought stress conditions in cotton will more clarify the mechanism to support the above as well as to identify the new metabolic indicator of drought in cotton.

Salient findings

Fifty-one cotton genotypes were screened for *in-gel*OxO activity under control and drought conditions. Band intensity of oxalate oxidase showed more expression in cotton under drought stress compared to their respective controls. Genome–wide identification of the *GLP1* isoforms/oxalate oxidase was performed and 50 such isoforms were identified in *G. arboreum*.These were further characterized for their tissue-specific expression (leaves, squares, ovules and cotyledon).

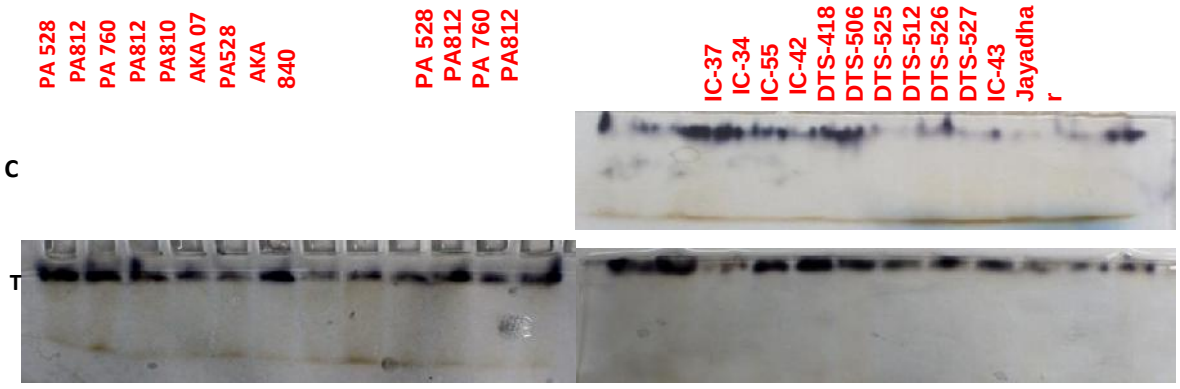


Fig. 8.10.1: Screening of cotton germplasm lines/genotypes for oxalate oxidase (*In-gel*) (C: Control; T: drought stress)

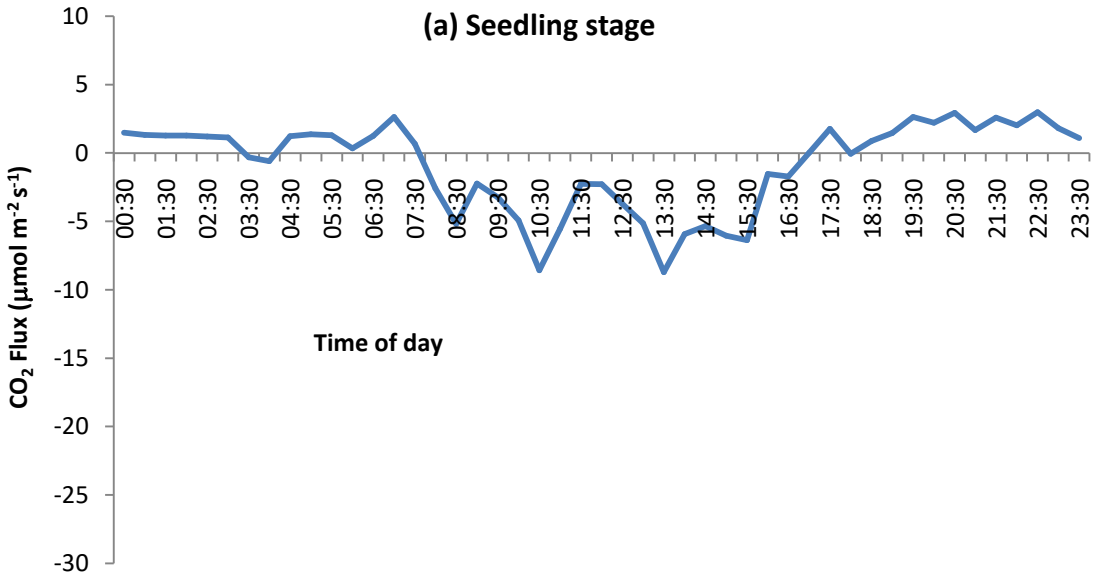
8.11Project Name: Quantitative estimation of carbon and moisture fluxes over the cotton based agro-ecosystem: Integrating ground observations, satellite data and modeling

Dr. MV.Venugopalan (PI); Co-PI -Dr. A Manikandan

Importance of the study: The project aims at a quantitative assessment of carbon/moisture fluxes and energy balance components over the cotton-based agroecosystems. The understanding and quantification of the spatial and temporal dynamics of the carbon, moisture and energy fluxes and stocks would help in modeling the net carbon sequestration at regional level. The outputs would be helpful for making policy decisions on environmental issues.

Salient findings

The diurnal Net Ecosystem CO_2 Exchange (NEE, µmol m^{-2} s^{-1}) at different crop stages is shown in Fig8.11.1 (a to c). Cotton crop behaved as a net C source during night time due to respiration. Whereas, it acted as a net carbon sink during day time as photosynthesis prevails over respiration.The night NEE was 5-10 µmol m^{-2} s^{-1} for cotton crop. The day time NEE reached its peak during 12:00 to 14:00 hrs depending on the net radiation and clear sky condition. The peak NEE during 1 Aug (nearly 30 DOS) was found to be -10 µmol m^{-2} s^{-1}. It has increased to -20 to -25 during µmol m^{-2} s^{-1} September-November during flowering and peak boll development stage.The total carbon sink decreased afterward as the senescence of cotton crop started from December to January. The peak NEE on 1 Jan was found to be -5 µmol m^{-2} s^{-1} during the day time.



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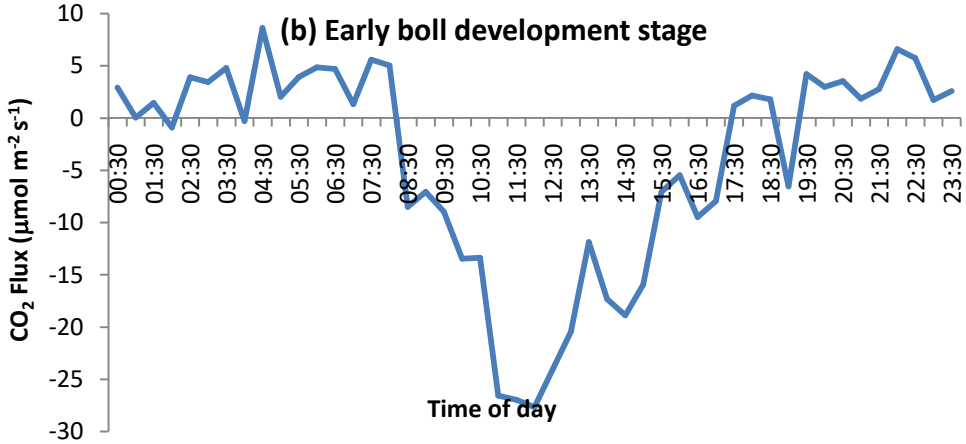


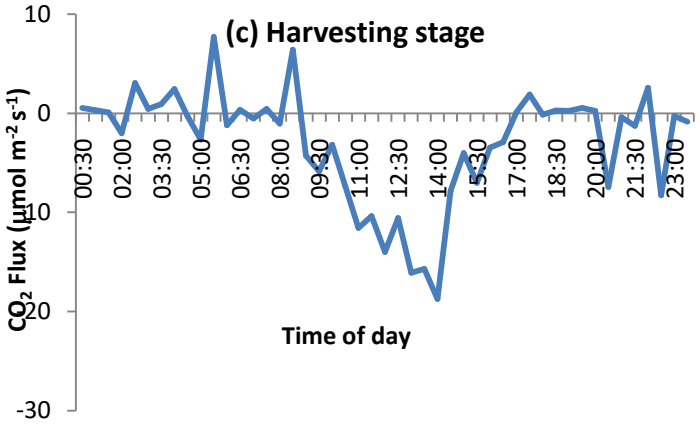


Fig. 8.11.1: Diurnal Net Ecosystem CO_2 Exchange (NEE, µmol m^{-2} s^{-1}) at different crop stages

8.12Project Name: On-station assessment of water footprint of cotton

Dr. Bhargavi. B (PI); Co-PIs -Dr. Blaise Desouza, Dr. P. Nalayini, Dr. K. Velmourougane

Importance of the study: Water footprint (WF) represents the extent of water consumption by the crop (green and blue water), and the amount of water required to dilute the ground water pollutants (grey water). Estimation of water footprint helps inthe optimization of limited available water resources. As cotton is primarily grown as rainfed crop, the estimation of water footprint helps in sustainable water management in cotton cultivation.

Salient findings

On-station experiment was conducted to estimate the water footprint of cotton production under three water management practices (Rainfed, Furrow irrigated, and Drip irrigated) at Nagpur and Coimbatore (Under ridge and furrow system). Cotton yield (t ha^{-1}) and crop evapotranspiration (mm) for rainfed and irrigated cotton were used to calculate the green and blue WF. The grey WF was estimated considering the effect of N fertilizer only. The total WF of rainfed cotton was 16384 m^3/t of seed cotton (Fig 8.12.1), of which the green WF was 12187 m^3/t, and the grey water foot print was 4198 m^3/t. The total WF of drip-irrigated cotton was 13310 m^3/t. The ridge and furrow-irrigated cotton at Coimbatore recorded higher WF 26541 m^3/t.Among the various agro-techniques evaluated to reduce water foot print, broad bed and furrow system with polymulch intercropped with green gram yielded higher SCY (3288 kg ha^{-1}) with less water requirement. While, ridges and furrows system yielded lesser SCY (1801 kg ha^{-1}).

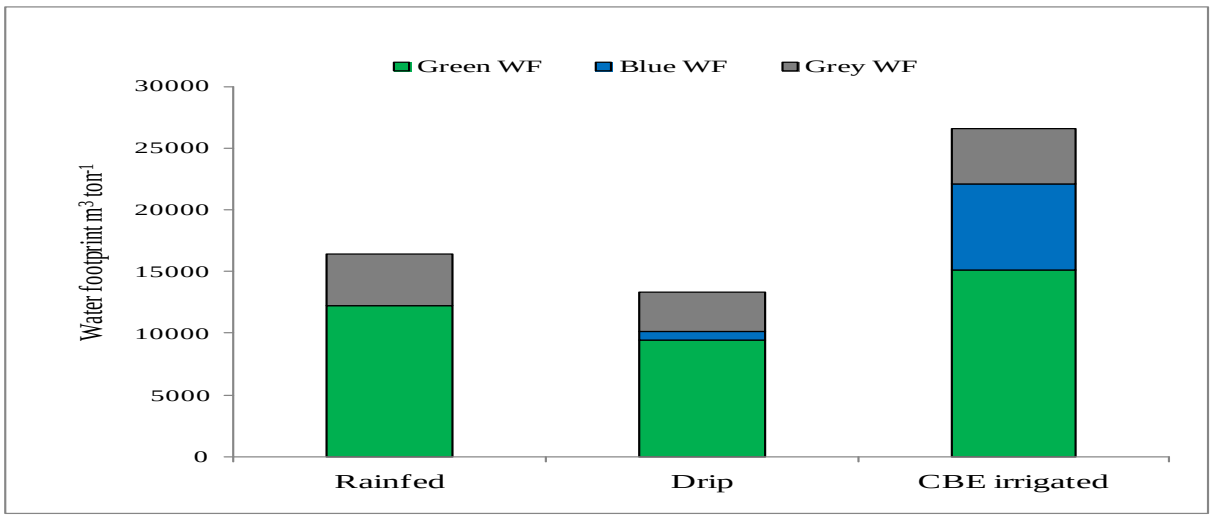


Fig. 8.12.1 Water footprint under different water management practices

BBF cotton intercropped with green gram

8.13 Project Name: Exploring the productivity potential of long-linted G. arboreum cotton

Dr. MV Venugopalan (PI); Co-PIs- Dr.K Sankaranarayanan, Dr. Jayant Meshram, Dr. GI Ramkrushna, Dr. PoojaVerma, Dr. SS Mahajan, Mr. TN Madhu, Dr. Neelakanth Hiremani, Dr. M Sabesh

Importance of the study: The project provides location-specific long lintedarboreums tailored with an agronomic package to maximize their productivity of cotton despite the uncertainties posed by climate change and rainfall aberrations.

Salient findings

Field experiments were conducted at Nagpur for 3 years 2017-18 through 2019-20 on two soils-a medium deep VerticInceptisol and a deep Vertisol. Six medium long to long linted genotypes of *G. arboreum* L. (PA 812, PA 760, PA 528, PA 402, DLSA 17, CNA 1041) and a short staple check- PhuleDhanwantary were evaluated at two spacing (60 × 10/15 cm – HDPS and 60 × 30 cm-normal) on two dates of sowing (timely with the onset of the

monsoon (D1) and late around 14 days after the first (D2)). The study indicated that, genotypes CNA 1041 and PA 528 were the highest yielders, followed by PA 812 and PA 760. The fibre quality of PA 812 and PA 760 were significantly superior to the rest (Table 8.13.1).

Table 8.13.1: Fibre quality attributes of *G. arboreum* genotypes

Genotype	UHML(mm)	UI (%)	MIC (µg/inch)	BS (g/tex)	El (%)
DLSA-17	27.3	81.1	4.89	28.3	5.9
PA-528	27.0	81.0	5.21	28.5	5.9
PA-402	25.3	79.8	5.18	27.9	6.1
PA-812	29.1	82.3	4.75	30.8	5.8
PA-760	28.9	82.7	4.66	30.2	5.86
CNA - 1041	24.8	79.3	5.6	28.6	6.2
PhuleDhanwantari	16.9	69.6	6.8	22.1	6.8

Salient findings

- The mean seed cotton yield gain due to HDPS was 228 kg/ha. However, there was a wide variation among genotypes ranging from 85 kg/ha in PA 402 to 352 kg/ha in PhuleDhanwantary
- The mean loss in yield due to a delay in sowing 411 kg/ha. However, the loss ranged from 67 kg/ha in P Dhanwantary to 570 kg/ha in PA 528.
- The VerticInceptisol was more productive than Vertisols for arboreum. The mean yield advantage was 330 kg/ha.
- DLSA 17 and PA 812 had a lower incidence of Grey mildew
- Stage-specific transcriptome analyses during fibre growth identified many genes preferentially expressed at fiber initiation, early and later elongation stages. *ACS* and *ACO* genes of ethylene biosynthesis pathways regulate ethylene release and its downstream signaling pathways. Ethylene may positively regulate the cotton fiber growth by promoting the fiber elongation, possibly due to acting on genes directly involved in fiber growth or by activating some downstream pathways which control the fibre traits in cotton.
- There was no effect of row orientation on the productivity of *G arboreum* under HDPS either at Coimbatore or at Nagpur.
- At Coimbatore, 4 August sowing realized seed cotton yield of 1346 kg/ha compared to 537 kg/ha with 4 September. P Dhanwanthry, K 12 and DLSA 17 were promising.
- Application of mepiquatchloride twice @ 25 g a.i./ha and de-topping+side shoot removal modified plant architecture, increased seed cotton yield, harvest index and seed quality

8.14 Project Name: Crop-weed interactions under ambient and elevated CO2 conditions

Dr. P. Nalayini (PI), Co-PI- Dr.A.H.Prakash, Dr. M. Amutha

Importance of the study: Anthropogenic increase in CO_2 level is predicted to impact agriculture production and productivity in terms of alteration in weed species and their interactions with crop species. Hence, it is essential to study the crop- weed interactions under elevated CO_2levels and devise

sustainable weed management strategies for changing climate.

Salient findings

Experiments were initiated during winter (August- February) season of 2020-21 cropping season with the following treatments: a) integrated weed management (IWM) under elevated CO_2, b) IWM under ambient conditions, c) Weedy check under elevated CO_2, d) Weedy check under ambient conditions, and e) Weed free treatment under ambient conditions. An elevated CO_2 ambience of 480 ppm was maintained continuously from the true leaf stage of cotton using CO_2 cylinders kept near the OTCs (open-top chambers).

The elevated CO_2 levels enhanced weed and cotton growth. However, there was 108% enhancement in weed dry matter accumulation over its ambient counterpart on 90 days after sowing as compared to 40% enhancement in dry matter accumulation in cotton was during this period.All the cotton growth attributes such as plant height, number of leaves, leaf area, squares,boll numbers, and biochemical parameters (soluble sugars and leaf chlorophyll content) were altered due to elevated CO_2.

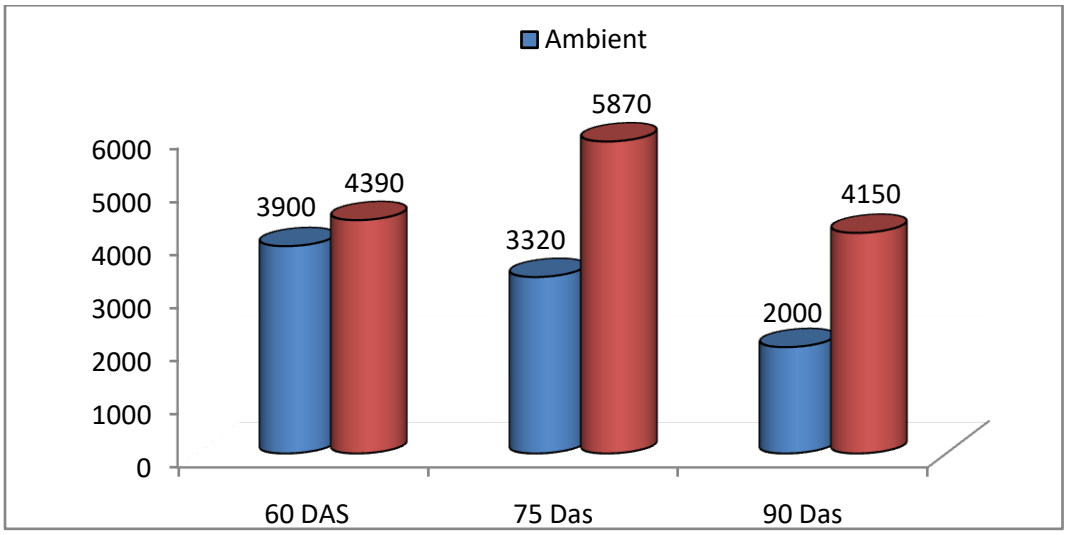


Fig. 8.14.1: Wheat dry matter production (Kg/ha) as influenced by elevated CO_2

Pendimethalin treated Vs. un-weeded under elevated CO_2

Integrated weed management (Suraj Bt) under ambient and elevated CO_2

8.15 Project Name: Evaluating of agrotechniques for overcoming of weather aberration of drought and water logging in cotton

Dr. K. Sankaranarayanan (PI); Co-PI- Dr.Annie Sheeba, Dr.M Amutha, Dr.P. Valarmathi,Dr. J.H.Meshram,Dr. B.Bhargavi

Importance of the study: The erratic distribution of rainfall during cotton growth leads to frequent wet and dry spells. Continuous dry/wet spells during critical crop growth stages such as squaring, flowering and boll development affect the yield and quality of cotton. The project aims to develop contingent measures to mitigate such adversities.

Salient findings

Adoption of soil moisture conservation techniques (ridges and furrows) followed by foliar application of Glycine Betaine @ 100ppm, 5 days after plant drought experience was found to produce significantly higher (29.3%) seed cotton yield (1966 kg/ha), total chlorophyll stability index (77.7%), and nitrate reductase activity (550.8 µ g/g) compared to control (rainfed) at first picking. The adoption of drainage practice (ridges and furrows) followed by foliar application of salicylic acid (0.5mM)3 days after water-logging resulted in significantly higher seed cotton yield (1982 kg/ha), total chlorophyll content (2.3 mg/g), and nitrate reductase activity (650.5 µ g/g) compared to control (water logging) at first picking. Increasing depth of sowing from 2.5 cm to 7.5 cm reduced 15%of the mean germination under control and 10% under water-logged condition (36 hours). Application of FYMduring the seed bed preparation, helpedin increasing the mean germination by 4.5% and 4.7%, for control and water-logging (36 h) conditions, respectively. Water-logging (36 h) reduced germination by 40.5%, 35.0%,21.0%, 37.6%,24.5%, and 26.3% respectively, in*arboreum*(PA 528), *barbadense*(Suvin), *hirsutum* (Suraj), herbaceum (G Cot 25), H×H (RCH 659 BG II), and H× B(MRC 7918 BGII).

8.16 Project Name: Sustainable Intensification of Extra Long Staple Cotton Production in South Zone

Dr.R. Raja (PI); Co-PIs- Dr. Annie Sheeba, Dr. K. Rameash, Dr. K. Rathinavel

Importance of the study: Maintenance of increased plant population per unit area and the judicious use of growth regulators for canopy management are expected to enhance the productivity of Extra Long Staple (ELS) cotton. Field experiment is being conducted at ICAR-CICR Regional Station, Coimbatore from July 2019 onward to study the effect of increased plant population per unit area and use of growth regulators on the productivity of ELS cotton. Two ELS cultivars (V_1: Suvin and V_2: RCHB 625 BGII) were grown under three spacing *viz*., S_1: 90×60 cm, S_2: 90×45 cm and S_3: 90×30 cm. Foliar sprays of growth regulator *viz*., G_1: MC (Mepiquat Chloride) @ 60ppm, G_2: CCC (Chlormequat Chloride) @ 50ppm, G_3: TIBA (2,3,5-triiodobenzoic acid) @ 100ppm and G_4: Water spray were done at 70 and 100 days after sowing based on Height-to-Node Ratio.

Salient findings

The application of growth regulators *viz*., MC and CCC at 70 and 100 DAS significantly reduced plant height in Suvin and RCHB 625 BGII at 125 DAS. Closer planting (S_2 and S_3) of Suvin and RCHB 625 BGII hybrid produced significantly higher number of bolls per unit area compared to normal planting (S_1). Planting Suvin at 90×45 cm spacing produced significantly higher SCY(1395 kg ha^{-1})than 90×60 cm (1150 kg ha^{-1}). Planting RCHB 625 BG II hybrid at 90×30 cm spacing produced significantly higher SCY (1892 kg ha^{-1})than 90×60 cm (1628 kg ha^{-1}) and 90×45 cm (1620 kgha^{-1}). Increased plant population and growth regulator application had no significant effecton fibre length, strength and uniformity index.

RCHB 625 BG II at 150 DAS grown under 90 ×30 cm spacing with MC spraying @ 60 ppm at 70 and 100 DAS

8.17 Project Name: Effect of long-term application of organic and inorganic sources of nutrients on continuous cultivation of Bt and non Bt cotton cropping system under irrigated conditions

Dr. D.Kanjana (PI); Co-PIs-Dr. K.Sankaranarayanan, Dr. Amarpreet Singh

Importance of the study: Long-term fertilizer experiments serve as an important tool to understand the changes in soil properties, nutrient dynamics and complex interactions between soil and crops due to continuous cultivation of high yielding crops and continuous application of fertilizers.

Salient findings

Field experiments were conducted in a split plot design during winter of 2018-19 and 2019-20 to study the cotton-maize and cotton-wheat cropping system with organic, inorganic and integrated sources of nutrients. After two years of continuous adoption of

cotton–maize and cotton-wheat cropping system under irrigated conditions, SCYincreased significantly by 26.5% and 134.6%in combined sources of organic (FYM once in two years) and inorganic (NPK + $MgSO_4$ + $ZnSO_4$ + Borax), treatments, respectively,compared to the control. Though, all the growth and yield-related parameters were significantly improved under *Bt* cotton hybrid-maize and *Bt* cotton hybrid-fallow cropping system, the highest SCY was observed under *Bt* cotton variety (HDPS) - maize cropping system. Under cotton-wheat cropping system, higher SCY was recorded in *Bt* cotton hybrid compared to non-*Bt* cotton hybrid, *Bt* and non-*Bt* cotton variety.

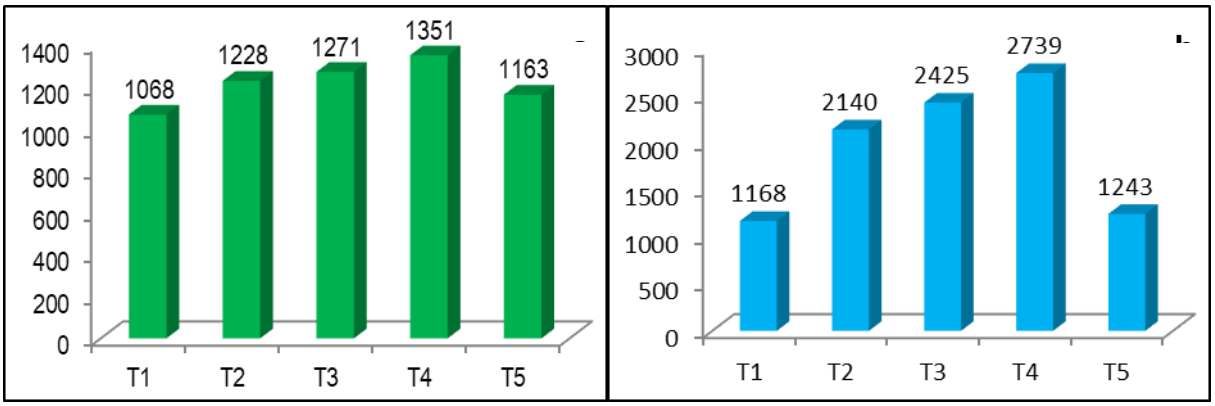


Fig.8.17.1: SCY (kg/ha) under a) cotton-maize and b) cotton-wheat cropping system (Mean of 2 years)

Cotton-maize cropping system (T1 – Control, T2 - NPK (100 %), T3 - NPK +MgSO4+ZnSO4+Borax, T4 - NPK +MgSO4+ZnSO4+Borax + FYM (once in two years), T5 - FYM (every year) + Azophos + Neem cake + Sunnhemp incorporation)

Cotton-wheat cropping system (T1 – Control, T2 - NPK (100 %), T3 - NPK +MgSO4+ZnSO4+Borax, T4 - NPK +MgSO4+ZnSO4+Borax + FYM (once in two years), T5 - FYM (every year)+Azophos+Neem cake+Daincha incorporation)

8.18 Project Name: Exploiting the epigenetic transgenerational inheritance of stress responsive traits for imparting abiotic stress tolerance in cotton

Dr. J. Annie Sheeba (PI)

Importance of the study: If the epigenetic change in response to environmental conditions is inherited, the epigenetic inheritance may allow the plants to continually adjust its gene expression to fit its environment without changing its DNA code. The potential value of epigenetic inheritance is reflected directly by the influence of variations in DNA methylation on important agricultural traits such as flowering time, plant height, drought tolerance and yield. The use of Epigenetic Regulating Chemicals (ERCs) for improving stress tolerance in plants is gaining importance. The following study was devised to explore the possibility of using epigenetic inheritance for imparting abiotic stress tolerance in cotton.

Salient findings

The ERCs treated Suraj and LRA 5166 were subjected to drought stress in the fourth generation and screened for drought tolerance. Sulfamethazine (10 µM) and 5 Azacytidine (10µM) improved the relative water content in Suraj over the control. The

SPAD values were higher in Nicotinamide (35 µM) treated plants (37.8) followed by Sulfamethazine (35) compared to control (23.9) in Suraj. In LRA 5166, Sulfamethazine treated plants recorded higher SPAD value (32.5) followed by Epi gallocatechin gallate (32.0) compared to control (26.2). Nitrate reductase (NR) activity was higher in control (668.9 µg NO_2 /g/h) compared to other treatments, which are followed by 5 Azacytidine 40µM (637.4 µg NO_2 /g/hr). NR activity was higher in 5 Azacytidine 40µM (865.6 µg NO_2 /g/hr) treated plants followed by Epi gallocatechin gallate (739.7) µg NO_2 /g/hr). Proline content is higher in 5 Azacytidine 40 µM treated plants in both Suraj and LRA 5166 over control (Fig.8.18.1). Chlorophyll stability index was positively influenced by the ERCs (Fig.8.18.2).

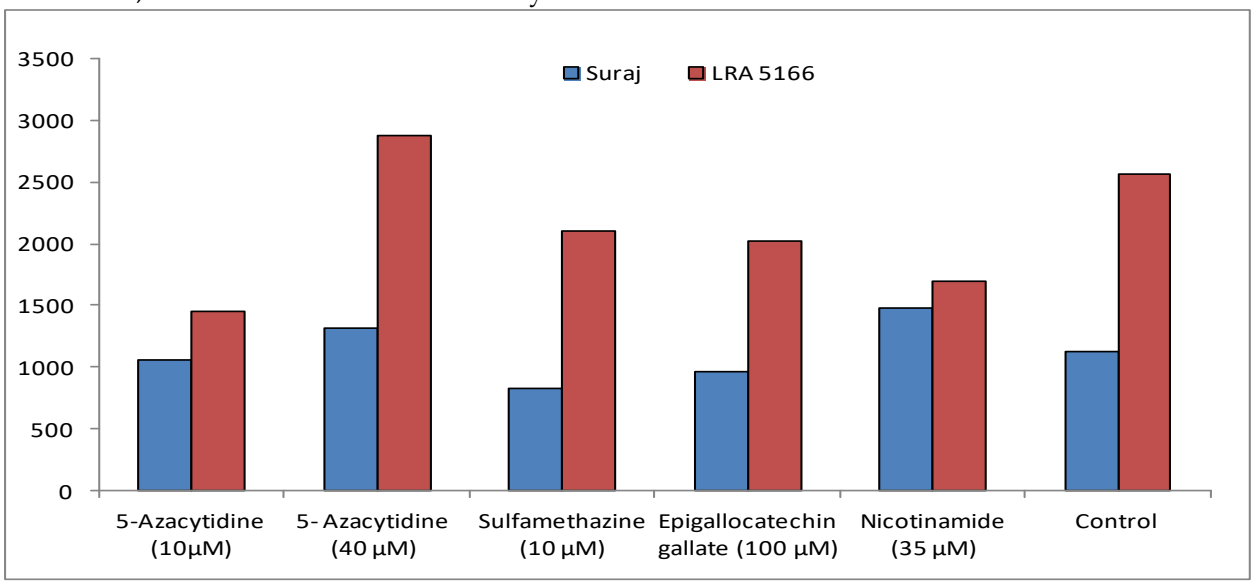


Fig. 8.18.1: ERC on proline content (µg/g fw) under stress conditions

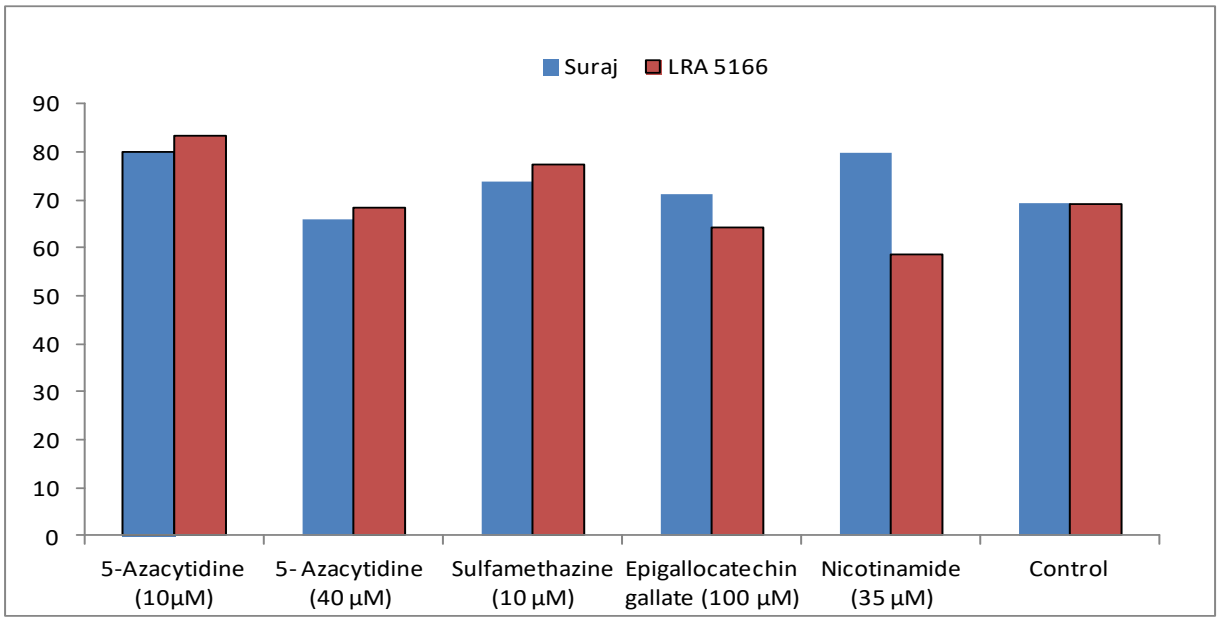


Fig. 8.18.2:ERC on chlorophyll Stability Index (%) under stress conditions

8.19Project Name: Development of cotton based cropping systems under conservation agriculture for North-Western Indian conditions

Dr. Amarpreet Singh (PI); Co-PIs-Dr.S.K. Sain, Dr. Rishi Kumar, Dr. K. Velmourougane

Importance of the study: The factor productivity (nutrient, water, energy) is declining under the irrigated cotton-wheat system due to the degradation of the soil system under conventional agriculture. Adoption of conservation agriculture systems can reverse this degradation process. There is a need to develop a suitable technology for conservation agriculture under cotton based cropping systems.

Salient findings

The seed cotton yieldwas significantly higher under M_6 (Zero tillage - permanent narrow raised bed with residue retention on surface) among all other treatments. The lowest seed cotton yield was obtained under M_1 (Conventional Tillage - Flat Bed without residue incorporation; i.e., farmers practice). However, it was at par with M_3 (Zero Tillage - Flat Bed without residue retention on surface). Among the cropping systems, significantly higher seed cotton yieldwas recorded under (S_3) [Cotton - Chickpea (Bengal gram)] compared to all other cropping systems. The second-best cropping system with respect to the SCYwas (S_2) [Cotton - Mustard (Raya)], which was at par with (S_7) [Cotton - Berseem (Fodder)] and (S_1) Cotton - Wheat cropping system. seed cotton yieldunder (S_1) Cotton - Wheat and (S_4) Cotton -Barley cropping systems were at par with each other. Lowest seed cotton yieldwas obtained under (S_5) [Cotton - Winter Maize (Spring Maize)] cropping systems.

Plate 1a **Plate 1b** **Plate 1c**

Plate 1a: Field view of Cotton based cropping systems during the cotton season; Plate1b: Mustard crops residue mixed in soil and cotton seedlings; Plate 1c: Berseem residue on soil surface (raised beds) & cotton

8.20 Project Name: Enhancement in productivity of cotton through improvement in agrotechniques under North-Western Indian conditions

Dr. Amarpreet Singh (PI); Dr.Rishi Kumar, Dr. S. K. Sain

Importance of the study: Under this project, three separate experiments were conducted with (a) Bt cotton variety (b) non-Bt cotton variety and (c) Bt cotton hybrid under split-split plot design with four dates of sowing as main plots, three plant spacing as sub-plots and three levels of MC application as sub-sub

plots at ICAR-CICR, Regional Station, Sirsa, Haryana 2020-21 cropping season.

Salient findings

(a). Bt cotton variety (CICR Bt-6) and non-Bt cotton variety (CSH 3075):

- Early sowing of Bt cotton variety (CICR Bt-6) and non-Bt cotton variety (CSH 3075) during [4th week of April] gave significantly higher SCYthan sowing at later dates.
- Spacing of 67.5 cm × 45 cm was superior to closer spacing at 67.5 cm × 10 cm.
- The response to the application of MC was significant.Spraying MC twice (20 g ai/ha) at 60 and 75 DAS was superior to a single spray at the same rate at 60 DAS.
- The interaction between sowing date and spacing was significant indicating when sowing was delayed until the second week of June; closer spacing (67.5 cm × 10 cm) gave higher yield than wider spacing (67.5 cm × 10/30 cm).

(b). Bt cotton hybrid (SP-7172):

- Early sowing of Bt cotton hybrid (SP-7172) during [4th week of April] gave significantly higher seed cotton yield than sowing at a later date.
- The optimum spacing was 67.5 cm × 60 cm.
- Application of Mepiquat chloride at 60 and 75 DAS significantly improved the seed cotton yield.
- The spacing × sowing date effect was significant. When sowing was delayed to the second week of June, planting at closer spacing (67.5 cm ×30 cm) gave higher yields than planting at wider spacing's (67.5 cm × 60 cm or 67.5 cm × 45 cm).

Theme 9: Socioeconomic dimension of cotton production system and technology transfer/dissemination and outreach

9.1 Project Name: e- Communication: Dissemination of Cotton Production Technology

Dr. S.M. Wasnik (PI); Co-PIs- Dr. S. Usha Rani, Dr. O.P. Tuteja

Importance of the study: E-Communication network greatly helped the public sector organizations to disseminate timely advisory to cotton farmers. Further, propagating the relevant and need based information in local languages helped farmers take timely crop management decisions. The Cotton App developed by ICAR-CICR was well received by the cotton stake holders, as the app was simple and user friendly with all informationabout cotton cultivation, including improvement, production, and protection.

Salient findings – 2019-20:

Farmer's database

- A total of 1,60,661farmers were registered for three centres Nagpur (1,27,231) Coimbatore (10,768), Sirsa (22,662)

Delivery of voice messages

- Uploaded 91,54,264 (81,02,023, 5,49,764, 5,02,477 from Nagpur, Coimbatore, Sirsa, respectively) during theyear 2020. Noise free and clear recorded voice calls on 108 messages on cotton production and protection technologies to the farmers in Marathi, Tamil & Hindi languages.
- Out of 39,98,710 (35,30,341 2,41,598, & 2,26,771 from Nagpur, Coimbatore, Sirsa, respectively) was received by the farmers regarding mitigation measures for tackling extreme weather conditions like rains, agro-practices, pest attack, pink bollworm, etc.

Cotton app

- CICR Cotton app is available on Google Play store and it is free to download & use
- Till date, 5000+ users have downloaded this app, and the rating for the app is 4.1 out of 5
- The app is available in five languages namely, English, Hindi, Marathi, Gujarati, Kannada
- The CICR Cotton app includes zone wise information on
  - Varieties & Hybrids:Bt Varieties & Hybrids, etc.
  - Crop Production: Cropping system, Nutrient management, Sowing time, etc.
  - Crop protection: IPM/IRM strategies, Disease Management.
  - Farmers Outreach: e-kapas/e-communication, MGMG, FLD's, IRM, TSP. KVK
  - Facts & Figures:Area production & productivity of cotton in state, MSP, etc.

9.2 Project Name: Development of Extension Model for Promoting the Production of Extra Long Staple Cotton in India

Dr. S. Usha Rani (PI); Co-PIs- Dr.S. Manickam, Dr.K. Sankaranarayanan, Dr.M. Sabesh, Dr. M. Amutha, Dr. P. Valarmathi, Dr. S. M. Wasnik

Importance of the study: As India accounts for 40% of the global share in the fine and super fine cotton yarn trade, it is important to identify the constraints of ELS cotton production and suggest solutions. There are good varieties, hybrids and other technologies available for improving the production of ELS cotton. But, diffusing them to end users through an appropriate tailor-made diffusion model, documenting the concerns of end users regarding cultivation and marketing of ELS cotton and providing empirical evident data for finalizing the policy are the pre-requisites. Similarly, the concerns of other stakeholders in ELS cotton and their expectations from the research and policy sectors also need to be collected, documented and brought to the attention of the concerned. Hence, to provide a comprehensive review of evidence on ELS cotton production sector considering information from published literature, document the concerns of stakeholders, provide empirical evidences from the potential ELS cotton growing districts and develop an extension model appropriated for promoting ELS cotton in India, an extension research has been planned.

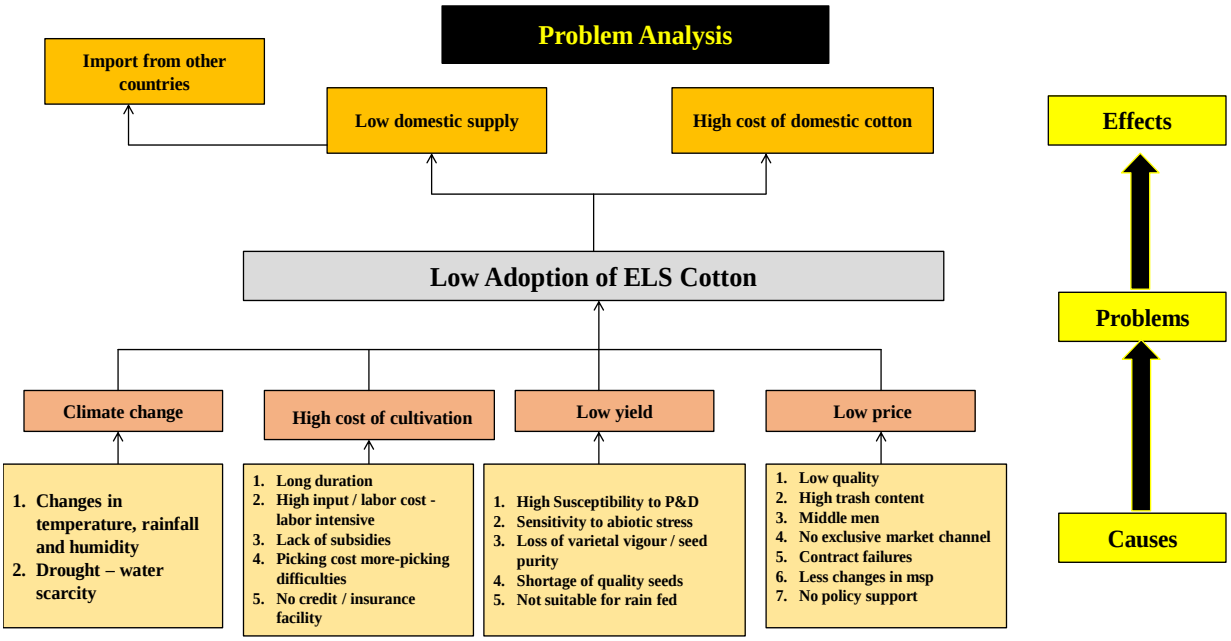
Salient findings

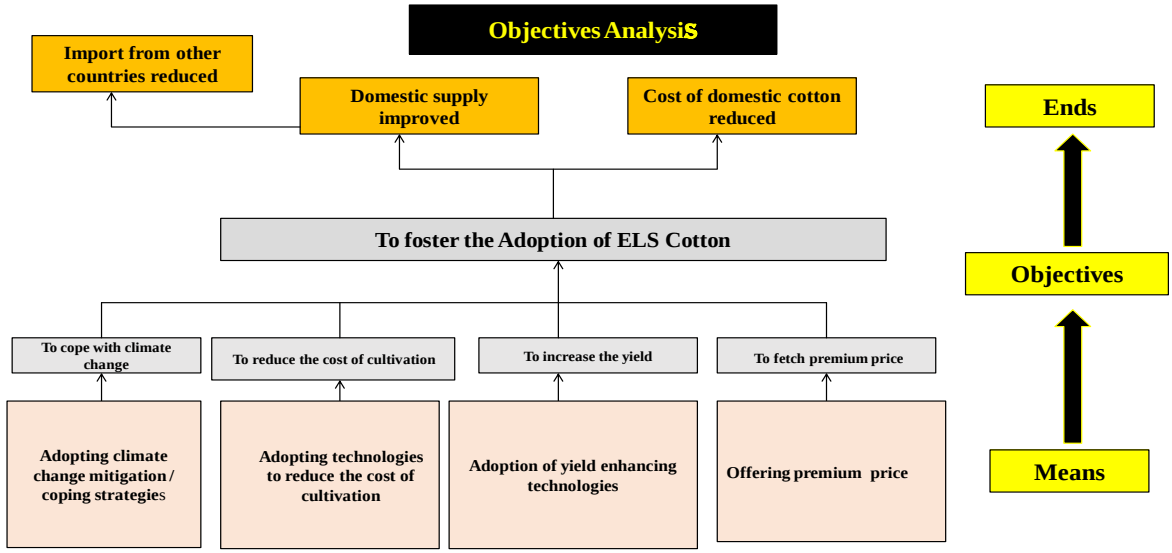
Perspectives of ELS cotton growers on constraints faced in ELS cotton cultivation were collected through PRA - Problem tree technique by conducting five Focus Group Discussions (FGDs) in Tamil Nadu and Karnataka. The major reasons for low adoption of ELS cotton are the high cost of cultivation, low yield, low price and climate change. The root causes for the reasons cited above are changes in climatic pattern, long duration, high input/labor (including picking) cost, lack of subsidies, picking difficulties, no credit/insurance facility, high susceptibility to P&D, sensitivity to abiotic stress, loss of varietal vigor/seed purity, shortage of quality seeds, low quality, high trash content, middle men, no exclusive market channel, contract failures and lack of policy support.

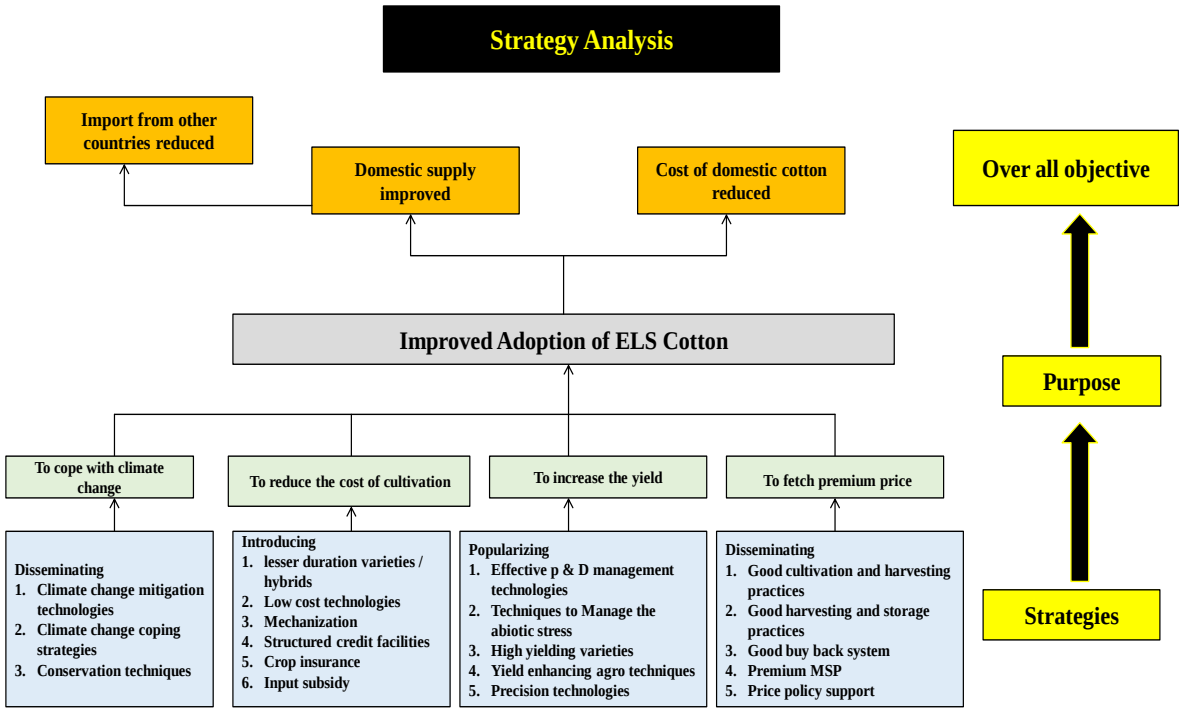
The objective analysis revealed means to foster the adoption of ELS cotton in India. They were adopting climate change mitigation/coping strategies, adopting low-cost technologies, adopting yield enhancing technologies to increase the yield, reducing the imports, increasing the domestic supply and reducing the cost of domestic ELS cotton.

The strategy analysis revealed the strategies viz., disseminating climate change mitigation technologies, climate change coping strategies (including conservation techniques), introducing early maturing varieties/hybrids, low-cost technologies (production, biotic and abiotic stress management) , mechanization, structured credit facilities, crop insurance and input subsidy, precision technologies to increase the yield, disseminating good cultivation and harvesting practices, good harvesting and storage practices, good buy back system, premium MSP and price policy support need to be implemented to foster the adoption of ELS cotton.

Perspectives of ELS Cotton Growers on Constraints Faced in ELS Cotton Cultivation – PRA (Problem tree technique)







9.3 Project Name: Impact analysis of shift in global cotton trade on Indian cotton scenario

Dr. Isabella Agarwal (PI)

Importance of the study: The global cotton market is shifting rapidly, from historical producers and consumers to new markets. The transition period would also induce changes in cotton trade flows resulting in new importers and exporters on the world market. In comparison to other countries, India is a far better and stable sourcing destination for international buyers. Empirical analysis and outcome of this study would give an insight of where India stands in the global cotton trade scenario and what are the measures to be taken to bring it to the forefront and benefit all the stakeholders in the cotton value chain to the maximum extent possible.

Salient findings

- Cotton farm profitability was seen in the cotton-growing states during most of the years (Table 9.3.1). A profit margin of 35 to 52% profit margin over Cost C2 was registered over the years.
- A unit increase in domestic production of cotton would increase the demand for Indian cotton by 6.02%.
- TFP growth rate during 2010 to 2016 was in decreasing trend (-6.8%) in almost all the cotton-growing States except Tamil Nadu to the tune of 4.84%.
- NPC explains the comparative advantage of Indian cotton mainly amongst China and Pakistan.
- Thailand and Taiwan were less stable in our cotton export, which must be taken care.
- RSCA indices reveal India's comparative advantage has started increasing over years after 2016.
- Commodity composition effects suggest that India concentrates on slow growth markets for Cotton (Table 9.3.2). The results of market distribution effects show that Indian export of Cotton is concerted in

the markets where demand is rising faster than world demand.

- India, rather than relying on China for its raw cotton exports, itmust concentrate on other potential importers such as Vietnam, Bangladesh, Pakistan, Indonesia and other country's group, which includes Hong Kong, Thailand and Malaysia, which depends on imports to meet the requirements of their export focused garment industries.
- In future. India needs to establish world class-manufacturing units along the cotton value chain to exploit the opportunities to produce finished products from raw cotton and export the same. This would absorb surplus domestic cotton and in turn provide additional employment opportunities.

Table 9.3.1:State wise Cotton Farm Profitability

States	Value of Product (VOP) Rs.		Ratio of VOP to Cost A2		Ratio of VOP to Cost C2	
	2004-2010	2010-2017	2004-2010	2010-2017	2004-2010	2010-2017
Andhra Pradesh	42132.27	66604.35	1.99	2.00	1.13	0.95
Gujarat	44101.97	82930.57	2.36	2.76	1.35	1.30
Haryana	40536.28	62792.25	2.68	2.85	1.15	1.01
Karnataka	20212.17	60558.63	1.95	2.61	1.18	1.21
Madhya Pradesh	31238.38	56341.07	2.18	3.01	1.12	1.06
Maharashtra	26068.83	67014.13	1.50	1.90	1.00	0.99
Odisha	33233.45	44841.07	2.40	2.33	1.21	0.94
Punjab	49773.12	70070.65	2.40	2.19	1.20	1.03
Rajasthan	36174.18	89909.22	4.27	5.21	1.52	1.48
Tamil Nadu	34431.43	78127.17	1.85	2.57	1.02	1.04

Table 9.3.2:Constant market Share analysis

Particulars	2011-2014	%	2015-2018	%
World Trade Effect	13238677	-15.37	47120288	53.29
Commodity Composition Effect	-8627779	114.54	41326011	46.74
Market Distribution Effect	15524605	-18.03	5958616	6.74
Competitiveness Effect	16243826	18.86	-5980061	-6.76
Change in exports	86108322	100.00	88424855	100.00

4. TECHNOLOGIES ASSESSED AND TRANSFERRED

4.1 Insecticide Resistance Management: Dissemination of Pink Bollworm Management Strategies

Pink bollworm (*Pectinophora gossypiella* Saunders) has now emerged as a major pest of Bollgard II in parts of central and south India. Department of Agriculture, Cooperation & Farmers' Welfare (Crops Division), Ministry of Agriculture and Farmers' Welfare, Govt. of India has approved a project on "Insecticide Resistance Management: Dissemination of Pink Bollworm management strategies" under Centrally sponsored scheme on "NFSM: Commercial Crops"

During 2019-20, the project was implemented by ICAR-CICR in collaboration with 10 State Agricultural Universities located in 8 cotton growing states covering total of 21 districts. In each district 50 farmers have been identified as IRM farmers to provide critical inputs. In total 1050 IRM farmers and 400 non-IRM farmers from 105 villages have been identified in 8 states (Maharashtra, Gujarat, Madhya Pradesh, Andhra Pradesh, Telangana, Karnataka, Tamil Nadu and Haryana).

Percent Pink bollworm infestation based on random (based on sampling of at least 20 green bolls per acre)

State	Till Mid November	After Mid November*
Maharashtra	Negligible	0-64
Gujarat	Negligible	0-96
Madhya Pradesh	10%	12-84
Telangana	Negligible, 4-21% in the fields near to ginning mills	0-56
Andhra Pradesh	Negligible	<10
Karnataka	Negligible	0-50
Tamil Nadu	Negligible	8-84
Punjab	Nil	0
Haryana	Negligible in rest of the state but up to 35 % in the fields near to ginning mills	
Rajasthan	Nil	Nil

Major outputs

- Enhancement of skill of 1050 beneficiary farmers, 17 SRFs, 20 Young professionals, input dealers, and other stakeholders
- Reduction in pink bollworm damage by 70 % due to timely interventions and integrated management approach
- Increased cost: benefit ratio (1:2.16)

5. EDUCATION, TRAINING AND CAPACITY BUILDING

5.1: Training and Capacity Building

5.1.1: Training Received

National

Scientist

Name of Scientist	Name of the Training	Place/Organized by	Period
Dr. Rishi Kumar	Training of voice message through E-Kapas	ICAR-CICR Nagpur	09 January 2020
Dr. K. Velmourougane	NABL accreditation of laboratories in ICAR	New Delhi, NABL	22 July 2020
Dr MV Venugopalan	Implementation of E office	ICAR-CICR, Nagpur	24 July 2020
Dr. A Manivannan	Online Abridge Refresher Course "Application of population genetics concepts in plant breeding"	UAS, Bengaluru	27 July to 21 August 2020
Dr. K. Sankaranarayanan	Implementation of e-Office	ICAR-CICR, Nagpur	27 July 2020
Dr MV Venugopalan	Design Thinking in Research Project Formulation and Implementation	ICAR-NAARM (on-line)	25-29 August 2020
Dr V. S. Nagrare	Drone remote sensing in Agriculture	Indian Society of Agrophysics in association with Division of Agricultural Physics, IARI, New Delhi (Virtual)	05 September 2020
Dr. B. Bhargavi	Climate Change: Challenges and Response	CDM, LBSNAA, Mussoorie	05-09 September 2020
Dr. Sunil S. Mahajan	Analysis of Experimental Data using SAS	ICAR-NAARM Hyderabad Online	09-11 November 2020
Dr. Debashis Paul	"Functional Foods, Bioactive Compounds and Phytochemicals for Better Nutrition"	Uttar Banga Krishi Viswavidyalaya	09-11 December 2020
Dr Raghavendra KP	GENOME EDITING	BENGALURU	13-23 December 2020
Dr. B. Bhargavi	Internet of Things	Engineering Staff College of India, Hyderabad	14-18 December 2020
Dr. M. Sabesh	Generic online training course in Cyber Security	C-DAC, Hyderabad	16 December 2020

Technical Staff:

Name of Scientist	Name of the Training	Place/Organized by	Period
Sanjeev Kumar	Production protocol for microbial and biopesticides	NIPHM, Hyderabad	27-31 Jan 2020

R.M. Ramteke	GM cotton testing	ICAR-CICR, Nagpur	02.03.2020 to 07.03.2020
Sujit Hiraman Kumbhare	GM cotton testing	ICAR-CICR, Nagpur	02.03.2020 to 07.03.2020
Satpal Singh	Pesticides application methods and safety measures	National Institute of Plant Health Management, Hyderabad	19-23 Oct., 2020
Mrs. Vandana Satish	Generic Online Training in Cyber Security for Central Government Ministries/Departments	CDAC, Hyderabad	16 December 2020
Mrs. Vandana Satish	Online training programme on Motivation, Positive Thinking and Communication Skills for Technical Officers of ICAR (T-5 and above)	ICAR- NAARM, Hyderabad	17-22 December, 2020

Administrative Staff:

Name	Desig-nation	Course / Training	Place	Duration
K. Vedvyas	Stenographer	Enhancing Efficiency and Behavioural Skills	ICAR-NAARM Hyderabad	24-29 February 2020

5.1.2: Training Imparted

Name of Training	Organized by	No. of participants	Period
GM Cotton testing	ICAR-CICR, Nagpur	15	02.03.2020 to 07.03.2020
Effective health management for enhancing work efficiency of ICAR employees, ICAR - Indian Institute of Horticulture Research	ICAR-CICR, Nagpur	32	22.10.2020 to 22.10.2020

5.2: Trainings organized for farmers and extension functionaries

Sl. No.	Name of the Training	Organized by and Scheme under which Training is held	Place	Date	Category	No.of partici pant
1.	IRM- Farmers Mela- Dissemination of Pink bollworm management strategies	ICAR- CICR Regional Station, Coimbatore under IRM	ICAR- CICR RS Coimbatore	04-01-2020	Farmers	105
2.	Handloom Entrepreneurship and startup business	ICAR-CICR under SCSP	Village Chakara Distt Bhandara	06-01-2020	Selfhelp Group, Mahila Bachat Gat, Artisans, Farmers,	75

					Handloom weaver	
3.	One day training cum farmers meet on Recent innovation in Agri-bio sciences in Strengthening Indian Economy	ICAR-CICR, Nagpur in collaboration with Dr. Ambedkar College Deekshabhumi,Nagpur under SCSP	Dr. Ambedkar College Deekshabhumi, Nagpur	01-02-2020	Farmers	200
4.	Awareness training on the use of quality seed and seed production practices in Agricultural and Horticultural crops	ICAR-CICR, RS,Coimbatore under TSP of National Seed Project	Thirupattur (Near Elagiri hills), Vellore District, Tamil Nadu	11-02-2020	Farmers	89
5.	Training on Cotton Production and protection technology	State Agri. Department under NSFM (CC)	Sirsa	13 and 14-02-2020	Extension Functionaries	40
6.	IRM - Farmers Field Training II	ICAR - CICR, Regional Station, Coimbatore under IRM	Kinathukadavu, Coimbatore Dt	22-02-2020	Farmers	60
7.	Study tour cum exposure visit	ICAR- CICR Regional Station, Coimbatore	ICAR-CICR Regional Station, Coimbatore	25-02-2020	Student	102
8.	Training on Nursery raising	KVK HAU, Sirsa	Sirsa	03-03-2020	Farmers	40
9.	Empowering Schedule Caste Unemployed Rural Youths for Developing Agribusiness and Entrepreneurship	ICAR-CICR, Nagpur under SCSP	Village Godhani Teh Umred Dist Nagpur	03-03-2020	Farmers	300
10.	In field Radio talk on improved cotton cultivation practices	ICAR-CICR, Regional Station, Sirsa, Haryana under MGMG	Village Bakerianwali , Sirsa	03-03-2020	Farmers	50
11.	Cotton Seed Production, Pink Bollworm Management, Pheramone Traps	ICAR-CICR, Nagpur under TSP	Ghatpendri, Parsheoni Tq, Nagpur Dt.	03-03-2020	Farmers	450
12.	Training on Cotton production technology	KVK, Sirsa	Sirsa	04 and 05-03-2020	Farmers	150
13.	Farmers Mela on Insecticide Resistance	ICAR-CICR, Regional Station, Sirsa under IRM	Sirsa	07-03-2020	Farmers	300

	Management: Dissemination of Pink Bollworm Management Strategies					
14.	Sensitization workshop on Dissemination of Pink bollworm Management Strategies- Important Diseases of cotton and their management	ICAR-CICR Regional Station, Coimbatore under IRM	ICAR-CICR RS Coimbatore	10-03-2020	Farmers, Extension functionaries and Farm Input Dealers	60
15.	IRM: PBW Sensitization workshop to input dealers, extension functionaries and cotton ginneries	ICAR - CICR, Regional Station, Coimbatore under IRM	Coimbatore	10-04-2020	Cotton input dealers, extension functionaries and ginneries	70
16.	Cotton Seed Production, Pest management especially Pink Boll Worm ,Use of Pheromone Traps	ICAR-CICR, Nagpur under TSP	Narhar, Parsheoni Tq, Nagpur Dt	14-05-2020	Farmers	300
17.	Integrated Cotton Management	ICAR-CICR, Regional Station	Sirsa	02-06-2020	Farmers	30
18.	World Environment Day and Online Cotton Workshop for Farmers on Diseases Management in cotton	ICAR- CICR, Nagpur	ICAR-Central Institute For Cotton Research (CICR), Nagpur. Virtual/Online	05-06-2020	Farmers	115
19.	Sucking pest management	KVK, Nagpur under CROPSAP	Virtual	11-06-2020	Farmers	40
20.	Invited lecture on Integrated Pest Management in Cotton	Cotton Connect, Aurangabad	On line	11-07-2020	Extension Functionaries	20
21.	Integrated pest management in Cotton	VANAMATI, Nagpur under CROPSAP	Virtual	20-07-2020	Farmers	50
22.	Technical training on sustainable cotton practices	ICAR-CICR, Nagpur	Nagpur-video conferencing	23 and 24-07-2020	Field staff of to BCI implementation partner-Cotton	72

					Connect	
23.	Farmers field Training organized under Insecticide Resistance Management: Dissemination of Pink Bollworm Management Strategies project in Villages of Dist.: Jind (Haryana).	ICAR-CICR, Regional Station, Sirsa under IRM	Jind	28-07-2020	Farmers	15
24.	Techniques for Sustainable High Yields Online-Training Course	International Cotton Advisory Committee, USA	Webinar	03 and 14-08-2020	Scientists & Agricultural Officers from CHAD, Africa	40
25.	Cotton crop management	ICAR-CICR	Virtual	07-08-2020	Extension Functionaries	100
26.	Timely management of pink bollworm	KVK, Sagroli, Nanded under CROPSAP	Virtual	12-08-2020	Farmers	287
27.	Pink bollworm management	RAMETI, Nagpur under CROPSAP	Virtual	14-08-2020	Farmers	35
28.	Pest management in Cotton	ICAR-CICR, Nagpur	ICAR-CICR, Nagpur	24-08-2020	Farmers	20
29.	Organized One day farmer's awareness camp on management of Cotton pests	ICAR-CICR, Nagpur under IRM-PBW	Ralegaon Tahshil Bhadravati, District Chandrapur	28-08-2020	Farmers	50
30.	Farm School on Introduction and Importance of High Density Planting in cotton varieties and hybrids	Department of Agriculture, Tamil Nadu under ATMA	Kinathukadavu	03-09-2020	Farmers	25
31.	IRM-Dissmenination of Pink bollworm management strategies-Identification and Management of Important Diseases in Cotton	ICAR-CICR Regional Station Coimbatore under IRM	Kinathukkadavu, Coimbatore District	03-10-2020	Farmers	60

32.	National Training programme on "Management of insect pest and diseases in the current context"	ICAR- CICR, Nagpur in collaboration with Better Cotton Initiative (BCI), IP Coordinator and PU manager	Virtual/online	07-10-2020	Field trainees	250
33.	Recent Advances in Agriculture Extension and Farm Management	State Agriculture and Extension Training Institute (SAMETI)	Puducherry	04 to 21-11-2020	Extension Functionaries	20
34.	One day field training on Dissemination of pink bollworm management strategies and boll rot management in cotton	ICAR-Central Institute for Cotton Research, Nagpur under IRM	Village-Arvi, Tah. Samudrapur, Distict-Nagpur	20-11-2020	Farmers	82
35.	Integrated management of insect pest especially pink bollworm in the current context	KVK, Nagpur	Virtual	01-12-2020	Extension Functionaries	120
36.	Interaction Meet on Emerging Problems in Cotton for KVK's of Maharashtra	ICAR-CICR, Nagpur and ICAR-ATARI, Pune	ICAR-CICR, Nagpur	01-12-2020	Extension Functionaries	52
37.	Intra state level training to farmers on Drip Irrigation	Tamil Nadu State Agriculture Department under ATMASSEPERS-2020	Tamil Nadu Agricultural University, Coimbatore & ICAR-CICR Regional Station, Coimbatore	19-12-2020	Farmers	40
38.	Organized one day "Farmer's Field Training" on "Management of Pink Bollworm in Cotton"	ICAR_CICR, Nagpur under IRM	Warora, Chnadrapur	21-12-2020	Farmers	92

6. AWARDS AND RECOGNITIONS

Awards

- Dr. A.H. Prakash - **Professional Excellence Award by Cotton Research & Development Association**, CCSHAU, Hisar on 22-01-2020
- Dr. K Sankaranarayanan, Dr. A.H. Prakash, Dr. A. Manivannan and Dr. M Sabesh - **Best Paper award** for the oral presentation by CRDA, CCSHAU, Hisar on 22-01-2020
- Dr. Rachna Pande, Dr. Madhu T N - **Best oral presentation award** by Applied Zoologists Research Association (AZRA), Cuttack, India on 14-02-2020
- Dr. K Rameash - **Prof. P. Kameswara Rao Award for the Oral presentation** by Applied Zoologists Research Association (AZRA), Cuttack, India on 14-02-2020
- Dr. V Chinna babu Naik - **Prof. Kameswara Rao Young Scientist Award** by Applied Zoologists Research Association (AZRA), Cuttack, India on 14-02-2020
- Dr. Babasaheb B. Fand - **Kanwar Virender Singh Memorial All India Best Publication Award 2019** by Society for Advancement of Human and Nature (SADHNA) on 28-02-2020
- Dr. Babasaheb B. Fand - **Early Career Researcher Award - 2020** by Royal Entomological Society of London, UK on 01-03-2020
- Dr. S Usha rani - **Nehru Women Excellence Award 2020** in the field of Vision and Innovation by Nehru Group of Institutions, India on 08-03-2020
- Dr. Blaise Desouza - **Fellow, NAAS** by National Academy of Agricultural Sciences on 13-08-2020
- Dr. Rachna Pande - **Women Scientist Award -2020** by Society for Biotic and Environmental Research (SBER) on 15-10-2020
- Dr. Rachna Pande - **Women Researcher Award -2020** by VDGOOD Scientist Awards on 18-10-2020
- Dr. K Shankarganesh & Dr. A Manivannan - **Research Excellence Award** by Society for Biotic and Environmental Research (SBER) on 15-11-2020
- Dr. Raghavendra K P - **Best Poster Presentation Award** by Department of Biotechnology and Crop Improvement, College of Horticulture, Bengaluru on 27-11-2020

Dr. V. S. Nagrare , Dr. Rishi Kumar, Dr. V. Chinna Babu Naik, Dr. K Rameash & Dr. K Shankarganesh - **Scientist Award 2020** by Dr. B. Vasantharaj David Foundation on 05-12-2020

Dr. Rachna Pande - **Young Scientist Award– 2020** by Dr. B. Vasantharaj David Foundation Excellence Awards -2020 on 05-12-2020

Dr. Babasaheb B Fand - **TN Ananthakrishnan Young Scientist Award** for the biennium 2018-19 by Prof TN Ananthakrishnan Foundation, Chennai, Tamil Nadu on 15-12-2020

Dr A. Sampathkumar - **Sree V. P. Ganesan Award** for the best outgoing student in Ph.D (Plant Pathology) in the field of Host-Pathogen interaction by TNAU, Coimbatore on 17-12-2020

Dr A. Sampathkumar - **Dr R. Samiyappan Award** for the best Ph.D thesis work in Molecular Plant Pathology by TNAU, Coimbatore on 17-12-2020

Dr Rachna Pande - **Young Scientist Award 2020** by The Society of Tropical Agriculture on 20-12-2020

Dr Vinita Gotmare - Bharat Ratna **Dr Abdul Kalam Gold Medal Award** by Global Economic Progress & Research Association on 26-12-2020

Dr. Satish Kumar Sain - **Outstanding Achievement Award-2020** by Society for Scientific Development in Agriculture & Technology (SSDAT) on 28-12-2020

Dr. Satish Kumar Sain - **Scientist of the Year - 2019** Award by Dr. Ram Avatar Shiksha Samiti (DRASS) on 29-12-2020

Dr. Debashis Paul, Dr. P.Valarmathi - **Young scientist award** by Astha foundation on 30-12-2020

Dr K. Sankaranarayanan - **Best presentation Award** by Astha Foundation in GRISAAS-2020 on 30-12-2020

- Dr. Satish Kumar Sain, Dr. Amarpreet Singh ,Dr. Debashis Paul - **Best Oral Presentation** by Astha Foundation in GRISAAS-2020 on 30-12-2020
- Dr. Amarpreet Singh - **Scientist of the Year Award** by Society for Scientific Development in Agriculture & Technology (SSDAT) on 30-12-2020

Recognitions/ Certificate of Appreciation

- Dr. P. Valarmathi - Certificate of apprehension as Reviewer for the journal "International journal of plant and soil science" by International journal of plant and soil science on 16-07-2020
- Dr. P.Valarmathi - Certificate of merit (with distinction) by ICAR-NRRI, Cuttack on 10-09-2020
- Dr. P.Valarmathi - Certificate as reviewer for the journal "Plant Cell Biotechnology and Molecular Biology by Plant cell biotechnology and molecular biology on 26-09-2020
- Dr. P. Valarmathi - Certificate as reviewer for the journal "Journal of Experimental Agriculture International" by Journal of experimental agriculture international" on 04-11-2020
- Dr A. Sampathkumar - Three Gold medals for three Awards in Ph.D (Plant Pathology) by Tamil Nadu Agricultural University, Coimbatore on 17-12-2020
- Dr. Satish Kumar Sain - Chairperson in the Technical Session VI: Food processing, value addition and post-harvest technology by the International Web Conference on Global Research Initiatives for Sustainable Agriculture & Allied Sciences (GRISAAS-2020): 28-30 December 2020 on 29-12-2020
- Dr. A Manivannan - Editorial Board Member (2020-21) by MASU Journal on 31-12-2020

7. LINKAGES AND COLLABORATIONS

AREAS OF LINKAGES	INSTITUTION
Refinement of spindle type header prototype for development of a cotton picker	CSIR-CMERI-CoEFM, Ludhiana
Crop pest surveillance in Maharashtra.	CROPSAP, Maharashtra
Insecticide Resistance Management (IRM): Dissemination of Pink bollworm Management Strategies.	DAC, Govt of India and SAU are Dr PDKV Akola, VNMKV Parbhani, MPKV Rahuri, NAU Surat, JAU Junagarh, RVSKVV Gwalior, UAS Dharwad, UAS Raichur, PITSAU Hyderabad and ANGRAU Guntur
Development of consensus genetic linkage map for *Gossypium* spp.	DBT, Ministry of Science and Technology, Govt of India
Development of thermal tolerant strain of biocontrol agent, *Acerophagus Papaya* for sustainable management of papaya mealybug,	DST-SEED, Ministry of Science And Technology, Govt of India
Pink bollworm: Resistance Monitoring, Fitness Costs, Inheritance of Resistance to Cry toxins	DST-SERB, Ministry of Science And Technology, Govt of India
Genetic diversity Pink bollworm in India	DST-SERB, Ministry of Science And Technology, Govt of India
Implementation of PVP legislation 2001 and DUS testing of cotton.	Protection of Plant Varieties and Farmers' Rights Authority, Govt of India
Evaluation of insecticide combinations against insect pest complex of cotton	M/s Gharda Chemicals Ltd, Thane Mumbai
Input management under Bt –hybrid cotton+ pigeon pea strip cropping system.	IFFCO, Pune
Development and validation of "Nutrient Expert System" for cotton	International Plant Nutrition Institute (IPNI) , Gurgaon, Haryana
Monitoring changes in baseline susceptibility to Cry toxins in cotton bollworms	MAHYCO, Jalna
ICAR project on Seed Production in Agricultural Crops and Fisheries.	ICAR, New Delhi
An Inclusive Agri-Business Model for Sustainable Cotton Marketing in the State of Maharashtra.	NASF, New Delhi
Quantitative estimation of carbon and moisture fluxes over the cotton based agro-ecosystem.	National Carbon Project, ISRO, Hyderabad
IPM strategies to combat whitefly and other emerging pests of cotton.	NICRA, Hyderabad
National Seed Project (Crops)	ICAR, New Delhi
Transgenic research plant protection	CSIR and NBRI, Lucknow
Pheromone technology	CSIR and IICT, Hyderabad
Molecular mapping	TNAU, Coimbatore and UAS, Dharwad

Value addition Naturally colored cotton	Dr. PDKV, Akola and ICAR-CIRCOT, Mumbai
Student collaboration for research	RTMNU, Nagpur
Production and commercialization of Bt cotton varieties.	Maharashtra State Seeds Corporation Ltd. (Mahabeej), Akola
Seed production and commercialization of Bt cotton varieties (Suraj Bt, Rajat Bt, GJHV 374 Bt and PKV 081 Bt)	Farmer Shri Raju Gotmare, Beed-Borgaon, Hingna
Seed production/ multiplication and commercialization of cotton varieties (Suraj , Surabhi, CNA 1003 (Roja) & CNA 1028) developed by ICAR- CICR	Group of tribal farmer, Beed - Borgaon, Hingna
HRD of implementation partners of BCI programme in India	Better Cotton Initiative, New Delhi
Whitefly management	PAU, Ludhiana, HAU, Hisar RAU, Sriganganagar
Dissemination of weekly advisories and HRD of officials on BMPs for cotton	State Agricultural Departments of cotton growing states

8. ICAR-AICRP ON COTTON

AICRP on Cotton – Annual Group Meet

All India coordinated research project on Cotton – Annual Group meeting was held on 18th and 19th May 2020 for Central and South zone through video conferencing hosted by ICAR-CICR, Regional Station, Coimbatore. The meeting was inaugurated by Dr. T. R. Sharma, DDG (Crop Science) and attended by Dr. R. K. Singh, ADG (CC), ICAR, New Delhi, Dr. P.G. Patil, Director, ICAR-CIRCOT, Mumbai, Dr. V. N. Waghmare, Director, ICAR - CICR, Nagpur, Dr. C. D. Mayee, Chairman, AICRP-Programme Advisory & monitoring committee, members, Dr. B.M. Khadi, Dr. T.M. Manjunath, Dr. A.R. Sharma.

Web versions of seven Publications were released, namely Annual report of AICRP on cotton, Annual Report of AICRP on Bt cotton (North, Central & South zone), Annual Report NFSM-FLD Frontline Demonstration in Cotton, Integrated Disease Management in Cotton- Technical Bulletin, and Field Technology Report of ICAR-CIRCOT, Mumbai.

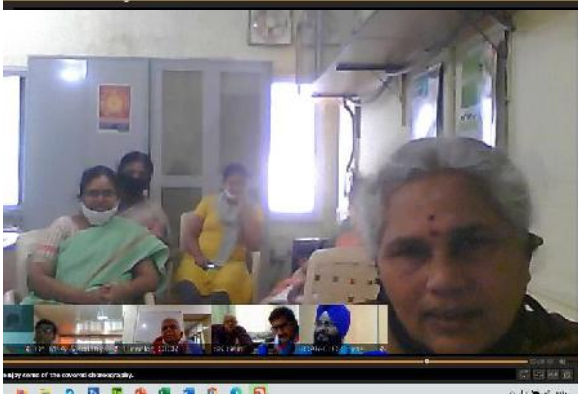
Hon'ble Deputy Director General (Crop Science), Dr. T. R. Sharma in his Presidential Address mentioned that cotton and jute are important commercial fiber crops where we have achieved self-sufficiency. However, he suggested that the importance of molecular breeding in cotton and utilization of the cotton genome sequence databases available in the public domain. He suggested the breeders work on specific traits by using the genome database and genome editing technologies. He stressed the importance of wild species and landraces, pre-breeding, apomixes, and the use of data mining, precision breeding, artificial intelligence in the cotton improvement program.Basic science research has to be initiated in the public institutes, creating expertise to work in data mining, artificial intelligence, and training of scientists in quality parameters. He emphasized the need for initiating work on water-use efficiency, nitrogen-use efficiency, and breeding for photo-insensitive cotton.He emphasized that guidelines have been issued by the ICAR to meet the impact of COVID 19 on carrying out agricultural activities.

On 19th May 2020, the technical program for 2020-21 was discussed and formulated. In the Breeding panel, the technical program for both Bt and Non-Bt trials for the central and south zone was finalized. In Agronomy, Physiology & Biochemistry panel formulated the technical program with main emphases on agronomic requirements of promising pre-release/ recently released genotypes; augmenting ELS cotton production; technology for organic cotton production and conservation agriculture; strategies to manage soil crust; PGR for optimum morpho frame and enhanced yield; preparing for climate change; screening for abiotic stress including waterlogging, drought and salinity; Estimation of seed oil, gossypol and protein; the biochemical basis of tolerance/susceptible of pest and disease.

Hon'ble Deputy Director General (Crop Science), Dr. T. R. Sharma in his concluding remarks opined that breeding strategy on yield potential which should include all Bt genes as a part of breeding programme. Breeding for mechanical harvesting was the key point from private sectors. Breeding for special quality traits like color cotton, disease resistance, and HDPS were also emphasized. Pre-breeding should be a directed approach with all latest technologies. Further, agronomy trials have to be carefully planned to assess the actual potential of the varieties. It was decided that HRD is very important and there will be structured training for Marker Assisted Breeding and quality parameters for breeders.

Varietal Identification Committee Meet

Varietal Identification Committee meeting held on 22nd June 2020 through video Conferencing under the chairmanship of Dr. T. R. Sharma, Deputy Director General (Crop Sciences), ICAR, New Delhi. Out of 101 proposals submitted for the release of Bt cotton, the committee has recommended 69 Bt cotton varieties/hybrids for commercial cultivation based on superiority on different traits of the varieties/hybrids for different zones of India. Similarly, 22 non-Bt cotton hybrids and varieties have been identified.



9. KRISHI VIGYAN KENDRA

9.1 On Farm Trials (OFT)

Veterinary Science

1. Assessment of performance of new breeds of Chicken – CARI-NIRBHEEK and GIRIRAJA under Back Yard System of rearing in farmer's field

There is a great demand for desi chicken and the current production is not able to meet the demand. Hence the trial was conducted on improved breeds of chicken to evaluate their performance which resembles to desi chicken.

Total 70 birds (10 weeks) of each improved varieties i.e. CARI-Nirbheek and Giriraja were distributed to 14 farmers of KVK adopted villages of Hingna tahsil of Nagpur district. These birds were reared under free range system with minimum inputs.

The study revealed that body weights of local chicken, CARI-Nirbheek and Giriraja birds at 20 weeks of age were 1.100 (TO1), 1.570 (TO2) & 1.690 (TO3) kg, respectively. Giriraja birds showed early sexual maturity at 155.15 – 157.27 days as compared to CARI-Nirbheek (170.25-172.86) and local chicken (181.17 -182.25). CARI-Nirbheek birds found more active and pungacious than Giriraja. Though weight gain is lower than Giriraja, it fetched more prices due to its resemblance with fighter Aseel breed.

New breed of Chicken – CARI-NIRBHEEK under Back Yard System of rearing in farmer's field

2. Evaluation of fodder hybrid napier varieties under scientific management in Nagpur district

In order to ensure the supply of quality green fodder to the dairy cows throughout the year, a trial was conducted at Ramtek tahsil on 'Evaluation of fodder hybrid Napier varieties under scientific cultivation. Two multi-cut perennial varieties of hybrid Napier i.e. DHN-10 and BHN-6 were compared with local prevalent variety CO4 on 2.69 ha area on 12 farmer's field. Both the varieties i.e. DHN-10 and BHN-6 showed better performance in terms of green fodder yield, number of tillers, number of leaves and milk yield on feeding of greens than locally grown CO4 variety. Highest yield of 312.00 q/ha was observed in DHN-10 followed by 307.48 q/ha in BHN-6 and 295.50 q/ha in CO4 variety (local check). However, green fodder intake was more in TO3, in which BHN-6 was fed to the cows. That might be due to less serration, high succulence and good palatability of BHN-6.

Hybrid Napier i.e.

Hybrid Napier i.e. DHN-10

Hybrid Napier i.e. BHN-6

Crop Production

1. Use of pre and post emergence herbicide in Soybean (*Glycine max* L.)

Results:

Application of post emergence herbicide Imazethapyr 35 % and Imazimox 35 % WG-40g/acre was found superior over the application of pre- emergence herbicide – Pendimethalin 38.7 @ CS @ 700ml /acre followed by application of post emergence herbicide Quizalofop-ethyl 5% EC - 400 ml/acre followed by farmers practice i.e. application of post emergence herbicide Imazithyper 10.8 SL @ 40gm/acre.

Plant Protection

OFT 1- Integrated management of pink bollworm (*P. gossypiella*) in Bt cotton- Ankur – 3028

Results:

On Farm Trail was conducted in Umred block in Nagpur district. The intensity of the problem is 30 to 35% and yield losses are upto 45 to 50%. The technologies selected for assessment is

1. Installation of Pheromone Traps @2/acre for monitoring at square formation. Spray Azadiractin 300 ppm @ 50ml/10 lit at flower initiation. 6 to 7 inundative releases of Trichogramma chilonis 60,000 per acre. Plucking of rosette flowers and ETL based application of Thiodicarb 75 WP 20 g per 10 lit water at boll formation followed by Deltamethrin 2.8 EC 10 ml per 10 lit water.
2. 1st Spray of profenophos 50 EC @ 20 ml per 10 lit water at 60 DAS. 2nd Spray Emamectin benzoate 5 SG @ 4.4 g per 10 lit water at 80 DAS 3rd spray Lambda cyhalothrin 5 EC @ 10 ml per 10 lit water at 100 DAS.
3. Farmers practice is to spray of two pesticide sprays comprising of Chlorpyriphos 20 EC 30ml, Triazophos 40 EC 30 ml per 10 lit water while taking the observations it was recorded that in T3 % of Green boll damage was 16.05 and % of locule damage 9% and that of in farmers practice it was recorded 28.44% green boll damage was 14.33% locule damage. Average yield of cotton on T3 was recorded 17.60 q/ha and that of in farmers practice it was recorded 14.50 q/ha. It was found that there was 21.31% increase in yield over the farmers practice.

Integrated Management of Pink bollworm (Pectinophora gossypiella) in Bt cotton

Horticulture Discipline

OFT-1:- Assessment of High Yielding Varieties of Marigold

Result: Kolkata marigold production is more by one quintal and fetches 71% more revenue compared with Orange Marigold.

Technology	No. of Farmers	Area (ha)	Yield (Qtl.)	% Increase in Yield	Net Return (Rs.)	% Increase in Net Return
T1 – Farmers Practice (Orange Marigold)	13	0.4	05		17500	
T2 – Refine Practice Kolkata Marigold	13	0.4	06	20%	30000	71%

High Yield variety Kolkata Marigold

Home Science Discipline

OFT-1:- Assessment of different models of Nutrition garden for small land holders for Nutritional Sustainability.

Result: Area under production of vegetable in Nutrition Garden in all trials **is 4 meter**? for four family members. Quality of Green leafy vegetable (GLV) & Cucurbitaceous vegetables in T3 trial is more resulted 26% higher production as compared to T1 practice and saves Rs. 208/- more as compared to T1 practice.

Demonstration of Nutrition Garden

9.2 Front Line Demonstrations (FLDs)

1.Livestock Production- Supplementation of probiotic *Saccharomyces cervisiae* to pre-rumunan cross bred calves @ 20 g/calf/day X 90 days.

Number of farmers: 10, Number of calves: 30

Major observation/Feedback:-

The body weight gain and feed/milk intake in calves fed with probiotic increased by 7.93% and 10.75% than local check, respectively, whereas incidence of diarrhoea was very less 6.60% in demo group as compared to 13.33% in local check.

2.Livestock Production- Feeding of area specific mineral mixture (ASMM) to lactating cows of Nagpur district @ 50 g/day/cow

Number of farmers: 10, Number of cows 30

Major observation/Feedback:- There was slight increase of 6.67% in milk yield and 5% fat content of milk in demo group, however reproductive performance of cows fed with ASMM enhanced significantly.

Cows feeding on ASMM

3. Livestock Production: Supplementation of mineral lick block to the local goats

Number of Farmers: 20

Number of Goats: 40

Mineral Lick Block for Goats

Major observation/Feedback:- Free access of mineral lick blocks in addition to daily diet of local goat in demonstration group resulted in 17.14% increased body weight gain than local check. Conception rate was also increased in demonstration group by 16.33%.

4. Livestock Production - Scientific cultivation of Fodder hybrid napier RBN-13 (Phule Jaywant) variety

Treatments: - T1: CO4 (Check), T2: RBN-13 (**Phule Jaywant)**

Number of farmers: 10, No. of Units- 20 Cows (Area covered 4 ha)

Major observation/Feedback:- In this trial, percentage increase was observed as 3.33%, 1.47% & 0.14% in average no. Of tillers/ clumps, average no. Of leaves / tiller, green fodder yield in first cutting (t/ha) of RBN-13 variety over CO4 variety (local check), respectively. Average milk yield on feeding of greens of both varieties to cows was same i.e. 7.50 l/cow/day.

5. <u>Plant Protection</u> Integrated management of soybean defoliator

Crop	Variety	No. of farmers	Area	Yield			Check	% increase	Parameters of Demo		Assessment of Check	
				High	Low	Avg.			No. of defoliator /MRL	B:C Ratio	No. of defoliator / MRL	B:C Ratio
Soybean	MAUS	13	5.2	16.5	11.30	13.80	10.6	30.18	2.33	1:26	3.67	1:16

-158	0	0	7	7

Integrated Management of Soybean

6. **Home Science enterprises:- Performance of Solar Conduction Dryer for vegetable dehydration.**

Fruits & Vegetable	Time required for Drying (kg/minute)	Colour and Appearance of Dried Vegetable	Weight of produce after moisture drying (%)
Methi	30	Excellent	14
Spinach	55	Excellent	18
Bitter Gourd	87	Excellent	21

Result: - Colour and appearance of methi, spinach and bitter gourd was excellent. Drying time of vegetable varied as per the moisture content of vegetable.

Demonstration of Solar Conduction Dryer for Vegetable dehydration

7. **Performance of soymittens in harvesting soybean crop.**

Treatment	Area Covered m2/h	% increase in Area Covered	% increase in ΔHR
T1 – Farmers Practice	103	00	38
T2 - Refined Practice-Use of Soymittens-Parbhani	116	12	32
T3 – Refined Practice-Use of multipurpose	121	17	30

Harvesting of Soybean using soymittens

soymitten - Dharwad

Result: Area covered was highest (17% increase over farmer's practice) and ΔHR was lowest by multipurpose soymitten of Dharwad.

9.3 Cluster Front Line Demonstrations on Oilseed and Pulses

Crop enterprises

Three CFLDs on oilseeds (i.e. Soybean (MAUS-158) & pulses (i.e. Pigeonpea (BDN-716), Chickpea (Rajvijay-203) were conducted in the adopted villages of Nagpur district viz. Chargaon, Muradpur, Hiwra, Surabardi, Ambazari and Saleghat.

Several extension activities like field day, field visit of farmers and extension functionaries, group discussion and scientist farmers meet etc. were conducted for effective implementation of technologies. These demonstrations were conducted on 150 farmer's field covering 60 ha. area.

CFLD on Soybean

CFLD on Redgram

9.4 Trainings organized

Sr. No.	Title of Training Programme / Webinar	Date	No. of topics	Total Participants	Participants from region
1	Online Farmers Training Series Programme	10 to 14.08.2020	12	442	Farmers from Vidharbha region and other regions.
2	Online Interaction Meet on Emerging Problems in Cotton	01.12.2020	6	297	KVK-Yavatmal, Jalna-I, Nandurbar and farmers from Vidharbha region.
3	Capacity Development of Anganwadi workers & Farm women on Poshan	17.09.2020	10	223	Anganwadi workers & Farm women from Nagpur district
4	Farmers Awareness Programme under KVK (GKMS) Gramin Krishi Mausam Seva-Atmosphere & Climate Research Modeling observing system and	05.03.2020, 27.06.2020, 14.09.2020, 30.09.2020, 17.10.2020	12	170	Farmers from Nagpur district region.

	service.				
5	Online Farmers Interaction programme for Awareness of Farmer Bill- 2020	28.10.2020	3	108	Farmers from Vidharbha region.
6	Awareness Programme on New Farmers Bill under DAESI Programme	04.11.2020	3	86	Farmers from Vidharbha region.
	Total		**46**	**1326**	

Training & Exposure visits for Students of RAWE (Rural Awareness Work Experience) :- Total 121 Student from different colleges and Universities are visited the KVK, ICAR-CICR, Nagpur during the period 2020

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Diploma course for input dealers (DAESI) at KVK, ICAR-CICR

Diploma Course in Agriculture Extension Services for Input Dealers (DAESI) was sanctioned to KVK ICAR-CICR, Nagpur during January 2020. The programme was sponsored by MANAGE, Hyderabad and supported by VANAMATI & ATMA, Nagpur. Sh R. Nema was appointed as Facilitator and started DAESI programme from February 2020. The programme was inaugurated at KVK, ICAR-CICR, Nagpur on 20th February 2020. Dr. V.N. Waghmare, Director, ICAR-CICR, Dr. S.M. Wasnik, PS & Head KVK, Dr. Nalini Bhoyar, Project Director, ATMA, Nagpur attended the inaugural function. It was highlighted about importance of the programme and its direct relevance to villagers and since the input dealers are to be trained as extension workers they have to work for the benefit of the farmers since Input dealers is the main source of transferring agriculture information to the farmers at village level. During the period four sessions were held and it was discontinued due to corona pandemic situation as instructed by VANAMATI/ATMA/MANAGE

Training cum Input distribution Programme under Paramparagat Krishi Vikas Yojana (PKVY) project

KVK, ICAR-CICR, Nagpur organized one day training Programme on "Model

Organic Farming" on 11th September, 2020 under Paramparagat Vikas Yojana. About 20 farmers of Chargaon and Muradpur villages participated in this training programme. In this training stress was given on Natural Resources based Integrated and Climate Resilient Sustainable Farming System. That ensure maintenance and increase of Soil Fertility, Natural Resource Conservation, On Farm Recycling and minimizing dependence of farmers on external inputs.

Mahila Kisan Diwas

KVK of ICAR-CICR, Nagpur organized "Shetkari Mahila Diwas" in Gumgaon Village, Hingna Taluka, Nagpur District to observe Mahila Kisan Diwas. The Chief Guest of the programme was Smt. Neeta Walke, Z.P. Member. The other Guest of Honours was Smt. P. Bawane Sarpanch Gumgaon, Smt. S. Ashtankar, Hingna P.S. Member. Smt. S. Chauhan, SMS of KVK, Nagpur highlighted the contribution of farm women in the field of agriculture and income generation through various Self Help Groups. During the programme, Dr. SM Wasnik, Head, KVK, ICAR-CICR, Nagpur felicitated the Farm Women. A

total of 60 Farm Women participated in the programme.

Awareness programme on New Farm Laws-2020 at villages

KVK, ICAR-CICR, Nagpur organized awareness programmes on Farm Laws-2020 on 19.10.2020 at village –Bhagimahari, Taluka- Parshivani and. also at village – Muradpur, Taluka- Umred on 22.10.2020. Both the programmes were Chaired by Padamshri Dr. Vikas Mahatme, Hon. MP (Rajya Sabha). At Bhagimahari apart from Dr. Mahatme, others attended programme includes Dr. S. M. Wasnik, Head KVK, ICAR-CICR, Nagpur, Dr. S. S. Patil, SMS and Sh. Raut Sarapnch, CEO MECL, BDO, Extension Officer and large number of farmers were present. At Muradpur also Hon MP and Sh G. Vyas, MLC, Maharashtra, Sh. S. Parwe Ex-MLA Umred, Smt Mendule Ex PS Member, and NGO working in the area were also present. Dr. Vikas Mahatme in his address stated that the Government of India introduced three farms laws recently, those were got approval from Hon President of Indian Sh. Ramnath Kovind on 27th September 2020. He said these farm laws give the freedom of choice of sale and purchase of farmers produces at remunerative prices. Dr. S. M. Wasnik shared the benefits of new farm laws as these laws provide platform to the farmers to sell their farm produces on online trading also. Dr. S.S Patil stated that these new laws provide "One Nation, One Market" and farmers need to avail benefits.

Live web casting of Hon'ble Prime Minister of India addressing the Farmers and releasing PM Kisan money to famers

KVK, ICAR-CICR, Nagpur organized Live web casting of Hon'ble Prime Minister of India addressing the Farmers and releasing PM Kisan money to famers on 25th December 2020 under PM Kisan Samman Nidhi Scheme. Under this scheme,

the 7th installment is credited into farmers account. On the occasion Rs 18,000 cr credited into the accounts of 9 cr farmers.

For this programme overall 867 farmers registered through online and 50 farmers attended the programme at KVK, ICAR-CICR, Nagpur.

9.5 Attracting and retaining rural youth in Agriculture (ARYA)

Visit to Citrus Farmers for Developing Citrus Nursery under ARYA

The Attracting and Retaining Rural Youths in Agriculture (ARYA) project was initiated in the year 2015-16. KVK-CICR, Nagpur is one operating on two enterprises for lively-hood of rural youth. 1) Developments of disease free sampling Nagpur mandarin 2) Fruits and vegetable processing. Project ARYA is focusing on creating awareness and capacity building training programmes for youths in rural areas to take up various agriculture, allied and service sector enterprises for sustainable income and gainful employment. During the year 2020-2021, the KVK trained 275 rural youths under enterprise no. 1 and 325 rural youth of different self help groups under enterprise no. 2. 15 rural youth developed their nursery and are generating significant income. 5 Green shade net houses are in process to be built up at rural youth farmers for developing diseases free citrus nursery. Three units of processing of pickles are

running successfully. 5 chilly processing and 5 orange juice processing units are under process. 2000 Nursery citrus plants are ready for budding process at KVK, Nagpur and 5000 new slot is in process. Ten rural youths established their disease free nursery of citrus and Nagpur mandarin after acquiring training under ARYA.

Under ARYA project Training programme on Custard apple and Sweet lime processing for 35 women of six SHGs of Nildoh Pannase, Mangrulpir and Meta Umri of Hingna tahasil, District Nagpur held at KVKV, ICAR-CICR, Nagpur on dated 04th Nov 2020. Dr. Y.G. Prasad, Director ICAR- CICR, Nagpur, Chaired the programme while Dr. S. M. Wasnik, PS, & Head KVK, ICAR-CICR, Nagpur and Smt. S. Chauhan, SMS, Shri. A. Gayakwad, Project manager, Shri. P. Gayakwad, Agri. Assistant and J. Shende, Field Coordinator of CARD was also present.

Dr. Y.G. Prasad, Director ICAR- CICR, Nagpur, focused on establishing micro enterprises related to agriculture and providing technical guidance and support to upcoming rural youth as well as economic empowerment. Also on the occasion, Leaflets on 'FAL PRAKRIYA EK UDYOG' and 'VALUE ADDITION ON CUSTARD APPLE' was released at the hands of Dr. Y.G. Prasad and distributed to SHG participants. Earlier, Dr. S. M. Wasnik, PS & Head KVK, ICAR-CICR, Nagpur

briefed about ongoing activities under ARYA project and strengthening of Rural youth through Agri entrepreneurships. Smt. S. Chauhan, SMS, provided technical and skill oriented training on Custard apple and Sweet lime processing to strengthen them economically.

9.6 Sponsored Projects

9.6.1 Dissemination of IRM Strategies for Pink Bollworm in Cotton in Nagpur district

KVK, ICAR-CICR, Nagpur implemented "IRM-Dissemination of Pink Bollworm Management Strategies" project Under Centrally sponsored NFSM: Commercial Crops in Nagpur district. Five villages near Bela viz. (Chargaon , Surabardi, Khapri, Muradpur and Nishanghat) in Umred tehsil have been identified field day, field visit of farmers, distribution of critical inputs(Pheromone traps, Neem oil, Flonicamid, Chlorpyriphos, Trichocards), awareness campaign and extension functionaries, group discussion, scientist farmers meet etc. were conducted for effective implementation of technologies for management of Pink bollworm in cotton.

Visit to adopted farmers under IRM-PBW project for management strategies recommended by ICAR-CICR Nagpur and Pink bollworm as well as sucking pest on cotton

9.6.2 GKMS Scheme of IMD

A District Agromet Unit (DAMU) started under the sponsored project "KVK (GKMS) Gramin Krishi Mausam Seva- Atmosphere & Climate Research Modelling observing system and service (ACROSS)" has started at KVK, ICAR, CICR-Nagpur in collaboration between India Meteorological Department and ICAR for issuing the district as well as block level weather based agromet-advisories for cultivated crops which will benefit the farming community, poultry, fishery and dairy stalk holder of

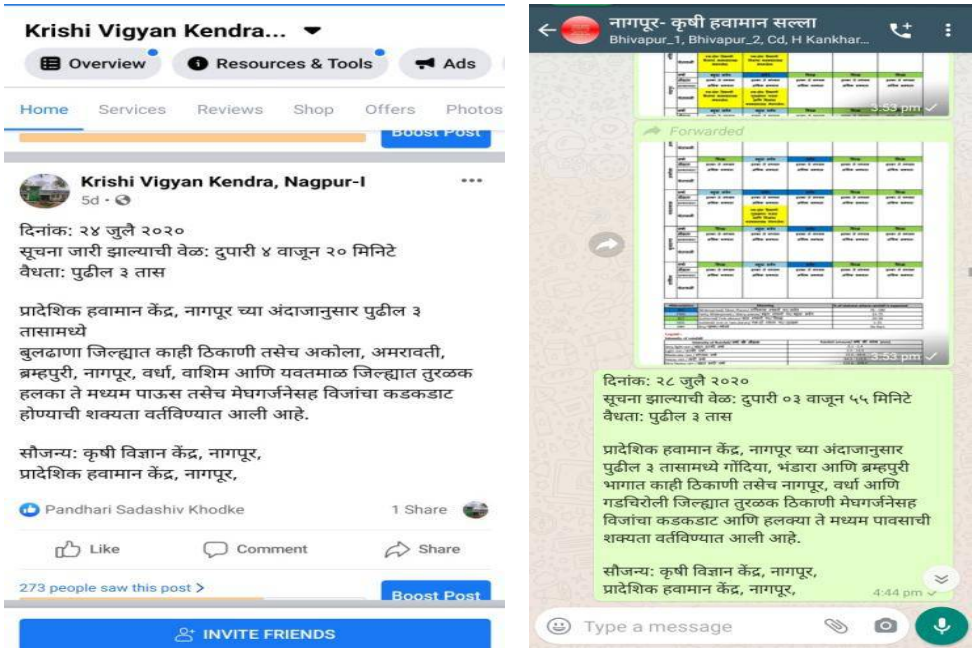
Farmer's awareness programme conducted at Paradshinga, Tq. Katol, Dist. Nagpur on

Nagpur district. The weather forecasting for next five days is included in the biweekly weather based agromet advisory prepared and disseminated by the District Agromet Unit (DAMU), Nagpur.

The biweekly Agromet Advisory Bulletins were prepared with consultation with the committee members of the District Agro Advisory Committee. DAMU Nagpur prepared District and Block wise weather based Agromet Advisory Bulletins on every Tuesday and Friday in English and regional Marathi language. The prepared AAS bulletins were disseminated through the Whats App group, Facebook account and page and Emails. There are 76 Whats app having total 7358 famers and under the DAMU, Nagpur and approx. 2000 farmers for five days rainfall forecast provided by RMC, Nagpur. The Nowcast warning and forecast are received from time to time by RMC, Nagpur is disseminated to the

farmers on priority on their registered mobile number through Whats App.

Status of Agro Advisory Services Bulletins and feedback :- No. of Bulletins prepared during 1st January to 31st December, 2020 i.e. 1456 & No. of Feedback taken during 2020 i.e 28.



Dissemination of Nowcast warning through Facebook page Krishi Vigyan Kendra- Nagpur-I and Whats App group

The farmer's awareness programme at. Post. Khairi Pannase, Tq. Hingana, Dist. Nagpur

The farmer's awareness programme at. Lakhmapur, Tq. Hingana, Dist. Nagpur

The farmer's awareness programme at. Post. Girola, Tq. Hingana, Dist. Nagpur

The field visit for observation of crop health status/pest and diseases on cotton at Mangrool Tq. Hingana Dist. Nagpur

Site selection for installation of Agro Automatic Weather Station

The site selection for installation of Agro Automatic Weather Station at KVK, ICAR-CICR, Nagpur campus had done in presence of, Dr. Vijay N. Waghmare, Ex. Director (Acting), ICAR-Central Institute for Cotton Research, Nagpur, Dr. S. M. Wasnik, PS & Head, KVK, Nagpur, Dr. P. B. Deulkar, Dr. Sachin Wankhede, SMS (Agro. Met.), Mr. Prashant Gayakwad, Agromet observer, KVK, ICAR-CICR, Nagpur and inspection team from Regional Meteorological Centre, Nagpur, Mr. P. S. Chinchole, Mr. Y. Lokhande, Mr. A. G. Tirodkar, Mr. R. G. Patki were present during the process of site selection for installation of Automatic Weather Station, date 02, July, 2020.

Site selection for installation of Agro Automatic Weather Station

9.7 Meetings

25th Scientific Advisory Committee Meeting - On-line

25th Scientific Advisory Committee Meeting (SAC) of Krishi Vigyan Kendra, ICAR-CICR, Nagpur was held on 10/06/2020 at its campus at Central Institute for Cotton Research, Nagpur. Members of line departments, Project Director ATMA, State and District Animal Husbandry Department, District Soil Testing Officer, RBI, NABARD, Associate Dean College of Agriculture-Nagpur, MAFSU, Prof. LAD College, Nagpur, All India Radio -Nagpur, ATARI, Pune and Innovative farmers of Nagpur district attended the meeting online.

Dr. V. N. Waghmare, Director, ICAR-CICR, Nagpur Chaired the meeting. While addressing the meeting, Dr. V. N. Waghmare appreciated the work of KVK, Nagpur for conducting outreach activities extensively along with Scientists of ICAR-CICR, Nagpur and suggested to take up seed productions of various crops and organize training on seed production at KVK, ICAR-CICR, Nagpur field.

Dr. S. M. Wasnik, PS & Head KVK presented achievements of KVK, ICAR-CICR, Nagpur and shared ICAR-CICR activities like e-Kapas, Cotton App, MGMG, IRM, ARYA, DAMU, SCSP, TSP, DAESI implemented in Nagpur

District during the year 2019-20. Annual Action Plan for 2020-21 was also discussed and suggestions from various Department officials joined on-line was recorded and will be incorporated for implementing the action plan of 2020-21.

Dr. Panchabhai, Associate Dean, College of Agriculture, Nagpur, Dr. P. Godghate from JDA-Nagpur, Dr. N. Bhoyar, Project Director ATMA, Smt. M. Kowe, NABARD, Nagpur, Sh. Rathod, District Manager, MAHABEEJ, Nagpur, Sh. S. Chepurkar, RBI, Nagpur, Dr. M. Pundalik, DDCAH, Nagpur, Dr. A. Thakre, DAHO, Nagpur, Dr. K. Jadhav, PGD Home Sci., RTMNU, Nagpur, T.K. Patil- District Soil Testing Officer, Dr. A. Kamble, ATARI, Pune, Dr. Blaise D., HoD, Crop Production and Dr. Nandini Gogte, HoD, Crop Protection, ICAR-CICR and other line department officials and SAC farmer members also attended and took keen interest in deliberations.

9.8 Extension Activities- field days/ farmers meet/treatment camps organized

Sr. No.	Title of programme	Date	Venue	No. of participants	Dignitaries attended the programme
1.	Yearlong constitutional day celebration 1. activity: "Important constitutional Amendments and their significance"	01.01.2020	KVK, ICAR-CICR, Nagpur	104	Dr. V.N. Waghmare, Director, ICAR-CICR, Dr. N.M. Khirale, HoD, Dept. of Law, Dr. Ambedkar College, Nagpur, Dr. S.M. Wasnik, Head KVK, ICAR-CICR, Nagpur.
	2. activity: "Talk on constitution and citizen duties, land legislations and reforms"	24.02.2020	KVK, ICAR-CICR, Nagpur	155	Dr. V.N. Waghmare, Director, ICAR-CICR, Prof. Ram Ghodeswar, Dr. S.M. Wasnik, Head KVK, ICAR-CICR, Nagpur.
2.	Training to DEASI trainees from Pipri Wardha	29. 01.2020	KVK, ICAR-CICR, Nagpur	40	Dr. S M Wasnik, Dr D. Nagrale, Dr Deulkar
3.	Training to cotton farmers on IPM & goat farming	12.02.2020	Meta Umari, Hingana	48	Dr. S M Wasnik, Dr SS Patil, Dr. U V Galkate, E. Shreedhar, KVK ICAR-CICR, Nagpur
4.	Training to cotton farmers on IPM	15.02.2020	Nildoh, Hingana	36	Dr. S M Wasnik, Dr BB Fand
5.	Training to farmers on kitchen gardening	18.02.2020	Nildoh, Hingana	43	Dr. S M Wasnik, Dr S. Chavan,
	Training to farmers on ARYA Activities, Agrometerology	04.03.2020	Paradsinga, Katol		Dr. S M Wasnik, Dr SS Patil
6.	International Women Day	08.03.2020	Abasaheb Khedkar Sabhagruha, Zilla Prishad, Nagpur	158	Dr. S.M. Wasnik, Smt. Sunita Chauhan, KVK, ICAR-CICR, Nagpur
7.	Webinar on dlroW yaD tnemnorivnE	05.06.2020	KVK, ICAR-CICR, Nagpur	251	Dr. S. K. Chaudhary, DDG, (Natural Resources Management), ICAR, New Delhi, Dr. C. D. Mayee, Former Chairman, ASRB, New Delhi. Dr. V. N. Waghmare, Director, ICAR-CICR, Nagpur. Dr. Lakhan Singh, Director, ICAR-ATARI, Pune, Shri. R. Bhosale, DJD, Nagpur, Shri. Dr. S.Nagre, DJD Agriculture, Amravati Dr. S. Wasnik, Head KVK ICAR-CICR, Nagpur.
8.	Guided farmers on cotton production technology during	13 June 2020	On-line Cloud HD Video meeting on Zoom organised by Dhanuka	65	Dr. S. M. Wasnik, PS & Head KVK, ICAR-CICR, Nagpur
9.	Krushi Din	01.07.2020	Village- Umta,	43	Dr. S.S. Patil

			Narkhed		
10.	Parthenium Awareness Week	16-22.08.2020	KVK, ICAR-CICR, Nagpur	27	Dr. S.M. Wasnik, Head KVK, ICAR-CICR, Nagpur & KVK Team
11.	Plantation Drive organised on 2nd October, 2020 under POSHAN Abhiyaan	02.10.2020	KVK, ICAR-CICR, Nagpur	13	Dr. S.M. Wasnik & Team KVK
12.	Mahila Kisan Diwas	15.10.2020	Gumgaon village, Nagpur	46	Dr. S.M. Wasnik & KVK Team
13.	World Food Day	16.10.2020	Webinar	52	Dr. S.M. Wasnik
14.	Constitution Day	26.11.2020	KVK, ICAR-CICR, Nagpur	23	Dr. S.M. Wasnik
15.	Kisan Diwas	23.12.2020	Village-Muradpur	60	Dr. S.M. Wasnik Dr. S.S. Patil
16.	Jay Kisan and Jay Vigyan Day	25.12.2020	KVK, ICAR-CICR, Nagpur	68	Dr. S.M. Wasnik & KVK Team

KVK Participates in Kaneri, Kolhapur Innovative Farmers Meet:

KVK, Kaneri, Kolhapur has arranged National level Organic Farmers Meet from 30.01.2020 to 01.02.2020. The two best organic cultivar, entrepreneur registered in KVK, Nagpur were nominated to participate in this meet. Sh. Jitendra Bhakane has presented Decorative cow dung products for income generation and Sh. Sandip Kubade has presented his organic horticulture production. Smt. Sunita Chauhan, SMS, KVK, Nagpur accompanied with the farmers for the meet.

Innovative Farmer Sh. Sandip Kubade, Nagpur Presentation in Meet

Fruits crops at KVK farm

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

Soil Testing Activities of KVK

Four hundred ninety five (495) soil samples were collected from villages of the Hingna and Umred blocks of Nagpur district and also from the field of adopted farmers of KVK. The soil samples were analyzed for 12 different parameters in KVKs soil testing lab and 495 Soil Health Cards generated depicting the soil test based fertilizer recommendations.

Development of fodder cafeteria at KVK's Farm:

KVK has established fodder cafeteria in its instructional farm with six perennial varieties of hybrid napier fodder crop viz. Phule Jaywant (RBN-13) and Phule Yashwant (RBN-9) developed by MPKV, Rahuri, BHN-6 developed by BAIF, Karnataka, DHN-10 developed by IGFRI, Regional Research Station, Dharwad, HBN-100 and CO4 developed by TNAU. Several farmers, rural youth, extension functionaries and trainees visited these demonstration plots during this year.

KVK generated a resource of Rs 36,900/- by selling 36,900 Stem cuttings/root slips of Hybrid Napier fodder crop to 30 farmers of Nagpur and surrounding districts during 2020. Besides that, 40,000 stem cuttings costing Rs.40,000/- was supplied to the 40 beneficiaries selected for

conducting On Farm Trials in adopted villages of KVK.

Hybrid napier DHN-10

Hybrid Napier BHN-6

Management of Osmanabadi Goat Unit at KVK:

KVK is managing a goat unit of Osmanabadi breed on scientific line at KVK's campus. Several goat owners and rural youths are benefited by acquiring practical skills from the goat unit. In addition, this goat unit has generated a resource of Rs.2,02,555/- during the year 2020 by selling 10 breeding bucks and 20 females which are bringing about genetic improvement in local goats.

IPM Module of Vegetable to enhance the income of farmers

Krishi Vigyan Kendra, ICAR - CICR, Nagpur has demonstrated the IPM module of vegetable in 2019-20, 2020-21 to enhance the income of farmers. Technological intervention as IPM component for controlling sucking pest (Aphid & Jassid) and nematodes have been undertaken in 5000 sq.ft area with an expectation of increased income in plot comprising of cabbage and cauliflower as main crop along with marigold, mustard and coriander. Sorghum was planted along the borders to act as crop and bird punchers. Yellow sticky trap, pheromone traps and trico- card were adopted. In this model Bio-Dynamic formulation such as Jivamrut, Decomposer and Neemark 5% was applied for pest and diseases management of cole crops. With the application of the organic inputs up to 60 days infestation of Diamond back moth was not observed. It lead to reduced expenditure on spraying of chemical for management of Diamond back moth.

Advisory Services Provided

KVK has provided advisory services to the farmers, rural youth and extension functionaries through personnel guidance, telephonic calls and mobile services on agricultural production, protection technology and allied fields. Through the advisory services 42,739 clients in Nagpur district were benefited.

International Women Day on 8th march-2020

KVK, ICAR-CICR and Anganwadi workers of Nagpur district collaboratively organized International Women Day on 8th March-2020 at ZP, Nagpur. In this programme Dr. S.M. Wasnik, PS & Head KVK, Smt. S. Chuahan, SMS, KVK, ZP Chairman- Smt. R. Barve, ZP CEO- Sh. S. Yadav, WCD Secretary -Smt. U. Dodhare, District Programme Officer of WCD (Rural) - Sh. B.G. Tambe, Disrtrict Programme Officer of WCD (Urban) - Sh. Jadhav & 80

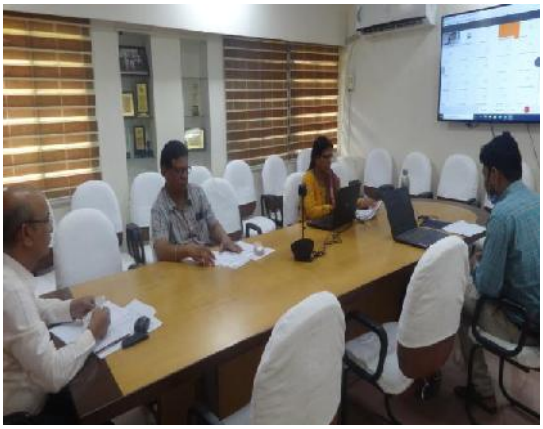
Anganwadi workers of Nagpur district were present.

Dr. S.M. Wasnik wished all women with happiness, health, success and prosperity in the years ahead and has praised the Anganwadi work women as they are Organizing pre-school activities, provide health and nutritional education to families especially to pregnant women breastfeeding practices, improve the nutritional and health status of children below the age of six years. Smt. S. Chuahan SMS, Home sci. of KVK has congratulated all the women and emphasized about establishment of

nutrition garden and its importance at house hold level to the anganwadi supervisors. After that ZP Chairman- Smt. R. Barve said today's woman is no longer dependent. She is self-reliant and Independent in every aspect and is capable of doing everything equal to men. We have to accept that both men and women contribute equally to the betterment of the home and society.

Rashtriya "POSHAN MAAH"

Third Rashtriya Poshan Maah (National Nutrition Month) was celebrated countrywide from September 1-30, 2020. Krishi Vigyan Kendra, ICAR-CICR, Nagpur also celebrated Poshan Maah from 9th to 30th September, 2020 in Collaborations with WCDD, ZP, Nagpur. This programme was inaugurated on-line by the hands of Dr. V.N. Waghmare, Director, ICAR-CICR, Nagpur. In his address, he highlighted the nutritional need of deficiency and Malnutrition of all ages. He stressed the need of consumption of locally available crops for balance diet and awareness about Biofortified crops in daily diet for getting higher amount of micronutrients. Dr. S. M. Wasnik, PS & Head KVK in briefed about the Month- long Poshan Maah programmes to be carried through KVK Nagpur with active cooperation from Anganwadi workers and ICDS department, Nagpur for improving the nutrition and health status of children's, pregnant and lactating mothers and adolescent girls. On this occasion 174 Anganwadi workers and supervisors of ICDS, Nagpur Rural has attended online training cum awareness programme. During Inauguration day in technical session different models of Nutrition Garden and its layout and management was explained by Smt. Sunita



Dr. V. N. Waghmare, Director, ICAR-CICR Inaugurated On- Line Inauguration function of month long Poshan Maah.

Chauhan.

KVK, ICAR-CICR, Nagpur as well distributed vegetable seeds on dated 17 Sep 2020. Around 100 Anganwadi workers and women farmers of Mangrul, Gumgaon and Adegaon villages of Nagpur District took part in programme organized at Mangrul in Hingan tahasil of Nagpur district in collaboration with IFFCO. Dr. S. M. Wasnik, PS & Head KVK, Smt. S. Chauhan, SMS, KVK, V. Magar, IFFCO, Zonal Manager, Sh. I. Kale, Upsarpanch, Sh. A. Gayakwad, Project Manager, CARD, Sh. P.

Dr. Siddharth M. Wasnik, Scientist, Extn.Edu. and Head KVK, ICAR-CICR, Nagpur distributing vegetables kits to Anganwadi workers and women farmers

Gaikwad, Coordinator-CARD, were also present on the occasion.

Sh. Chinchane, CDPO Hingna, observing Poshank Thali prepared by Anganwadi Workers, Hingna under Poshan Maah.

Dr. S. M. Wasnik, PS & Head KVK in his addressed explained about the importance of Nutritive diet in daily life. On the occasion 100 vegetable kit supplied by IFFCO was distributed among Anganwadi workers and women farmers. Also KVK, ICAR-CICR, Nagpur organized Local Nutrition Rich Food Products Preparation Competition at village Waghdhara, Tah.- Hingna, Nagpur district on 23rd September, 2020. 34 Anganwadi workers of Butibori circle have attended the programme. Smt. S. Chauhan, SMS, Home Sci. guided the Anganwadi workers for preparation and proper presentation of Nutritious recipes from Sorghum, Perl Millet, Ragi, Maize, Bottle Gourd, Papaya, Drumstick. On the occasion Dr. S.M. Wasnik, Sh. Chinchane, CDPO Hingna, Sh. Patil, Sarpanch, Waghdhara, Dr. S.S. Patil, Dr. U.V. Galkate, felicitated the best Anganwadi workers about Nutrition Thali and gave prizes of winners of Nutritious Snacks, Traditional Festival Thali and Nutritious Thali.

"World Soil Day" Programme at village Gumthala, Nagpur

KVK, ICAR-CICR, Nagpur and District Agriculture Department-Nagpur Jointly organized **"World Soil Day"** Programme at Gumthala village Nagpur on dated 05-12-2020. The programme was celebrated on the theme **"Keep Soil alive, Protect Soil Biodiversity".** The programme was attended by Dr. S. M. Wasnik, PS & Head KVK, ICAR-CICR Nagpur, Dr. S. S. Patil, SMS, KVK, ICAR-CICR, Nagpur, Mr. R. Bosle, JD Agri. Dept.Nagpur, Sh. Milind Shinde - DSAO Nagpur, Sh. T. K. Patil-District Soil Testing Officer Nagpur and Sh. Eluka Sridher-Soil Lab Technician ,KVK, ICAR-CICR, Nagpur were present.

On the occasion Dr. S. M. Wasnik, PS, Head KVK, ICAR-CICR, Nagpur urged the farmers to conserve good quality of soils and stop the excess use of fertilizers which have led to serious hazards on the soil health. Mr. Ravindra Bosle - JDA, Nagpur chaired the function and spoke about importance of Soil testing and application of fertilizers as per recommendation given on Soil Health Cards for reducing cost of cultivation. After that Sh. Milind Shinde - DSAO Nagpur suggested to the farmers to focus on Organic farming and applying Organic manure is the only solution to improve the Soil Organic carbon productivity in the future. About 50 Farmers attended this programme.

Swachhta Pakhawada was observed from December 16 to December 31, 2020

Krishi Vigyan Kendra, ICAR-CICR, Nagpur Conducted Swachhata Pakhwada from 16/12/2020 to 31/12/2020. Under this program various activities related to cleanliness were carried out as follows

Swachhata Pakhwada 16th Dec to 31st December Conducted at KVK, ICAR -CICR, Nagpur

9.9 Meetings/ Workshop/Conference/Training attended

Name of the officials	Name of event	Location	Date
Meetings			
Smt. Sunita Chauhan	National level Organic Farmers Meet	KVK, Kaneri, Kolhapur	30.01.2020 to 01.02.2020
Dr. S. M. Wasnik	Interdisciplinary National Conference on Recent Innovations in Agri- Biosciences in strengthening the Indian Economy. Challenges & Prospects & Farmers meet (RIABSIECP-2020)	Dr Ambedkar College, Deekshabhumi Nagpur	01.02.2020
Dr. S. M. Wasnik	ATMA Governing Body meeting	Collector office Nagpur	11.02.2020
Dr. S. M. Wasnik	Manav Vikas Yojana meeting	Collector office Nagpur	24.02.2020
Dr. S. M. Wasnik	Quarterly Meeting of All India Radio	Akashwani Nagpur	26.02.2020
Dr. S. M. Wasnik	XIth Annual National Conference of KVKs organised by DDG Extension	NASC complex ICAR New Delhi	27.02.2020 to 01.03.2020
Dr. S. M. Wasnik **Dr. P.B. Deulkar**	Workshop on "Empowering Schedule Caste Unemployed rural youth for developing agribusiness and entrepreneurship"	Village - Godhani, Tah - Umred, Dist.- Nagpur	03.03.2020
Head KVK and KVK Team	Online Video Conferencing meeting of Vidharbha KVKs organized by ATARI Director, ZONE-VIII Pune.	Webinar	15.04.2020
Head KVK and KVK Team	State Level On-line Annual Action Plan Workshop of KVKs of Maharashtra and Goa organized by ATARI Director, ZONE-VIII Pune	Webinar	27-28.05.2020
Dr. S. M. Wasnik	On-line ZONAL Research and Extension Advisory Committee (ZREAC) Meeting organized by Dr PDKV.	Webinar	11.06.2020
Dr. S. M. Wasnik	On-line Scientific Advisory Committee Meeting (SAC) of Krishi Vigyan Kendra Yavatmal on 20 June 2020	Webinar	20.06.2020
Head KVK and ARYA Team	Online ARYA Workshop chaired by Hon'ble Secretary DARE & DG ICAR.	Zoom	16 June 2020
Dr. S. M. Wasnik	On-line Scientific Advisory Committee Meeting (SAC) of KVK, Wardha	Webinar	24.06.2020
Dr. S. M. Wasnik	Annual Zonal Workshop of KVKs of Maharashtra, Gujarat and Goa organized by ICAR - ATARI, Pune.	Online	10th to 12th July, 2020
Dr. S. M. Wasnik	"Enhancing Global Competitiveness of Indian Agriculture" organized by Confederation of Indian Industry.	Webinar	24.07.2020
Head KVK and KVK Team	Foundation Stone Laying Ceremony of Administrative Building of KVK, Surat	Webinar	05.08.2020

Head KVK and KVK Team	Online Programme of Hon'ble PM transferring funds of PM Kisan of over Rs 17000 cr to 8.5 cr farmers and launching Agriculture Infra Fund of Rs 1 lakh cr loan.	Webinar	09.08.2020
Dr. S. M. Wasnik	Meeting at collect orate office in connecti with FPO formation	Collectorate office Nagpur	14.08.2020
Dr. S. M. Wasnik	Formation and effective functioning of FPO organized by ICAR-RCER.	webinar	18.08.2020
Dr. S. M. Wasnik Dr. U. V. Galkate Dr. P. B. Deulkar	Fostering Freshwater Aquaculture Technology Dissemination through KVK Network	Webinar	27.08.2020
Dr. S. M. Wasnik	Online Programme of "Inauguration of Academic and Admin Building in Rani Lakshmi Bai Central Agricultural University" by Honourable PM	Webinar	28.08.2020
Dr. S. M. Wasnik Dr. S. S. Patil	e-Talk on "Digital Platforms for Effective Outreach" jointly organized by ICAR-ATARI, Pune, KVK- Kolhapur-II and KVK-Pune-II.	Webinar	29.08.2020
Head KVK and DAMU Team	Zonal Review Workshop Gramin Krishi Mausam Sewa (GKMS) Project: DAMUs organized by ATARI, Pune; IMD, New Delhi and KVK Jalna-I.	Webinar	03.09.2020
Head KVK and KVK Team	Capacity Development of Anganwadi workers & Farm women on Poshan	Webinar	17.09.2020
Dr. S. M. Wasnik Dr. S. S. Patil	Three days online "National Oilseed Brainstorming Meet (Research-Industry-Farmer Interface)" jointly organized by ICAR-IISR, Indore; ICAR-IIOR, Hyderabad; ICAR-IIOPR, Pedavegi; ICAR- DGR, Junagarh and ICAR- DRMR, Bharatpur	Webinar	23-25.09.2020
Dr. S. M. Wasnik Dr. S. S. Patil	Two-Day National level Consultation on Natural Farming organized by NITI Aayog	Webinar	29-30.09.2020
Dr. S. M. Wasnik	Review meeting of KVKs of Maharashtra, organised by Commissioner Agriculture, Maharashtra, Pune	Webinar	30.09.2020
Dr. S. M. Wasnik	Meeting on Farmers Act addressed by Ministers, DG,DDGs, Govt of India dignitaries.	Webinar	03.10.2020
Head KVK and KVK Team	Virtual meet on Outreach program for KVK farmers on Farm Act by MoS	Webinar	07.10.2020
Dr. S. M. Wasnik	Meeting at collect orate office in connecti with FPO formation	Collectorate office Nagpur	09.10.2020
Head KVK and KVK Team	Popularization of FARMs Mobile App through KVKs	Webinar	09.10.2020
Dr. S. M. Wasnik Dr. U. V. Galkate Dr. P. B. Deulkar	Online workshop - All India Fodder Production Officers: Rabi.	Webinar	13-15.10.2020
Dr. S. S. Patil	Virtual Krishi Mela 2020	Webinar	13-14.10.2020
ARYA Team	National Citrus Webinar	Webinar	13-14.10.2020

Dr. S. M. Wasnik	World Food Day programme organized by ICAR	Webinar	16.10.2020
Sh. Eluka Sridhar	National webinar on quality improvement and proficiency testing of soil laboratories in India	Webinar	31.10.2020
ARYA Team	Export Quality Mango Production	Webinar	3-6.11.2020
Dr. S. S. Patil **Dr. S. Y. Wankhede**	Online Training Program on "Climate Resilient Development in Agriculture"	Webinar	7-11.11.2020
Dr. U. V. Galkate	World Fisheries Day	Webinar	21.11.2020
Dr. S. M. Wasnik	Curtain raised programme of IISF2020	Webinar	16.12.2020
Dr. S. M. Wasnik	Inauguration of Sixth edition of 'India International Science Festival (IISF-2020)	Webinar	22.12.2020
Head KVK and KVK Team	Agricultural Scientists Meet	Webinar	23-24.12.2020
Dr. S. S. Patil **Smt. Sunita Chauhan** **Dr. P. B. Deulkar**	National Webinar on Onion Seed Production	Webinar	24.12.2020
ARYA Team	Online Training on Hi-Tech Cultivation of Vegetables & Grafting in Vegetables (Dutch Technology)	Webinar	24.12.2020
Head KVK and KVK Team	Valedictory function of Sixth edition of 'India International Science Festival (IISF-2020)	Webinar	25.12.2020
Head KVK and KVK Team	Live web casting of Hon'ble Prime Minister of India addressed to the farmers and released PM Kisan money to farmers.	Webinar	25.12.2020
DAMU Team	Biweekly meeting of forecast and Advisory on every Tuesday and Friday of the week	KVK, Nagpur	Every Tuesday and Friday of the week
Guest Speaker			
Dr. P.B. Deulkar	Delivered lecture on "Goat & Poultry Farming" in one day workshop on "Empowering Schedule Caste Unemployed rural youth for developing agribusiness and entrepreneurship" under SCSP Project	At Godhani village Tah-Umred Dist.-Nagpur	03.03.2020

9.10 List of publications

1. Sunita Chauhan; S. M. Wasnik (2020) Farm women empowerment through use of Drudgery reduction tools, Interdisciplinary National Conference on Recent Innovation in Agri-Bioscience in strengthening the Indian economy: Challenges and prospects and farmers meet (RIABSCIECP-2020) pp-72. Feb 2020.
2. Processing of Fruits and Vegetables: Profitable Enterprise. (Author- Smt. Sunita Chouhan, SMS (Horticulture), Editor -Dr. S. M. Wasnik, Principal Scientist (Agri. Ext.) & Head KVK, ICAR-CICR, Nagpur Publisher- Dr. V. N. Waghmare, Director, ICAR-CICR, Nagpur)
3. Value addition of Custard Apple. (Author- Smt. Sunita Chouhan, SMS (Horticulture), Editor -Dr. S. M. Wasnik, Principal Scientist (Agri. Ext.) & Head KVK, ICAR-CICR, Nagpur Publisher-

Dr. V. N. Waghmare, Director, ICAR-CICR, Nagpur)

4. Dr. S.M. Wasnik, Shri. K.I. Chaple and Dr. S.S.Patil. Techniques of Bt. cotton cultivation, '**Krushi Jagran'** Special issue June 2020, pp: 22-29.
5. Dr. S.M. Wasnik, Shri. K.I. Chaple and Dr. S.S. Patil. Irrigation management in cotton crop, '**Agrowan'** Special issue July 15th 2020, pp: 14.
6. Dr. S.M. Wasnik, Shri. K.I. Chaple**,** and Dr. S.S. Patil. Pheromone traps for integrated pest management, **'Agrowan'** Special issue July 17th 2020, pp: 11.
7. Dr. S.M. Wasnik, Shri. K.I. Chaple, and Dr. S.S. Patil. Types of pheromone traps and their crop wise used, '**Agrowan'** Special issue July 18th 2020, pp: 14.
8. Dr. S.M. Wasnik, Shri. K.I. Chaple and Dr. S.S. Patil. Identification of Bio-pesticides and fertilizers, '**Krushi Jagran'** Special issue July 2020, pp: 20-23.
9. Dr. S.S. Patil and Shri. K.I. Chaple. Major Sucking pest on Cotton and their management, '**Krushakonnati'**, Special issue Aug 18th 2020, pp:10
10. Dr. S.S. Patil and Shri. K.I. Chaple. Pink bollworm management on Cotton, '**Krushakonnati'**, Special issue September 1st 2020, pp:11

Popular article:

1. S. M. Wasnik, S. Y. Wankhede, P. S. Gayakwad. 2020. *Meghdoot: Hawaman Aadharit Vyavasthapanasathi Mobile App.* Krushakonnati: 29th April, 2020.
2. S. M. Wasnik, S. Y. Wankhede. 2020. *Pikachya Kadhani ani Malani Kalat Corona Pratibandhak Margadarshak Suchana.* Krushakonnati: 29th April, 2020.
3. S. M. Wasnik, S. Y. Wankhede. 2020. Corona mule Lockdown Chya Shetakari Bandhavanni Ghyavayachi Kalaji. Krushakonnati: 29th April, 2020.
4. S. Y. Wankhede, S. M. Wasnik, P. S. Gayakwad. 2020. *Meghdoot Sangel Hawamanacha Andaj.* Deshonnati: Krushak Jagar: 05th October, 2020.
5. S. Y. Wankhede, S. M. Wasnik, P. S. Gayakwad. 2020. *Hawaman Aadharit Krushi Vyavasthapanasathi Meghdoot App Tharanar Shetakaryansathi Waradan.* Krushakonnati: 06th October, 2020.
6. S. Y. Wankhede, S. M. Wasnik, P. S. Gayakwad. 2020. *Hawaman Aadharit Krushi Vyavasthapanasathi Meghdoot App Tharanar Shetakaryansathi Waradan.* Krushakonnati: 13th October, 2020.
7. S. Y. Wankhede, S. M. Wasnik, P. S. Gayakwad. 2020. *Gharabaher Asatana Vijecha Dhoka Kami Karanyasathi Suchana.* Krushakonnati: 20th October, 2020.

Radio Talks (AIR, Nagpur):

- Dr. P.B. Deulkar delivered radio talk on "Cultivation of hybrid Napier for nutritious fodder" on 22/01/2020 and broadcasted on 03/02/2020 at 7.30 pm on "Maz Ghar Maz Vavar Programme".
- Dr. S. M. Wasnik, PS & Head KVK, ICAR-CICR, Nagpur**,** delivered On-line Radio Talk on May 29, 2020 on KVK Nagpur & CICR Technologies for farmers in coming Kharip Season.
- Dr. S M Wasnik, PS & Head KVK, ICAR-CICR, Nagpur, delivered TV talk Micro Enterprises Programme for Farmers on March 11, 2020 through Sahyadri Vahini of Doordarshan Kendra, Mumbai.

Agricultural Technology Information Centre

The Agriculture Technology Information Centre (ATIC) was established at ICAR-Central Institute for Cotton Research, Nagpur during **2001**, as a **'single window support system'** to make available all the information to the farmers under one roof. ATIC acts as single window system to allow optimistic interaction between farmers and scientist for effective technology transfer and livelihood improvement.

Services provided by ATIC

- Diagnostic services for soil and plant testing.
- Diagnosis of plant/animal/crop problems.
- Supply technology products such as cotton seed and other planting materials, livestock breeds, process products etc. emerging from the institution and ICAR-CICR, KVK for testing and adaptation.
- Sale of publications and communication materials produce by the research organization.

A. Details on ATIC

Sr. No.	Name of the ATIC	Name of the Host Institute	Year of establishment	Name of the ATIC Incharge
1	ATIC (Central Institute for Cotton Research) Nagpur	ICAR-Central Institute for Cotton Research, Nagpur (Maharashtra)	2001	**Dr. S. M. Wasnik ,** Principal Scientist,Agri. Extension & Head KVK CICR,Nagpur Phone: 9423680707

B. Facilities available in the ATIC

Sr. No.	Particulars	Number available
1	Reception counter	01
2	Sales counter	01
3	Weather based agro advisory	01
4	Training hall	02
5	Museum	01
6	Intercom facility	01

C. Farmers / Extension Personnel / Stakeholders Visits:

During the period under report, a total of 1693 farmers, **302** extension personnel and **504** other stakeholders visited ATIC. Altogether, **2459** persons visited the ATIC, out of which, 962 visited for information and **432** visited for technology products.

Communication with Stakeholders:

A total of **2412** farmers contacted ATIC through various means of communication like phone calls, video shows, emails, webinars and participation in training.

D. Publication:

Under publications, **04** books, **40** technical bulletins, **04** Folders and -- DVDs were produced and provided to the ATIC visitors or those requested by mail. Totally, **950** farmers and other stakeholders were benefited by these publications and documents.

E. Technology Services Provided:

During the reporting period, **495** soil and plant samples were tested at institute.

F. Technology Products Provided:

Among different technology products, **7.34** quintals of cotton seeds, **36,900** number of planting material (fodder), sale of 30 Osmanabadi Goats, worth of **Rs.1.63 lakh**, **Rs. 0.36** lakh and **Rs. 2.02** lakh respectively were provided to farmers.

G. Revenue Generated:

An amount of Rs. **4.26** lakh was generated through various technology products/ publications and services provided through ATIC.

LIST OF PUBLICATIONS AVAILABLE FOR SALE THROUGH ATIC

Sr. No.	Name of Bulletin /Publication	CICR Bulletin No.	Price (Rs).
1	Aboitic Stresses in Cotton: A Physiological Approach (in English)	2	25=00
2	Naturally Coloured Cotton (in English)	4	25=00
3	Wild and cultivated Species of Cotton (in English)	5	100=00
4	Nutrient Management in Rainfed Cotton (in English)	6	25=00
5	An Evolving Systems Approach of IPM in Cotton :Perception and prescription (in English)	9	25=00
6	Cotton Biotechnology (in English)	10	40=00
7	Glanded and Glandless Cotton (in English)	12	25=00
8	Cotton Varieties and Hybrids (in English)	13	40=00
9	Breeding Hybrid Cotton (in English)	14	40=00
10	Use of Rainfall Analysis in the Planning and Management Of Rainfed Cotton (in English)	15	40=00
11	Cotton Genome Mapping For Crop Improvement	16	50=00
12	Biotechnological Approaches for Cotton Improvement	17	50=00
13	Training, Consultancy, Contract Research and Contract Service in Cotton Production: An Information Brochure	18A	50=00
14	Constraints to Cotton Production in India	19	25=00
15	Mechanization of Cotton Production in India	20A	40=00
16	Genetic Improvement of cotton seed oil	21	25=00
17	Nematode infested seed and planting Material: Denematization and salving Techniques	20	50=00
18	Technology Transfer in Cotton	23	25=00
19	Male Sterility In Cotton	24	25=00
20	पराजीनी बीटी कपास (मराठी)	25	20=00
21	Cotton Seed Oil Quality, Utilization and Processing	25A	25=00
22	Genetic Enhancement in Cotton	26	25=00
23	Plant Parasitic Nematodes of Cotton-farmer's hidden enemy	27	25=00
24	Physiological Disorders in Cotton	28	50=00
25	Mirco –Irrigation Management in Cotton	31	60=00
26	Epitome of Agro –Meteorology : Nagpur (1916-2002)	32	50=00
27	Rainwater Management Techniques for Cotton Based Cropping System.	33	50=00
28	Twenty five years Achievements in Cotton Pathology At CICR (1976-2001)	33A	50=00
29	Cotton – March Towards New Millennium	33B	100=00
30	उस्मानाबादी शेळी	----	5=00
31	शेळयासाठी पौष्टिक हिरवा चारा लसूनघास	-----	5=00
32	Identification of sources of Resistance to Gray mildew disease (Ramularia Areola) in diploid cotton Gossypium arboreum	34	40=00
33	Bharat Mein kapas Anusandhan and vikas (in Hindi)	34A	350=00
34	Fibre Quality Traits of G.Arboreum Germplasm	35	100=00
35	Fibre Quality Traits of G.herbaceum Germplasm	36	100=00

36	Nector Glands in Gossypium	37	50=00
37	कपाशीवरील मिलीबगचे व्यवस्थापन	-----	10=00
38	कपास मे मिलीबग का प्रकोप और इसका प्रबंधन	----	10=00
39	Compendium of Cotton Mealybugs (English)	2011/1	50=00
40	Handbook of Cotton Plant Health (English)	Book	200=00
41	कपाषीवरील किडी व रोगांचे प्रभावी व्यवस्थापन (मराठी)	-----	60=00
42	Crop Growth Calender for Rainfed Cotton Pest Management (English)	-----	10=00
43	कापूस पिकात एकात्मिक किड व्यवस्थापनातील नूतन संषोधन (मराठी)	-----	60=00
44	कपास के नाषीकीटो का प्रभावी प्रबंधन (हिंदी)	Folder	5=00
45	कपाशीवरील गुलाबी बोंडअळी व्यवस्थापन (मराठी)	------	10=00
46	Cotton: Integrated pest, Diseases and Nematode Managent (English)	1/2019	70=00
47	कपास : नाशीजीव , रोग एवं सूत्रकृमि का समेकित प्रबंधन	2/2019	70=00
48	कापूस : किडीं , रोग व सूत्रकृमिचे एकात्मिक व्यवस्थापन	3/219	70=00

Note: Mode of payment through Cheque, RTGS/NEFT in favour of ICAR Unit, CICR, Nagpur. Account No. 11072609110, IFSC Code-SBIN0001633 SBI, Ramdaspeth, Nagpur -440012.

Contact : Dr.P. B. Deulkar (Mob.No.9657726508), ATIC Manager, CICR, Nagpur

10. GENERAL

10.1: List of Publications

10.1.1 Research Papers

10.1.1.1 Research papers (NAAS rating> 6)

1. Abdelmoghny AM, Raghavendra KP, Sheeba Annie J, Santosh HB, Meshram Jayant, Singh Suman Bala, Kranthi KR, Waghmare VN. (2020). Morpho-physiological and molecular characterization of drought tolerance traits in *Gossypium hirsutum* genotypes under drought stress. *Physiology and Molecular Biology of Plants*, 26(12), 2339-2353. (NAAS rating:7.54)
2. Asha Bharti, Prasanna R, Velmourougane K, Kumar Arun, Shivay YS, Lata Nain. (2020). Development of Nutrient-Rich Media Through Cyanobacterial Amendment and Their Characterization. *Waste and Biomass Valorization*, 11: 6003-6016. (NAAS rating:8.36)
3. Biswas KK, Bhattacharyya UK, Palchoudhury S, Balram N, Kumar A, Arora R, Sain SK, Kumar P, Khetarpal RK, Sanyal A, Mandal PK. (2020). Dominance of recombinant cotton leaf curl Multan-Rajasthan virus associated with cotton leaf curl disease outbreak in northwest India. *PLoS ONE*, 15(4): e0231886. https://doi.org/10.1371/journal.pone.0231886. (NAAS rating:8.78)
4. Blaise D, Kranthi KR, Ravindran CD and Thalal K. (2020). High plant density can improve productivity of Asiatic cotton (*Gossypium arboreum* L.). *Archives of Agronomy and Soil Science*, https://doi.org/10.1080/03650340.2020.1741553. (NAAS rating:7.68)
5. Blaise D, Manikandan A, Verma P, Nalayini P, Chakraborty M, Kranthi KR. (2020). Allelopathic intercrops and its mulch as an integrated weed management strategy for rainfed Bt-transgenic cotton hybrids. *Crop Protection*, 135: 105214. (NAAS rating:8.17)
6. Bhargavi Bussa, Behera Umakant. (2020). Securing the livelihood of small and marginal farmers by diversifying farming systems. *Current Science*, VOL. 119 (5), Page 854-860. (NAAS rating:6.76)
7. Kanjana D. (2020). Foliar application of magnesium oxide nanoparticles on nutrient element concentrations, growth, physiological, and yield parameters of cotton. *Journal of Plant Nutrition*, DOI: 10.1080/01904167.2020.1799001. (NAAS rating:6.75)
8. Das Anup, Basavaraj Savita, Layek Jayanta, Ramkrushna G I, Lal Rattan, Krishnappa R, Yadav G S, Babu Subhash, Ghosh P K and Ngachan S V. (2020). Can conservation tillage and residue management enhance energy use efficiency and sustainability of rice-pea system in the Eastern Himalayas?. *Archives of Agronomy and Soil Science*, 66(6): 830–846. (NAAS rating:7.68)
9. Pande Rachna. (2020). Study on biology of tea bunch caterpillar Andraca bipunctata on alternative host plant *Eurya acuminata* of Meghalaya. *Journal of Environmental Biology*, 41 782-787. (NAAS rating:6.56)
10. Fand BB, Amala U, Yadav DS, Rathi R, Mhaske SH, Upadhyay A, Shabeer ATP, Kumbhar DS. (2020). Bacterial volatiles from mealybug honeydew exhibit kairomonal activity towards solitary endoparasitoid *Anagyrus dactylopii*. *Journal of Pest Science*, 93: 195–206. (NAAS rating: 11.13)
11. Fand BB, Nagrare VS, Deshmukh V, Naikwadi BV, Gokte-Narkhedkar N, Waghmare VN. (2020). A simple and low-cost laboratory rearing technique

for cotton pink bollworm, *Pectinophora gossypiella* (Suanders) (Lepidoptera: Gelechidae) using detached green bolls of cotton. *Phytoparasitica*, 48 (1): 25-33. (NAAS rating:7.02)

12. Hiremani NS, Verma P, Gawande SP, Sain SK, Nagrale DT, Salunkhe VN, Shah V, Gokte-Narkhedkar N, Waghmare VN. (2020). Antagonistic potential and phylogeny of culturable endophytic fungi isolated from desi cotton (*Gossypium arboreum* L.). *South African Journal of Botany*, https://doi.org/10.1016/j.sajb.2020.03.0 . (NAAS rating:7.5)
13. Sethi Khushboo, Siwach Priyanka, Verma Surender Kumar. (2017). Linkage disequilibrium and Association Mapping of fiber quality traits in elite Asiatic Cotton (*Gossypium arboreum* L.) germplasm populations".. *Czech Journal of Genetics and Plant Breeding*, doi:10.17221/142/2016-CJGPB. (NAAS rating:6.65)
14. Kumari Arti, Kumar R R, Singh Jyoti Prakash, Verma Pooja, Singh Gyanendra P, Chinnusamy Viswanathan, Praveen Shelly, Goswami Suneha. (2020). Characterization of the starch synthase under terminal heat stress and its effect on grain quality of wheat. *3 Biotech*, 10.1007/s13205-020-02527-4. (NAAS rating:7.79)
15. Laneesha M, Suroshe Sachin S, Fand Babasaheb B and Shankarganesh K. (2020). Papaya mealybug, *Paracoccus marginatus* (Hemiptera: Pseudococcidae): A new threat to agri-horticulture ecosystem. *Indian Journal of Agricultural Sciences*, 90:3,455–62. (NAAS rating:6.25)
16. Manivannan A. (2020). Analysis of multi-environment yield trails of clusterbean [*Cyamopsis tetragonoloba* (L.) Taub.] genotypes using GGE biplot. *Legume Research*, 43(5): 698-701. (NAAS rating:6.34)
17. Nagrale DT, Gawande SP, Hiremani NS, Gokte-Narkhedkar N. (2020). Occurrence and pathogenicity of *Enterobacter* sp. causing sprout decay and seedling stunting of upland cotton (*Gossypium hirsutum* L.). *Journal of Phytopathology*, 168(7-8):391–398. https://doi.org/10.1111/jph.12903. (NAAS rating=7.1). (NAAS rating:7.1)
18. Nagrale DT, Gawande SP, Gokte-Narkhedkar N, Waghmare VN. (2020). Association of phytopathogenic Pantoea dispersa inner boll rot of cotton (*Gossypium hirsutum* L.) in Maharashtra state, India. *European Journal of Plant Pathology*, 158, 251–260. https://doi.org/10.1007/s10658-020-02071-0 (NAAS rating:7.74)
19. Peddu H, Fand BB, Sawai HR, Lave NV. (2020). Estimation and validation of developmental thresholds and thermal requirements for cotton pink bollworm *Pectinophora gossypiella*. *Crop Protection*, 127: 104984. DOI: https://doi.org/10.1016/j.cropro. 2019. 104984. (NAAS rating:8.17)
20. Verma Pooja, Venugopalan MV, Blaise D and Waghmare VN. (2020). Ethylene mediated regulation of fiber development in Asiatic cotton (*Gossypium arboreum* L.). *South African Jounal of Botany*, 135:349-354 https://doi.org/10.1016/j.sajb.2020.09.014. (NAAS rating:7.5)
21. Prabhulinga T, Kranthi Sandhya, Raghavendra K P, Kumar Rishi , Suke Ruchika, Chawla Shilpa and Kranthi Keshav Raj. (2020). Mitochondrial COI based genetic diversity and phylogeographic structure of whitefly *Bemisia tabaci* (Gennadius) on cotton in India. *International Journal of Tropical Insect Science*, https://doi.org/10.1007/s42690-020-00354-x. (NAAS rating:6.85)
22. Raghavendra KP, Kumar R, Das J, Santosh HB, More SA, Ramakrishna N, Chawla SG, Kranthi S, Kranthi KR. (2020). Quantitative real-time PCR based evaluation and validation of reference genes in *Gossypium arboreum*. *Indian Journal of Agricultural Sciences*, 90(1): 40–47. (NAAS rating:6.25)
23. Rishi Kumar, Kranthi S, Prasad Rao GMV, Desai H, Bheemanna H,

Dharajothi B, Choudhary Alka & Kranthi K R. (2020). Assessment of bollworm damage and yield loss in seed blends of Bollgard-II with corresponding Non-Bt hybrid as 'built in refuge' in cotton. *Phytoparasitica*, https://doi.org/10.1007/s12600-020-00846-z. (NAAS rating:7.02)

24. Rishi Kumar, D. Monga, V. Chinna Babu Naik, Paramjit Singh and V.N. Waghmare. (2020). Incipient infestations and threat of pink bollworm *Pectinophora gossypiella* (Saunders) on Bollgard-II cotton in north cotton growing zone of India. *Current Science*, 118(9) 1454-56. (NAAS rating:6.76)
25. Savitha S and Sreenivasa MN. (2019). Molecular characterization of native pink pigmented facultative methylotrophs of chilli and their induced systemic resistance mechanism in management of anthracnose. *Journal of Environmental Biology*, http://doi.org/10.22438/jeb/41/6/MRN-1362. (NAAS rating:6.56)
26. Salunkhe V N, Gawande S P, Gokte-Narkhedkar N, Nagrale D T, Hiremani N S, Waghmare V N. (2020). First report of *Colletotrichum siamense* causing leaf anthracnose on cotton in India. *Plant Disease*, 104(7),https://doi.org/10.1094/PDIS-09-19-1992-PDN. (NAAS rating:9.58)
27. Shah Vivek, Pande Rachna, Verma Pooja, Gokte-Narkhedkar Nandini and Waghmare Vijay N. (2020). Identification of oviposition deterrents from pink bollworm, *Pectinophora gossypiella* (Saunders). *Journal of Environmental Biology*, Vol. 41: 644-649. (NAAS rating:6.56)
28. Shankarganesh K, Selvi C and Karpagam C. (2020). Effects of thermal stress on the antioxidant defenses in *Paracoccus marginatus* Williams and Granara de Willink (Homoptera: Pseudococcidae) parasitized by *Acerophagus papayae* Noyes & Schauff (Encyrtidae: Hymenoptera)". *International Journal of Tropical Insect Science*, http://link.springer.com/article/10.1007/s42690-020-00222-8. (NAAS rating:6.85)
29. Kumar Vijay, Kular Jagdev Singh,Kumar Rishi , Sidhu Sukhdev Singh and Chhuneja Pardeep Kumar. (2020). Integrated whitefly [*Bemisia tabaci* (Gennadius)] management in Bt-cotton in North India: an agro ecosystem-wide community-based approach. *Current Science*, VOL. 119, NO. 4, 618-24. (NAAS rating:6.76)
30. Desouza ND, Blaise D. (2020). Impact of aerosols on deep convective clouds using integrated 6 remote sensing techniques. *Air Quality, Atmosphere and Health*, 10.1007/s11869-020-00838-2. (NAAS rating:8.87)

10.1.1.2 Research papers published by the Institute's scientists NAAS rating< 6

1. Sampath Kumar, Eraivan Arutkani Aiyanathan A K , Nakkeeran S and Manickam S. (2020). Validation of Screening Technique for Cotton Bacterial Blight Resistance under Controlled Condition. *Current Journal of Applied Science and Technology*, 39(7): 138-145. (NAAS rating:5.32)
2. Agarwal Isabella. (2020). Impact analysis of global shift in cotton trade on Indian cotton scenario. *Journal of Cotton Research and Development*, p.157-164. (NAAS rating:4.69)
3. Agarwal Isabella and Narala Anuradha. (2020). Comparing Predictive Accuracy Through Price Forecasting Models in Cotton. *Journal of Cotton Research and Development*, 34(1):146-157. (NAAS rating:4.69)
4. Narala Anuradha and Usha Rani S. .(2020). Women in Cotton Farming in Vidarbha Region of Maharashtra. *Indian Journal of Extension Education*, 56(2):1-6. (NAAS rating:5.32)
5. Baghyalakshmi K, Jeyaprakash P, Ramchander S, Raveendran M and Robin S. (2020). Two dimensional in-vitro phenotyping of root system architecture using Poly Ethylene Glycol

in backcross inbred lines harboring drought tolerant QTLs of rice (*Oryza sativa* L.). *Electronic Journal of Plant Breeding*, 11(2):335-345. (NAAS rating:4.97)

6. Baghyalakshmi K, Ramchander S, Raveendran M and Jeyaprakash. (2020). Unravelling of Osmotic genes involved in Drought tolerance in Backcross inbred lines of rice (*Oryza sativa* L.) cultivars. *Research journal of Biotechnology*, Vol. No.15 (7) 52-60.. (NAAS rating:5)
7. Baghyalakshmi K, Shaik M, Mohanrao M, Shaw R, Lavanya C, Manjunatha T and Senthilvel S. (2020). Development and characterization of tetraploid castor plants. *Plant Genetic Resources: Characterization and Utilization*, doi:10.1017/S1479262120000039. (NAAS rating:5.12)
8. Balasubramani G, Raghavendra KP, Amudha J, Patil B R and Waghmare VN. (2020). Expression analysis of genes associated with secondary cell wall biosynthesis in cotton (*Gossypium hirsutum* L.). *Plant Cell Biotechnology and Molecular Biology*, 21(45&46):103-114; 2020 ISSN: 0972-2025. (NAAS rating:4.31)
9. Deborah Anne Kitty D, Balasubramani Ganesan and Waghmare VN. (2020). Identification of Green Tissue Specific Genes in Cotton Employing Transcriptome Sequencing. *Int. J. Curr. Microbiol. App. Sci*, 9(10): doi: https://doi.org/10.20546/ijcmas.2020.910.xx. (NAAS rating:5.38)
10. Kanjana D. (2020). Evaluation of Foliar Application of Different Types of Nanofertilizers on Growth, Yield and Quality Parameters and Nutrient Concentration of Cotton under Irrigated Condition. *International Journal of Current Microbiology and Applied Sciences*, 9(7): 429-441. (NAAS rating:5.38)
11. Deepika M, Asokhan M and Usha Rani S. (2020). Knowledge Level of ELS cotton growers in Vellore District – An Analysis. *Journal of Cotton Research and Development*, 34(1): 129-134. (NAAS rating:4.69)
12. Sahu DK , Manikandan A, Blaise D, Shukla PK. (2020). Identification of Relationship among Exogenous NaCl with Cotton Leaves on Cation Uptake, Nutrient Ratios and Status in Rhizosphere Soil. *Chemical Science Review and Letters*, 9(36): 956-965. (NAAS rating:5.21)
13. Pande Rachna. (2020). Wax moths and their parasitoid *Apanteles galleriae* wilkinson from mid-hills of Meghalaya. *Indian Journal of Entomology*, 82(4):771-776. (NAAS rating:5.89)
14. Dhamayanthi KPM, Rameash K. Manivannan A. Annie Sheeba J and Abirami S. (2020). Studies on leaf hairiness and sucking pest resistance in Egyptian cotton (*Gossypium barbadense* L.). *Journal of Entomology and Zoology Studies*, 8(1): 591-594 . (NAAS rating:5.53)
15. Nagrare VS, Naik Chinna Babu V, Naikwadi Bhausaheb Vithoba and Gokte Narkhedkar Nandini. (2020). Spatio- temporal diversity of natural enemies of mealybug infesting cotton in Central India. *Journal of Applied Zoological Researches*, 8(5), pp.2031-2037. https://www.entomoljournal.com/search/?q=VS+Nagrare+. (NAAS rating:4.22)
16. Tuteja OP and Verma S K. (2017). Estimation of Economic Heterosis for Seed Cotton Yield components and Fibre Traits of American cotton (*Gossypium hirsutum*). *Cotton Research Journal* ISCI, 8(2).42-45. (NAAS rating:3.45)
17. Palve S M, Mandhyan P K, Waghmare V N and Kate N. (2019). Analysis of fibre quality in a *Gossypium hirsutum* × *G. barbadense* backcross introgression population. *Cotton Research Journal*, 10(1): 16-20. . (NAAS rating:3.45)
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10.1.2 Other Publications

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10.1.2.2 Technical Bulletins/leaflets:

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3. Rameash, K., Pramoth Kumar, Balakrishnan, V., Prakash, A H.(2020).பருத்தி இளஞ்சிகப்பு காய்ப்புழு ஒருங்கிணைந்த பூச்சி மேலாண்மை (Integrated Management of Pink bollworm on Cotton).ICAR - Central Institute for Cotton Research.Pp6 (Tamil)
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10.1.2.3 Popular Articles:

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15. Valarmathi, P. (2020). Copper fungicides and its mode of action. *AGROBIOS Newsletter*.Pp. Vol. XIX (4): 114., 17-09-2020 (English)
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24. Dipak T Nagrale, Shailesh PG, V,Chinna Babu Naik and YG Prasad (2020). Boll rot Management in cotton. *Vyavsayam* monthly MagazinePp. December , 2020, page No: 19-20, 01-12-2020 (Telugu)
25. Raghavendra Santosh (2020). Genome sequencing. *Cotton Innovate*Pp. 23 (10), 15-12-2020 (English)
26. Pande, R. Ramkrushna G. I., Verma, P. and Shah V. (2020). Role of Honey Bees for Income Generation in Farming System. *Biotica Research Today* Pp. 2(2): 1122-1125, 23-12-2020 (English)
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29. Sankaranarayanan K, A H Prakash and K Rajendran. (2020). Effect of sowing time on productivity of Bt and non Bt cotton under climate change situation. *Bulletin of the National Research Centre* Pp.44:146 https://doi.org/10.1186/s42269-020-00400-1 (English)
30. Gaikwad K, Senthilkumar T, Santosh HB. (2020). The journey of cotton from seed to fabric. *Food and Scientific Reports* Pp. 1(8): 59-621(8): 59-62, (English)

10.1.2.4 Training manuals:

1. M. Sabesh. (2020). Need of ICT in Cotton Production System. In Training Manual on Capacity Building Program on Cotton Production Technologies. Edited by Dr. A. H. Prakash, Dr. S. Usha Rani, Dr. M. Sabesh, Sh. S. Sathyakumar. P 115-119 (English)
2. G. Balasubramani. (2020). Bt expression analysis by ELISA Qualitative and Quantitative Methods. In Training Manual on "GM Cotton Testing". Edited by G. Balasubramani, J. Amudha, K. P. Raghavendra and N. Chandrashekar. P 41-50 (English)
3. Balasubramani, G., Amudha, J.,Raghavendra, K.P.,Chandrasekar,N. (2020). Isolation of Cotton DNA, DNA Fingerprinting. In GM Cotton testing. Edited by Balasubramani, G., Amudha.J.,Raghavendra, K.P.,Chandrasekar,N. P 24-26,51-55 (English)

10.2: List of on-going projects

S. No.	Programmes	Project as per IRC proceedings 2020
1	Cotton genetic resources and pre-breeding	**Nagpur**
		1. Harnessing the potential of wild and unadapted germplasm in cotton improvement- A pre-breeding approach. (2018-2023) 2. Collection, conservation, evaluation, documentation and maintenance of germplasm of cultivated species of *Gossypium*. (2018-2023)
		Sirsa
		3. Development of Cotton Leaf Curl Virus resistant genotypes using *G.arboreum*/ *G.herbaceum* through introgression. (2015-2021)
2	Accelerating genetic gains for productivity and quality and climate resilience	**Nagpur**
		4. Development of broad based high yielding varieties of diploid and tetraploid cotton through recurrent selection. (2020-2026) 5. Development of compact plant type with improved quality traits through selective mating system.(2017-2022) 6. Breeding of upland cotton for improved fibre yield, quality and resistance to biotic stress (Jassid). (2005-2021) 7. MAS/MAB for Water-logging in Cotton. (2012-2023) 8. Breeding to improve performance of *Gossypium herbaceum* for adaptation to climate change in central India. (2015-2022) 9. Development of high yielding, early maturing Asiatic cotton (*Gossypium arboreum*) genotypes suitable to south Zone. (2015-2023) 10. Breeding for early maturity compact plant type and jassid tolerance in cotton. (2014-22)
		Coimbatore
		11. Breeding for high yielding, early maturing sucking pest tolerant extralong staple G.barbadense genotypes with improved fibre properties. (2017-2025) 12. Development of high strength cotton genotypes by reducing the short fiber content. (2017-2025) 13. Induced Mutagenesis for Improvement of ELS (*G. barbadense*) cotton. (2020-2025) 14. Development and Evaluation of ELS interspecific hybrids with better yield and fiber quality. (2019-2024)
		Sirsa

		15. Identification of male sterile plants in genetic male sterility (GMS) using molecular markers. (2012-2021) 16. Development of varieties of upland cotton having better fibre traits and tolerance to CLCuD. (2017-2025)
3	Maintenance breeding, seed research and quality seed production	**Nagpur**
		17. ICAR project on Seed Production in Agricultural Crops and Fisheries. (2007-2021) 18. Seed characterization based on protein quantification and profiling in cotton. (2019-2022) 19. Strategies to augment quality and storability of cotton seed under different environmental conditions. (2017-2022)
		Coimbatore
		20. National Seed Project (Crops). (1999-2021) 21. Implementation of PVP legislation 2001 and DUS testing of cotton under ICAR-SAU system. (2003-2021)
4	Gene discovery and trait improvement through omics and transgenics	**Nagpur**
		22. An efficient regeneration system for transformation studies with *CICRcry2Ab1Ac* and fiber strength genes in Cotton (*G. hirsutum*). (2017-2022) 23. Exploration of genomic resources for identification of candidate genes and promoters for cotton improvement.(2020-2025) 24. Targeted mutagenesis of ghPHYA1 through CRISPR/Cas9 in Cotton. (2017-2023) 25. Development of Bt cotton varieties using deregulated and non deregulated transgenic events. (2018-2023) 26. Development of consensus genetic linkage map for *Gossypium* spp with SNP markers and QTL analysis for fibre traits. (2017-2021) 27. Unveiling the potential of cotton WNT-like gene in somatic embryogenesis through genetic engineering. (2018-2021)
5	Documentation of genetic diversity of cotton insect pests, parasitoids, predators, pathogens and economically important microbial populations in cotton	**Nagpur**
		28. Pink bollworm, *Pectinophora gossypiella* (Saunders): Resistance Monitoring, Fitness Costs, Inheritance of Resistance to Cry toxins expressed in Bt cotton. (2017-2021) 29. Genetic diversity in geographical Population of Pink bollworm *Pectinophora gossypiella* (Saunders) in India. (2017-2021) 30. Studies on prevalence of *Xanthomonas citri* pv. *malvacearum* races of cotton and breeding for BLB resistant varieties. (2018-2021) 31. Identification of endophytes from cotton with special reference to *desi* cotton and evaluation of biocontrol activity against major diseases. (2017-2021) 32. Prevalence, distribution and management of emerging diseases and plant parasitic nematodes of cotton. (2020-2025) **Sub project 1**: Studies on inner boll rot of cotton caused by *Pantoea* spp. And other pathogens **Sub project 2**: Studies on target leaf spot of cotton caused by *Corynespora cassiicola* **Sub project 3**: Studies on grey mildew disease of cotton caused by *Ramularia areola*
		Coimbatore
		33. Diversity, Ecology and improvement of eco-compatible management of Thrips in cotton ecosystem. (2017-2021) 34. Studies on symptom expression, host range, transmission and spread of *Tobacco Streak Virus* infecting Cotton. (2017-20)

		35. Molecular characterization, virulence and genetic diversity analysis of *Alternaria* leaf spot disease of cotton. (2017-2021) 36. Prevalence, distribution and management of emerging diseases and plant parasitic nematodes of cotton. (2020-2025) **Sub project 4**: Studies on plant parasitic nematodes of cotton
		Sirsa
		37. Whitefly: Studies on ecology and host plant resistance. (2020-2023)
6	Consolidating ecologically compatible and sustainable insect pest management strategies for conventional, transgenic and organic cotton	**Nagpur**
		38. Investigations on bioefficacy of entomopathogens against cotton Pink bollworm, *Pectinophora gossypiella* Saunders. (2020-2023) 39. Crop pest surveillance and advisory project (CROPSAP) in Maharashtra. (2010-2021) 40. Insecticide Resistance Management (IRM): Dissemination of Pink bollworm Management Strategies. (2018-21) 41. Identification of oviposition deterrent for ethological management of cotton bollworm *Helicoverpa armigera* Hübner. (2017-2022) 42. Investigations into exacerbation of pest status of cotton pink bollworm *Pectinophora gossypiella* (Saunders) in the context of climate change through development of phenology model. (2017-2021) 43. Studies on chemical cues mediating sucking pests and natural enemy interactions in cotton eco-system. (2016-2021) 44. Push-pull strategy for management of pink bollworm in cotton. (2016-2021) 45. Exploration of beneficial microorganisms for biotic stress management in Cotton. (2020-2025) **Sub project 3**: Establishment of In-house short term culture collection repository **Sub project 4**: Mass multiplication of CICRTrichocash (*Trichodrma harzianum*) and validation of their efficacy under MGMG fields
		Coimbatore
		46. Development of wireless smart trap for automated monitoring of lepidopterous pests in cotton. (2019-2022) 47. Biology and holistic management strategies for emerging pest Tea mosquito Bug (*Helopeltis*) in Cotton. (2020-2023) 48. Identification of semio-chemical associated with host plant cotton and insect pest stem weevil *Pempheres affinis*. (2019-2022) 49. Investigation on the susceptibility status and possible detoxification mechanism for neonicotinoids and newer molecules against cotton leaf hopper. (2019-2022) 50. Exploration of beneficial microorganisms for biotic stress management in Cotton. (2020-2025) **Sub project 2**: Development of biocontrol consortia with multifaceted fungi for the management of important pests and nematodes of cotton.
		Sirsa
		51. Exploration of beneficial microorganisms for biotic stress management in Cotton. (2020-2025) **Sub project 1**: Collection, characterization and evaluation of beneficial fungal microorganisms from North, Central and South Cotton growing zones.
7	Precision based cotton farming with mechanical harvesting	**Nagpur**
		52. Investigation on the effect of skips and multiples on the productivity of machine planted cotton. (2020-22) 53. Evaluation and Refinement of spindle type header prototype for

		development of a cotton picker **(**ICAR-CICR, Nagpur & CSIR-CMERI- CoEFM, Ludhiana. (2019-2022)
8	Enhancing the productivity, diversity and sustainability of cotton based production systems through efficient resource management	**Nagpur** 54. Alleviating soil compaction – a production constraint in cotton. (2017-2022) 55. Validation of impact of input on economics of Bt –hybrid cotton+pigeon pea strip cropping. (2017-2021) 56. Improving farm income from cotton grown on shallow and calcareous soils farm income through Nano and other inputs. 57. Integrated farming system to double income of cotton farmer. (2017-2021) 58. Efficient nitrogen fixing legumes for cotton based cropping systems. (2015- 2021) 59. Studies on sorption of sulphur formulations and commercial nitro phosphate fertilizers to different soils. (2019-2021) 60. Evaluation of PGPR and microbial inoculants to alleviate drought stress in cotton (*G. hirsutum* L). (2019-2022) 61. Development of microbial biofilm formulations for cotton: effects on yield, pests, diseases and soil health. (2017-2022) 62. Microbial dissolution of carbonate to ameliorate soil sodicity in Black Soil Regions of Maharashtra. (2019-2022) 63. Bioprospecting microbial volatiles for plant growth promotion and sucking pest (Whitefly and Jassids) management in Bt cotton. (2019-2022) 64. Land resource inventory of Pench National Park for ecological restoration (NBSS & LUP, Pench Tiger Reserve Project). (2020-21) 65. Microbial interventions for potassium nutrition in cotton. (2017-2021) 66. Metabolite exploration of drought stress in cotton. (2017-2021) 67. Quantitative estimation of carbon and moisture fluxes over the cotton based agro-ecosystem: Integrating ground observations, satellite data and modelling. (2017-2021) 68. Estimating water footprint in cotton production system. (2019-2022) **Coimbatore** 69. Crop-weed interaction under ambient and elevated CO2 conditions (2020-2023) 70. Evaluation of agro techniques to overcome the impact of weather aberrations (drought, water logging) in ELS cotton. (2020-23) 71. Sustainable Intensification of Extra Long Staple Cotton Production in South Zone. (2019-2023) 72. Effect of long-term application of organic and inorganic sources of nutrients on continuous cultivation of Bt and non Bt cotton with maize cropping system under irrigated conditions. (2017-2022) 73. Exploiting the epigenetic transgene rational inheritance of stress responsive traits for imparting abiotic stress tolerance to cotton. (2016-2021) **Sirsa** 74. Development of Cotton based cropping systems under Conservation Agriculture for North-Western Indian conditions. (2018-2023) 75. Enhancement in productivity of cotton through improvement in agro-techniques under North-Western Indian conditions. (2019-2022)
9	Socioeconomic	**Nagpur**

	dimension of cotton production system and technology transfer/dissemination and outreach	76. An Inclusive Agri-Business Model for Sustainable Cotton Marketing in the State of Maharashtra. (2018-2021) 77. e- Communication: Dissemination of Cotton Technology.(2017-2022) **Coimbatore** 78. Economic Analysis of Value Chain of the Cotton Market in Tamilnadu. (2020-2022) 79. Ex Ante analysis of the impact of COVID 19 on cotton economy in India. (2020-2022) 80. Development of Extension Model for Promoting the Production of Extra Long Staple Cotton in India. (2019-2021) 81. Discontinuing Adoption Behaviour of Cotton Growers and Scope for Continuous Adoption – A Critical Enquiry. (2019-2022)

10.3: Consultancy, Patents, Commercialization of Technology

10.3.1 Contract Research / Revenue generation:

Items	Amount (Rs. in Lakhs)
Commercialization of varieties	26.00
Seed/ planting material sale	0.10
Sale of other products	23.91

10.3.2 MoU Signed:

Sl. No.	ICAR-CICR signed MoU/ MTA with Institutions	Date	Area of work
1.	Material Transfer Agreement (MTA) with CSIR-NBRI, Lucknow	20-02-2020	Evaluation of transgenic cotton event Tma-12 for whitefly resistant.
2.	M/s. Vikas Biosciences Pvt Ltd., Hyderabad	18-06-2020	Multiplication and Commercialization of ICAR-CICR released Bt cotton varieties
3.	M/s. Dhanlakshmi Seeds Pvt. Ltd, Kurnool, A.P	16-07-2020	Multiplication and Commercialization of ICAR-CICR released Bt cotton varieties.
4.	MAHYCO contract project	04-08-2020	Monitoring for shift in susceptibility in population of the cotton bollworms (*H. armigera and P. gossypiella*) against Cry1 Ac protein in various cotton growing country
5.	MAHYCO contract project	04-08-2020	-Monitoring for shift in susceptibility in population of the cotton bollworms (*H. armigera and P. gossypiella*) against Cry2Ab and Cry1 Ac + Cry 2 Ab protein in various cotton growing country
6.	M/s. SSR Enterprise, Nagpur	24-09-2020	Marketing non-exclusively KVK-CICR Cotton Picking Bag for harvesting matured cotton lint from the field
7.	Telangana State Seed Development Corporation Limited (TSSDCL), Hyderabad	20-11-2020	evaluation, multiplication and commercialization of ICAR-CICR released Bt cotton varieties

10.4:Significant decisions of RAC Meeting

10.4.1 : Research Advisory Committee (RAC) meeting

The first meeting of the newly constituted Research Advisory committee (RAC) of the ICAR- CICR, Nagpur was held on 27th and 28th November 2020 under the chairmanship of Dr. S. A. Patil, Hon'ble Chairman, Farmers Commission of Karnataka, Former Director ICAR-IARI, New Delhi and Former Vice Chancellor UAS, Dharwad. Due to the COVID -19 pandemic, only the Chairman and Dr. O. M. Bambawale, one of RAC member could physically attended the meeting while the other RAC members viz. Dr. P.A. Kumar, Prof. S. S. Siwach, Dr. A. R. Sharma, Dr. A. J. Shaikh, Dr. R.K. Singh and Shri Vishvaas Naamdev Sawant, Shri Makrand Mukandrao Korde (IMC Members and non-official RAC Members) attended through virtual mode.

Dr. M. V. Venugopalan, Member Secretary, welcomed the Chairman and the other members of the RAC. Dr. Y. G. Prasad, Director, ICAR-CICR, Nagpur emphasized the importance of the RAC meeting in up gradation of cotton research in the wake of new challenges posed with changing time. Dr. M. V. Venugopalan, Member Secretary presented the Action Taken Report on the recommendations of the previous RAC meeting held on 7th December 2019. The Heads of the Divisions and Regional Station presented a brief account of the research achievements.

Dr. S. A. Patil, Chairman RAC appreciated the conduct of the meeting and urged the institute to incorporate the suggestions of the members in the research programmes of the institute. The committee proposed the following recommendations and the same were subsequently approved by the Council.

1. Top priority should be given to popularize the Bt varieties of CICR through aggressive seed production, maintenance and demonstration. For this, a Rs 5 crore programme on

released/notified Bt varieties may be prepared and pursued. These varieties should be demonstrated widely and promoted aggressively in locations where they perform well.
2. Prepare a time bound programme for scaling up of ELS cotton production. Commercial production of ELS, G. barbadense varieties alone may not be cost effective (except in and around Coimbatore). More emphasis may be given for developing and popularizing high yielding premium quality H x B hybrids
3. For PBW management, insecticidal efficacy of cry1Ac (Tg2E-13/Mon531 + cry2Ax1 (CH-12) may be studied. As cry1D is extremely effective against PBW and has no cross resistance to cry1Ac and cry2Ax1, research programme should be initiated to synthesize cry1D gene and to be explored for its insecticidal efficacy and development of transgenics for PBW management. Multi-pest resistant 3rd generation Bt cotton can be developed by stacking NRCPB-vip3a14, cry1Fa1 for Spodoptera, cry1D for PBW along

with cry1Ac and cry2Ax1in a phased manner

4. Targeted genome editing is an important tool for trait improvement in crop plants. Hence, isolation, characterization and cloning of EPSPS gene from cotton, and a comparative analysis with the rye grass EPSPS gene may be explored for genome editing options for glyphosate tolerance in cotton
5. Develop a Cotton Technology Demonstration park (minimum 2 ha) at the headquarters and regional stations to showcase the best technologies in both compartmental and integrated mode to assess the potential of the best locally adapted varieties/hybrids under the given agro-ecological settings by providing the state of art crop management practices. Also develop high fertility plot of 2 hectares for evaluating Bt-segregating individual plants and progenies.
6. Promotion of long-linted arboreum and its seed production should be given importance. Prepare an action plan to scale up the area and production of long linted G. arboreum cotton. Demonstrations on long linted arboreums may be upscaled in PPP mode with relevant partners
7. Prepare a status paper and database on the cotton value chain (seed to garment), including problems and potentials for reorientation of existing research programmes. The problems should reflect the national, state and zonal wise yield targets, production constraints and potentials, export targets, etc
8. Cotton cultivation is nutrient demanding and labour intensive. It is essential that mechanization (mechanical harvester, artificial intelligence, robotics, and drones) aimed at improved efficiency and reducing the cost of cultivation in various operations (tillage, sowing, weeding, inter-culture, spraying, harvesting and processing etc.) is given due importance in the research programmes. Also a part of the crop residue produced must be recycled to improve soil health
9. As recommended by the RAC in 2019, the possibility of double cropping with the availability of early duration cotton varieties should be explored by utilizing the harvested rainwater in an efficient manner. A good double cropping system may provide an alternative to the practice of extension of cotton crop and help in the management of Pink Boll Worm.
10. Special thrust on organic cotton cultivation should be given. Conduct large scale demonstration on commercial organic cotton cultivation. Compile the organic package developed by different universities and ICAR-CICR, test them and potential ones may be integrated into existing package of practices. Discuss the ways to enhance organic cotton production in the country with organic producer/marketing organizations.
11. Breeding on plant types may be intensified by introducing suitable genotypes from Russia, USA & Brazil.
12. As release of susceptible populations of PBW may not be a viable option for PBW management, identification of entomopathogenic viruses from pink bollworm management in cotton has to be emphasized. Large scale field demonstrations of promising entomopathogenic viruses can be

attempted during the flowering stage by aerial spray to prevent pink bollworm proliferation in

13. Conduct large scale demonstrations on PBW management with the available technologies (minimum 100 demonstrations) in different agro-ecological zones of cotton growing regions of the country for the management of pink bollworm. Plan one cluster or block demonstration on 25-50 ha contiguous area in one village. The management practices for PBW may be updated through a technical group discussion

The RAC meeting concluded with the vote of thanks been proposed by the Dr. V. N. Waghmare, Head Division of Crop Improvement, ICAR- CICR, Nagpur.

10.5: Other Important Meetings / Events

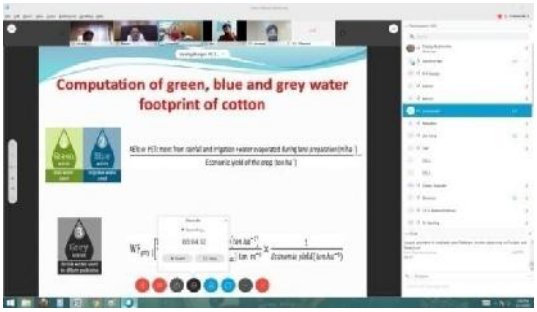
10.5.1: MEETINGS

Project Monitoring and Evaluation meet at ICAR-CICR RS, Coimbatore

The Project Monitoring and Evaluation Committee visited ICAR - CICR, Regional Station, Coimbatore during 6th - 8th January, 2020 and reviewed ongoing research projects being under taken at Coimbatore. The committee visited the demonstration plots and experimental fields and interacted with the PIs and Co-PIs of various projects.

Annual IRC Meet

The Annual Institute Research committee (IRC) meeting of ICAR-CICR was conducted as a virtual meeting using video conferencing (due to pandemic Covid-19 problem) from 11th -15th May and 22nd May 2020 at ICAR-CICR, Nagpur. Dr. V.N. Waghmare, Director, ICAR-CICR, Nagpur chaired the IRC meeting. Dr. Blaise D, I/c Head, Crop Production Division, Dr. Nandini Gokte-Narkhedkar, I/c Head,



Crop Protection Division, Dr. M.V. Venugopalan, Head, PME Cell, Dr. A.H. Prakash, I/c Head and PC, ICAR-CICR, RS, Coimbatore, Dr. O.P.Tuteja, I/c Head, ICAR-CICR, RS, Sirsa and all the Scientists from Nagpur, Coimbatore, Sirsa joined the virtual meeting. Among the projects presented and discussed include, 19 concluding projects, 14 new projects and 83 ongoing projects (including one student's work). Out of 21 new projects presented, only 14 were approved. Similarly, a thorough review was done for all the on-going projects and those seeking extension before arriving at a consensus. The chairman in his concluding remarks provided few major recommendations such as strengthening of pre-breeding and heterotic pool development, taking up production projects in a long term programme mode especially, mechanization, hormonal application study

etc., releasing technologies developed through AICRP (Cotton), publishing good research articles and utilization of seminar halls in all three stations for video conferencing through broad band connection.

REVIEW MEETING of Insecticide Resistance Management (IRM): Dissemination of Pink Bollworm Management Strategies

The REVIEW MEETING of Insecticide Resistance Management (IRM): Dissemination of Pink Bollworm Management Strategies was held on 03rd June, 2020 through video conferencing. During 2019-20, the project was approved and implemented across north, central and south cotton growing zones covering 21 districts of eight major cotton growing states.

Smt. Shubha Thakur, IAS, Joint Secretary (Crops and Oil Seeds), DAC&FW (Crop Division), MA&FW, Govt. of India, New Delhi chaired the meeting. Dr R. K. Singh, ADG (CC), ICAR, New Delhi, Dr A. P. Singh, Additional Commissioner (Crops), DAC&FW (Crop Division), MA&FW, Govt. of India, New Delhi were the Guests of Honour. Dr. R. P. Singh, Director, Directorate of Cotton Development, Nagpur, Dr. V. N. Waghmare, Director, ICAR-CICR, Nagpur, Dr. Blaise Desouza, Head I/C, Crop Production Division, ICAR-CICR, Nagpur, Dr. Nandini Gokte-Narkhedkar, Head I/C Crop Protection Division, ICAR-CICR, Nagpur, Dr. A. H. Prakash, Project Coordinator & Head, ICAR-CICR, RS Coimbatore, Dr. O. P. Tuteja Head I/C ICAR-CICR, RS Sirsa, Dr S. M. Wasnik, Principal Scientist and I/C KVK, ICAR-CICR, Nagpur, Dr. M.V. Venugopalan, Principal Scientist and I/C PME cell, ICAR-CICR, Nagpur, Dr. V. S. Nagrare, Principal Scientist and Principal Investigator of the Project, ICAR-CICR, Nagpur were prominently present. Participants from ICAR-CICR, 10 State Agricultural Universities (SAUs) and 3 KVKs, coordinating 21 districts from eight major cotton growing states participated in the Review Meeting.

Working group meeting of ICAR (CICR, Nagpur) and CSIR (IICT, Hyderabad) on pheromone application technology (PAT) for management of pink bollworm

The Second Working group meeting

between scientists of ICAR (CICR, Nagpur) and CSIR (IICT, Hyderabad) was held on 03rd July, 2020 through Video conferencing. The meeting was held to review results of experiment conducted during 2019-20 and finalize the technical programme for exploration of pheromone application technology (PAT) for management of pink bollworm in the crop season of 2020-21. Dr. V. N. Waghmare, Director, ICAR-CICR, Nagpur chaired the meeting. Dr. B.V. Subba Reddy, Chief Scientist and Head, Fluoro & Agrochemicals Division CSIR-IICT, Dr. B. Nagendra Babu, Senior Scientist, Fluoro & Agrochemicals Division CSIR-IICT and Dr. Sudhakar Bansod, Scientist, Fluoro & Agrochemicals Division, CSIR-IICT participated. From ICAR-CICR, Nagpur Dr. Nandini Gokte-Narkhedkar, Principal Scientist and Head I/c, Crop Protection Division, Dr. V. S. Nagrare, Principal Scientist, Agril. Entomology, Dr. Chinna Babu Naik, Scientist, Agril. Entomology, Dr. Rachna Pande, Scientist, Agril. Entomology, Dr. Babasaheb B. Fand,

Scientist, Agril. Entomology and Dr. Shah Vivek, Scientist, Agril. Entomology participated.

ORIENTATION WORKSHOP "Insecticide Resistance Management (IRM): Dissemination of Pink bollworm Management Strategies" project.

ICAR-Central Institute for Cotton Research (ICAR-CICR), Nagpur organized ORIENTATION WORKSHOP of the project "Insecticide Resistance Management (IRM): Dissemination of Pink bollworm Management Strategies" on 9th July 2020 through video conferencing under the chairmanship of Dr V. N. Waghmare, Director, ICAR-CICR, Nagpur. The profit is implemented through 10 State Agricultural Universities and 3 Krishi Vigyan Kendras. It is aimed at dissemination of Pink bollworm management strategies in Bt cotton in eight cotton producing states viz., Maharashtra, Gujarat, Madhya Pradesh, Andhra Pradesh, Telangana, Karnataka and Tamil Nadu covering 21 districts in an area of 1050 acres. Preparedness for implementation of the project in the current crop season was discussed at length. Dr V. S. Nagrare, Principal Scientist & Principal Investigator of the Project, Dr Nandini Gokte-Narkhedkar, Head I/c, Crop Protection Division, Dr S. M. Wasnik, Principal Scientist (Ag Extension), Dr V. Chinna Babu Naik, Scientist (Ag Entomology), Dr Shailesh Gawande, Scientist (Plant Pathology), Dr Dipak Nagrale, Scientist (Plant Pathology), Dr Babasaheb Fand, Scientist (Ag Entomology) from ICAR-CICR Nagpur and 21 district coordinators from 8 states participated in the Workshop.

E –Samwad on Cotton Crop Cultivation

The Scientists- Agricultural officers–Farmers E –Samwad on Cotton Crop Cultivation was organized by ICAR CICR through video conferencing on 7th August 2020. Dr V. N. Waghmare chaired the programme and enlightened about the current crop situation in the region. Shri Ravindra Bhosale, Divisional Joint Director Agriculture, Nagpur explained crop situation in Nagpur Division. Dr G. I Ramakrushna, Scientist Agronomy delivered talk on fertilizer, water & weed management; Dr Vishlesh Nagrare Principal Scientist on Pest management, Dr Shailesh Gawande on disease management and Dr S. M. Wasnik on E-Kapas. The programme was attended by 100 farmers.

Mid-Term Review meeting of Insecticide Resistance Management: Dissemination of Pink Bollworm Management Strategies Held on 18th November, 2020 (Virtual)

The Mid-Term Review Meeting of project "Insecticide Resistance Management: Dissemination of Pink Bollworm Management Strategies (IRM-PBW) was held on 18th November, 2020 under the Chairmanship of Dr. Y. G. Prasad, Director, ICAR-CICR. At the outset Dr. M. V. Venugopalan Head, Project Monitoring and Evaluation cell, ICAR-CICR Nagpur welcomed the participants. Dr. V. S. Nagrare, Principal Scientist (Ag. Entomology) and Principal Investigator, IRM-PBW Project, ICAR-CICR, Nagpur coordinated the meeting. He gave overview of activities carried out during current year. Dr. Y. G. Prasad, in his opening remarks expressed concern over the observations on PBW infestation during current

season. Further, he advocated recording incidental pest/diseases during the season devising interventions on the event of excess rainfall by analysis of available pest data, to strengthen extension activities and use of real time data generated through this project in preparation of advisories for the cotton production stakeholders, etc.

Dr V. N. Waghmare, informed that large scale implementation of pink bollworm management strategies formulated by ICAR-CICR, Nagpur helped to a greater extent to keep the pest under control in central and south Indian cotton growing states during 2018-19 and 2019-20. Also he appreciated all the district coordinators for their efforts taken in the implementation of PBW management strategies.

Presentations were made by each district coordinator highlighting the levels of PBW infestation PBW management strategies implemented/ interventions carried out, critical inputs distributed, monitoring visits, outreach activities carried out, incidental pest and diseases, physical and financial progress, constraints faced, etc.

The meeting concluded with a vote of thanks proposed by Dr. Dipak Nagrale Scientist, Plant Pathology propose.

VIRTUAL INTERACTION WITH KVKS and ICAR-CICR, Nagpur

A virtual interaction meeting with KVKs in Maharashtra was jointly organised by ICAR-ATARI & ICAR-CICR on emerging problems in cotton on 1st December 2020. The purpose of meeting was to take stock of the emerging pest and disease problems faced by cotton farmers and to develop a concrete action plan for next season in consultation with ICAR-CICR experts.

In his opening remarks Dr. Lakhan Singh recalled the joint campaign for management of Pink Bollworm (PBW) in cotton since 2017 by involving all stakeholders.

Dr. Y G Prasad, Director, ICAR-CICR, Nagpur presented technologies ready for transfer for inclusion in On-Farm Trials, Frontline demonstrations and mass extension campaign by KVKs. ICAR-CICR released four new Bt varieties which can be taken for demonstration to farmers in suitable agro-ecologies in Vidarbha and Marathwada. ICAR-CICR has standardized agronomy package for long-linted arboreum varieties which are ready for large scale demonstrations in Marathwada in collaboration with Vasantrao Naik Marathwada Krishi Vidyapeeth (VNMKV), Parbhani and KVKs.

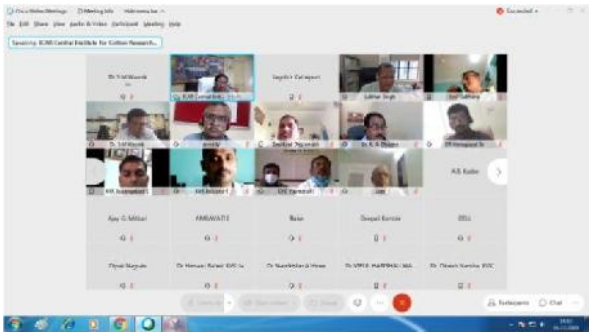
KVKs were asked to take immediate campaign to dissuade farmers to prevent the extension of cotton crop season in view of prevailing PBW and Boll rot infestation. Also trapping of adults moths emerging in ginning mills is to be promoted with the support of State Department of Agriculture.

Earlier, KVKs of Yavatmal, Jalna and Nandurbar districts presented report on crop condition prevailing in the three regions of Maharashtra and highlighted emerging issues of concern.

Dr. D. T. Nagarale, Scientist (Plant Pathology), Dr. V. S. Nagarare, Principal Scientist (Entomology), Dr. G. I. Ramkrushna, Scientist (Agronomy), Dr. J. H. Meshram, Principal Scientist (Plant Physiology) and Dr. A. R. Reddy, Principal Scientist (Agri. Economics) interacted with KVKs on pest and disease, nutrient and crop canopy management and need for production system diagnostic surveys. The virtual interaction was attended by Heads of Divisions/Sections of ICAR-CICR, Nagpur and KVKs along with 85 Subject

Matter Specialists. Dr. S. M. Wasnik, Head, KVK, Nagpur coordinated the virtual interaction meet.

Source: ICAR-Agricultural Technology Application Research Institute (ICAR-ATARI), Pune.



10.5.2: Events

New Year Celebration 2020

ICAR-CICR , Nagpur and its Regional Stations Coimbatore and Sirsa celebrated the 71st Republic Day on 26th January 2020

ICAR-CICR, Nagpur celebrated Chhatrapati Shivaji Jayanti on 19th February 2020

ICAR-CICR, Nagpur observed International Women's Day on 8th March 2020.

74th Independence Day was celebrated on 15th August 2020 at ICAR-CICR , Nagpur and its Regional Stations Coimbatore and Sirsa

15th Parthenium Awareness and Eradication Week was observed from 16th to 22nd August 2020.

Week long Celebration on the eve of 150th birth anniversary of Mahatma Gandhiji at ICAR-CICR, Nagpur from 28th September to 2nd October 2020

Vigilance Awareness week observed at Nagpur and its Regional Stations, Coimbatore and Sirsa



National Unity Day (Rashtriya Ekta Diwas) was celebrated on 31st October 2020 at ICAR-CICR, Nagpur to commemorate the birth anniversary of Sardar Vallabhbhai Patel and Pledge taking by staff of Institute

Constitution Day was observed on 26th Novemebr 2020




Swachhta Pakhwara at ICAR-CICR, Nagpur and it's Regional Stations Coimbatore and Sirsa.

World Environment Day

ICAR-Central Institute For Cotton Research (CICR), Nagpur organized an online cotton workshop for farmers through video conferencing on June 05, 2020, to mark World Environment Day . The objective was to guide farmers on cotton crop in the coming kharif season. Dr. S. K. Chaudhary, Deputy Director General, (NRM), ICAR , New Delhi was the Chief Guest. Dr. C. D. Mayee, Former Chairman, ASRB, New Delhi inaugurated the workshop. Dr. Lakhan Singh, Director, ICAR- ATARI, Pune, Shri. Ravindra Bhosale, JDA, Nagpur, Shri. Dr. Subhash Nagre, Divisional Joint Director of Agriculture, Amravati were the special Guests. Dr. Siddharth Wasnik, Head KVK and Principal Scientist, (Agril. Extension), ICAR-CICR, Nagpur coordinated the programme. A large number of farmers as well as agricultural staff attended the workshop online. Dr. S. K. Chaudhary in his address guided the participating farmers on the management of natural resources especially. Dr. C. D. Ma yee addressed on the issue of water management in cotton crop and ways to maximize yields by reducing cost of production. Dr. Lakhan Singh emphasized on biodiversity conservation. Dr. Waghmare, Director, ICAR-CICR highlighted the importance of biodiversity and conservation of indigenous crop varieties.

A technical session was arranged for the farmers in which Dr. Blaise D eSouza, Head, Crop Production Division, guided on Cotton Production Technology, Dr. Vinita Gotamare talked about the straight and hybrid varieties of cotton , Dr. Vishlesh Nagarare spoke on Insect pests and Pink Bo llworm management strategies in cotton, Dr. S hailesh Gawande gave a talk on Diseases Management in cotton and Dr. S. M. Wasnik provided information on e- Kapas / e-Communication, Cotton App , cotton FLDs, MGMG and Scheduled Caste Sub Plan (SCSP).

'World Cotton Day' celebrated at ICAR-CICR by imparting training to BCI

Second 'World Cotton Day' was celebrated at ICAR- Central Institute for Cotton Research, Nagpur by imparting a virtual training to PU managers of Better Cotton Initiative (BCI), India, The training was for one day on "Management of insect pest and diseases in the current context" (Virtual). Dr. Nandini Gokte-Narkhedkar, Principal Scientist and Head I/c Crop Protection Division, ICAR-CICR Welcomed the participants. Dr. Blaise Desouza, I/c Director and Head, Crop Production Division in his opening

remarks emphasized on importance of integrated insect pest and disease management in cotton. Miss. Jyoti Kapur, Director BCI, India in her remark urged the trainees to take the advantage of this training and implement this knowledge for betterment of farming community. Dr. Vishlesh Nagrare, Principal Scientist (Entomology) delivered talk on integrated management of insect pest especially pink bollworm in the current context. Dr. Shailesh Gawande, Scientist (Plant Pathology) delivered talk on Identification of important diseases of cotton and their management in current situation. Dr Dipak Nagrale, Scientist (Plant Pathology) delivered a lecture on 'Safe use of pesticides'. The training was attended by 250 PU managers of BCI located across Maharashtra, Gujarat, Telengana, Karnataka, Punjab, Rajasthan and Madhya Pradesh. Ms. Saleena Pookunju, BCI. Dr. Shailesh Gawande proposed the vote of thanks

ICAR-CICR welcomes New Director

Dr. Yenumula Gerard Prasad took charge as Director, ICAR-Central Institute on 12th October 2020. Since 2015 he served as Director, ICAR-Agricultural Technology Application Research Institute (ATARI) at Hyderabad coordinating 71 Krishi Vigyan Kendras (KVKs) in the states of Andhra Pradesh, Telangana, Tamil Nadu, and Puducherry. He is an entomologist and worked extensively on farmer participatory evaluation of Integrated Pest Management (IPM) practices and developed eco-friendly bio-pesticides. Lead multi-institutional consortium projects funded by the World Bank – National Agricultural Technology Project on Pest forewarning and World Bank-funded National Agricultural Innovation Project on development of decision support systems for insect pest management (CROP PEST DSS). He co-ordinated the country-wide efforts on preparation of district-level agricultural contingency plans for 580 districts to meet aberrant monsoon weather situations while at the Central Research Institute for Dryland Agriculture (CRIDA), Hyderabad. He coordinated the Technology Demonstration component of the National Innovations in Climate Resilient

Agriculture (NICRA) project operated through 121 KVKs across the country.

Mahila Kisan Diwas

In line with the United Nations decision to observe October 15 as International Day of Rural Women, the Ministry of Agriculture and Farmers Welfare **October 15** was observed as **Mahila Kisan Diwas**. The aim of this day is to recognize and acknowledge the exemplary contribution of rural women in the field of agriculture, food and nutritional security, health and hygiene, encouraging rural savings and alleviating poverty. The theme of the celebrations this year is Building rural women's resilience during Covid-19.

Speaking on this occasion, Dr. Y G Prasad, Director highlighted the role of women farmers and farm labour in agriculture. He pointed out that cotton is a labour intensive crop and more than 70% of the farm operations in the cotton field are performed by women. The hybrid seed cotton production industry is heavily dependent on women for crossing and seed production activities. He urged the scientists gathered, to develop technologies that would reduce drudgery in farm operations.

10.5.3: Farmers Outreach Activities:

Farmer's Mela

One day 'Farmers Mela' was organized by ICAR-CICR, Nagpur at Warora, District Chandrapur on 28th January 2019 under "IRM-PBW Insecticide Resistance Management– Dissemination of Pink Bollworm Management Strategies". A total of 1000 farmers from 20 villages participated. Exhibition of various farm inputs was displayed by different stakeholders in 12 stalls. One street play on 'Safe use of insecticides' was enacted for the benefit of farmers.

Five IRM farmers were awarded with certificate for their best performance under IRM-PBW project. Eleven other farmers were felicitated as outstanding farmers in cotton production. Cotton storage bags were distributed to farmers under TSP Scheme.

Exposure visit to farmers at ICAR-CICR RS, Sirsa

ICAR-CICR RS Sirsa organized one day exposure visit to a group of 30 farmers from Nagaur, Rajasthan on 6th Feb 2020. Dr. Amarpreet, Scientist (Agronomy) gave a talk on agronomic practices for better cotton production. Dr. Rishi Kumar, Principal Scientist (Entomology) spoke on integrated pest management in cotton with respect to sucking pest and Dr S. K. Sain, Senior Scientist (Plant Pathology) discussed in detail about integrated disease management in cotton.

Farmers Mela at ICAR-CICR RS, Sirsa

A Farmers Mela was organized at ICAR-CICR RS, Sirsa on 7th March 2020 under "Insecticide Resistance Management: Dissemination of Pink Bollworm Management Strategies". It was organized to create awareness for effective management of Pink Bollworm. About 300 farmers from Haryana, Punjab, and Rajasthan were benefitted through this programme. Dr. D. Monga, Ex-Head, ICAR-CICR Regional Station, Sirsa presented the latest cotton scenario and current situation of Pink Bollworm incidence in India with special emphasis on North Zone. Dr. O.P Tuteja, Head I/c, explained the cotton research and extension activities being undertaken by ICAR-CICR, RS Sirsa. Dr. S.K Verma delivered a lecture on cultivation of *arboreum* cotton. Dr. Rishi Kumar spoke on awareness and dissemination of pink bollworm management strategies and IPM in cotton of north zone. Dr. Satish Kumar Sain delivered a lecture on identification of disease and their management. Dr. Amarpreet Singh discussed in detail about novel cotton production techniques. Exhibition stall depicting life cycle of PBW was also displayed. Mr. Deepak, Senior Research Fellow and Mr. Dharamveer, Young Professional-I explained to farmers about the life cycle of PBW, sampling procedure through green boll dissections to the farmers and also demonstrated the installation of Pheromone traps. Pamphlet on "Integrated management of Pink Bollworm in North India" (both Hindi and English version) was released on this occasion. A question–answer session was also conducted for the benefit of farmers.

Inputs distributed under various schemes

ICAR-CICR RS Sirsa

Dr S. K. Verma, Principal Scientist (PBG) distributed the seeds of male and female lines of *G. arboreum* hybrid CICR-2 to 5 progressive farmers of North cotton growing zone for hybrid seed production in the month of April.

Dr Amarpreet Singh, Scientist (Agronomy), distributed the seeds of improved cotton varieties developed by ICAR-CICR, Regional Station, Sirsa, Haryana *i.e.*, CICR Bt-6 (Bt variety), CSH 3075 and CSH 3129 (non-Bt varieties) to 13 farmers for Front Line Demonstrations (FLDs) on Integrated Crop Management (ICM) under National Food Security Mission-Commercial Crops (NFSM-CC) during 2020-21 cropping season in various cotton growing districts of Haryana and nearby cotton growing districts of Punjab & Rajasthan.

Field diagnostic Survey in North India

A team comprising Dr Rishi Kumar, Principal Scientist (Entomology), Dr S.K. Sain, Sr. Scientist (Plant Pathology), Dr Amarpreet Singh, Scientist Sr. Scale (Agronomy) from ICAR-CICR RS, Sirsa and Dr Vijender Chauhan, Asstt. Plant protection Officer, Department of Agriculture, Sirsa surveyed cotton fields in villages of Distt. Fatehabad and Sirsa 31 Aug, 15 Oct, 20 Oct and 07 Nov 2020 Area

affected by abiotic (water-logging, nutrient stresses), insect pests (whitefly) and diseases (root rot, para wilt) were identified. It was informed that due to fear of whitefly resurgence, majority of the farmers surveyed had not applied proper nutrition to the cotton crop. For the management of whitefly, 4- 5 sprays of insecticides were applied in mixtures. These insecticides/fungicides/micronutrients mixture along with abiotic stress have led to wilting in cotton.

Fields at Sirsa and Fatehabad

Survey on diseases and insect-pests in North Zone: Haryana, Rajasthan

A team consisting of Dr. S. K. Sain, Principal Scientist (Plant Pathology), along with Dr Amarpreet Singh, Scientist Sr. Scale (Agronomy) and Mr. Debashis Paul, Scientist (Seed Technology) from ICAR-CICR, Regional Station, Sirsa surveyed cotton fields in villages of Sirsa, Siwani, Hisar, Bhadra, and Hanumangarh, of Hanumangarh and Shriganganagar districts on 15th, 20th October and 7th November 2020. During the survey, CLCuD, whitefly, fungal leaf sport and pink bollworm incidence were recorded and about 60 cotton rhizosphere soil samples were collected. The team also visited the farmer's field demonstration trials of CICR Bt-6.

Field visit under IRM-PBW project

Dr. Rishi Kumar Principal Scientist (Entomology) and Principal Investigator (AICRP on Cotton) visited IRM-PBW village Sadewala, Dist. Sirsa on 23rd October 2020 and, interacted with farmers regarding the spread of Pink Bollworm in fields around and adjoining to cotton ginning cum oil extraction units. Weekly whitefly survey of field locations was also conducted at village Kharian. Dr. Rishi Kumar visited village Hasangarh, Sarsod, Panghal and Danoda villages along with the representatives from Rasi Seeds Pvt Ltd on 27th October, 2020

Field training and input distribution at Coimbatore District

Critical inputs Flonicamid (Ulala -60gm), Chlorphyriphos 20EC (Hilban – 1 litre) were distributed to the 50 adopted farmers at Palanigoundanur, Muthugoundanur, Sokkanur, Veerappagoundanur, Sattakkalpudur (Kindathukadavu Taluk, Coimbatore district) on 17th November 2020. Field demonstrations and hands-on training was given to the farmers on monitoring of pink bollworm populations using the pheromone trap, identification of different sucking pests in cotton and to safe handling of pesticides and precautions to be taken while spraying the pesticides. Weekly field visits were made to collect data on flowers infestation; green boll infestation and pheromone trap catches in the IRM adopted villages.

Distribution of Egg parasitiod, *Trichogramma bactrae* at Coimbatore

Trichocards (egg Parasitoid, *Trichogramma bactrae*) were distributed to farmers during December 2020 as a critical input under the project "Insecticide Resistance Management (IRM): Dissemination of Pink bollworm management strategies" at the rate of 3 cc per farmer. Field demonstrations and hands-on training was given to the farmers on release of egg parasitiod in cotton crop for the management of pink bollworm and precautions to be taken while releasing the parasitiods. 50 farmers from Palanigoundanur, Muthugoundanur, Sokkanur, Veerappagoundanur, Sattakkalpudur villages (Kindathukadavu Taluk, Coimbatore district) attended the training and received the inputs.

10.6: Participation of Scientists in Conference/Seminars/ Symposia

Name of Scientist	Name of Conference/ Seminar / Symposia/Place
Dr. K. Shankarganesh	4th IUPAC International Conference on 'Agrochemicals Protecting Crops, Health and Natural Environment - Discovery and Development of Synthetic and Natural Products for Health and Pests Management', Society for the Promotion of Sustainable Agriculture 7-10 Jan., 2020, New Delhi
Dr. P.Valarmathi, Dr. A. Sampathkumar	7th International Conference Indian phytopathological society on "Phytopathology in achieving UN sustainable development goals" ICAR-IARI, during 16 to 20 Jan. 2020 New Delhi
Dr. A Manivannan, Dr. S. Manickam, Dr. S Usha Rani, Dr.	National Symposium "Cotton Production Technologies in the Next Decade : Problems and Perspectives" at OUAT/ CRDA, 22to 24 Jan 2020, Bhubaneshwar

P. Nalayini, Dr. Rishi Kumar, Dr. Amarpreet Singh Dr. A. Manikandan	
Dr. Chandrashekhar N	International Conference "Advanced Functional Materials" at Kamla Nehru Mahavidyalaya, Nagpur, 23 to 25 Jan 2020
Dr. Nandini Gokte Narkhedkar, Dr. V. S. Nagrare, Dr. S. M. Wasnik	National Conference on Recent Innovations in Agri- Biosciences in strengthening the Indian Economy, Ambedkar College, Deekshabhumi Nagpur, 01-02-2020
Dr. K Rameash, Dr. V. C. B Naik, Dr. J.Gulsar Banu, Dr. V. S. Nagrare, Dr. Shah Vivek	XVII AZRA International Conference 'Frontier Research in Applied Zoology and Insect Pest management Strategies: A way Forward for Food and Nutritional Security,t UAS, Raichur, 12 to 14 Feb. 2020
Dr. K Rameash	International Seminar on Trans-boundary Pest Management, TNAU, Coimbatore, 04 to 05-March 2020
Dr. G. Balasubramani, Dr. Raghavendra K.P, Dr. H B Santosh	International E-Conference On Genetics and Plant Breeding Research In Post Covid-19 Era, Ch. Charan Singh University, Meerut, 13to 14 June 2020
Dr. Debashis Paul	Recent advances " Seed Health Management" ICAR-IISS, Mau, 05 Oct.-2020
Dr. P Valarmathi, Dr. A. Sampathkumar	International E - Conference "Multidisciplinary approaches for plant disease management in achieving sustainability in agriculture" UAS, Bagalkot and College of Horticulture, Bengaluru, 06 to 09-Oct. 2020
Dr. J.Gulsar Banu	"Biopesticides - Registration and Quality Control: Issues - Way Forward" ICAR-NBAII, Bangaluru, 06 Oct. 20
Dr. P Valarmathi	5th National conference "Agricultural Scientific Tamil", TNAU, Coimbatore during 09-10 Oct 2020
Dr. Neelakanth S Hiremani	"National Symposium on Plant Health Management"College of Agriculture, Bharuch, NAU Navsari Gujarat, 02 to 04 Nov. 2020
Dr. Raghavendra KP, Dr. H B Santosh	International E-Conference 'Advances and Future Outlook in Biotechnology and Crop Improvement for Sustainable Productivity', College of Horticulture, Bengaluru , 24 to 27 Nov., 2020
Dr. J Annie Sheeba	"International Colloquium on Crop Physiology",TNAU, Coimbatore during 26to 27 Nov. 2020
Dr. Raghavendra KP	"Plant germplasm resources" ISSP New Delhi, 03 to 05 Dec 2020
Dr. Rishi Kumar, Dr. Rachna Pande	2nd National Conference "Recent Scientific Advances In Agricultural and Environmental Sciences" Porur, Chennai, 05 Dec. 2020
Dr. Savitha Santosh, Dr. Pooja Verma, Dr. B. Bhargavi, Dr.Raghavendra KP, Dr. H B Santosh	International Plant Physiology Virtual Conference – 2020, Sher-e-Kashmir University of Agricultural Science & Technology, Jammu, India and Indian Society for Plant Physiology, New Delhi, 06 to 07 Dec. 2020
Dr. SK Verma, Dr. S.K Sain, Dr. P Valarmathi, Dr. Debashis Paul, Dr. Amarpreet Singh	International Web Conference "Global Research Initiatives for Sustainable Agriculture & Allied Sciences" Astha Foundation, Meerut, 28 to 30 Dec.2020

Meetings:

Name of Scientist	
Dr. A.H. Prakash	Joint Meeting under the Co-Chairmanship of Secretary (Agriculture and Farmers Welfare) and Secretary (Textiles) - issues related to cotton and jute, ICAR, New Delhi on 22-01-2020
Dr. Vijay N Waghmare Dr. A R Reddy	Meeting of Commission for Agricultural Costs and Prices for formulating Price policy for Kharif Crops 2020-21 by Commission for Agricultural Costs and Prices, New Delhi during 12 to 13, Feb. 2020
Dr. Blaise Desouza	First meeting of the Steering Committee for implementation of Cotton Technical Assistance Programme (C-TAP), Phase-II by Department of Commerce on 19 Feb. 2020
Dr. Vijay N Waghmare	Meeting of Directors of ICAR Institutes conveyed by Hon'ble Secretary (DARE) & Director General (ICAR) held on 10 April 2020.
Dr. P. R. Vijaya Kumari	NSP- Review Meeting-Seed Production & Certification by IISS, Mau during 08 to 09 May 2020
Dr. P. R. Vijaya Kumari	Joint Annual Review Meeting of AICRP(NSP) Crops & ICAR Seed Project by IISS, Mau during 14-05-2020 to 15-05-2020
Dr. Vijay N Waghmare,Dr. Blaise Desouza, Dr. A. H. Prakash,Dr. MV Venugopalan, Dr. S.K. Sain, Dr. Rishi Kumar, Dr. Amarpreet Singh, Dr. A. Sampathkumar, Dr. S. Manickam Dr. S Usha Rani Dr.K.Sankaranarayanan Dr. V Chinna Babu	Annual Group Meeting of AICRP on Cotton by ICAR-AICRP on Cotton during 18 to 19 May 2020
Dr. Blaise Desouza	Technical Committee Meeting,WCRC7 by ICAC, Washington, 02 June 2020
Dr. Vijay N Waghmare	Inaugural Session of XXVII Annual Review Meeting-AICRP on Weed Management,CAR-Directorate of Weed Research, Jabalpur, 08 June 2020
Dr. Vijay N Waghmare Dr. Blaise Desouza Dr. M V Venugopalan	Futuristic Crop Planning through video link at Nagpur on 10 June 2020
Dr. Vijay N Waghmare	47th Academic Council Meeting of SRTMU, Nanded on 20-06-2020
Dr. MV Venugopalan	Core Committee meeting- Policy document on Futuristic Crop Planning for 2030/2050 by ICAR-IIFSR, Modipuram on 25-06-2020
Dr. Vijay N Waghmare Dr. A.H. Prakash	Central Sub-Committee on Crop Standards, Notification and Release of Varieties for Agricultural Crops by Assistant Commissioner, Quality, DAC, GOI, New Delhi on 06-07-2020
Dr. Vijay N Waghmare	Annual Zonal Workshop of KVKs, ICAR-ATARI, Pune on 10 July 2020
Dr. Vijay N Waghmare	Impact Evaluation of Bt Cotton in Indian context, under chairmanship of Agriculture Commissioner, DAC&FW, 14 July, 2020
Dr. Vijay N Waghmare	Agrovision Advisory Council meeting as Member by Agrovision Foundation at MAFSU, Vice-Chancellor Office, Nagpur on 23-07-2020
Dr. A.H. Prakash	Meeting of Directors/PCs of CS Div. Instts by DDG (CS), ICAR, New Delhi on 30 July 2020
Dr. Vijay N Waghmare	Cry protein estimation and bioassay on Helicoverpa and pink bollworm under AICRP at ICAR-CICR, Nagpur on 01 Aug. 2020
Dr. V. S. Nagrare	Action taken on the recommendations by SIT on Pesticide poisoning in Yavatmal district (2017) Maharashtra State Agriculture department, Nagpur on 07 Aug. 2020

Dr. Vijay N Waghmare	XXII Agriculture Research Council of MPKV Rahuri, 11 Aug. 2020
Dr. Blaise Desouza	Twenty-seventh GB Meeting, Academy by NAAS, New Delhi 13 Aug. 2020
Dr. Vijay N Waghmare	Domain Expert Group Meeting 'Next generation insect pest resistant cotton' in mission mode- second meeting, CSIR on 14 Aug.2020
Dr. Vijay N Waghmare	Stakeholders meeting on Bt Cotton under the chairmanship of Director of Agriculture, Odisha , 21 Aug. 2020
Dr. Vijay N Waghmare	Cotton Technical Assistance Programme (C-TAP) Phase-II for African Countries , 31 Aug.2020
Dr. MV Venugopalan	Meeting of Committee on Cotton Production and Consumption by Mumbai, Office of Textile Commissioner, 21 Sept 2020
Dr. Vijay N Waghmare	SMSP Project Presentation - DACFW, New Delhi on 05 Oct. 2020
Dr. Y. G. Prasad Dr. A.H. Prakash Dr. Blaise Desouza Dr. Dipak T. Nagrale Dr. Shailesh P. Gawande, Dr MV Venugopalan	Discussion "Sstatus of Cotton Crop in Andhra and Telangana due to heavy rains" 17 Oct. 2020
Dr. A.H. Prakash	Joint Monitoring of AICRP-NSP (Crops) and ICAR Seed Projects (2020-21) for centres of Southern Zone II by Director, IISR, Mau, 20 Oct.2020
Dr. Y. G. Prasad	Co-chair Technical session II: Field crops, crop improvement and strategies (48th Joint Agresco-2020), Dr. PDKV, Akola, 28 Oct 2020
Dr. A.H. Prakash	1 st Half-Yearly Meeting 2020-2021 for TOLEC by Town Official Language Implementation Committee, Coimbatore,04 Nov. 2020
Dr. Y. G. Prasad Dr M.V. Venugopalan	Third Party Impact Evaluation-CSS of ICAR, ISAP, New Delhi, 08 Nov.2020
Dr. Rishi Kumar	Scientific Advisory Committee meeting of KVK, Sirsa, 09 Nov. 2020
Dr. Y. G. Prasad Dr. A.H. Prakash Dr. V. N Waghmare	85th meeting of Central Sub-Committee on Crop Standards, Notification and Release of Varieties for Agricultural Crops by Deputy Commissioner (QC), MoA&FW, GoI, 09 Nov.2020
Dr. V. S. Nagrare	2nd Steering Committee meeting of CROPSAP by Agri. Department Maharashtra (Virtual) on 11-11-2020
Dr. Y. G. Prasad Dr. Vijay N Waghmare	Review meeting of ICAR-CICR EFC for 2021-26 held under the Chairman of DDG (CS) 11 Nov. 2020
Dr. V. S. Nagrare	District level pink bollworm management Committee- CROPSAP by Agri. Department Chandrapur on 12 Nov. 2020
Dr. Y. G. Prasad Dr. A.H. Prakash	Annual Conference of VC's of SAUs/CAUs, Directors of ICAR Institutes & project Coordinators by ICAR, New Delhi on 05 Dec 2020
Dr. MV Venugopalan	Interaction Meeting with the KVKs in Maharashtra on Emerging Problems in Cotton at ICAR-CICR 10 Dec -2020

Webinar

Name of Scientist	Name of Webinar/ Place/Organized by and date
Dr. A. H. Prakash	Mainstreaming Biodiversity for Sustainable Food and Environment by Society for Science of Climate Change and Sustainable Environment on 04 June 2020
Dr. Vinita Gotmare	Shetkari e-samvaad & margadarshan - Colour Cotton : Kapus lagvadiche navin tantragyan, Agrovision Foundation and ICAR-CICR, Nagpur, 15 June 2020
Dr. Blaise Desouza	Agriculture Startups – Opportunities & Challenges, Agro-Vision, 10 July 2020
Dr. A Manivannan	From Mendelian Genetic to Modern Genomics, IARI, New Delhi, 11 July2020
Dr. D. Kanjana	Soil Science in Sustainable food system beyond COVID 19, Rattan Lal, TNAU, Coimbatore, 21 July 2020

Dr. Ramkrushna G.I.	"Achieving Land Degradation Neutrality" by IASWC, ICAR-IISWC, and ICFRE, Dehradun, 22 to 24 July 2020
Dr. Blaise Desouza	FPOs for better Future, Agro-vision, Nagpur 22 July 2020
Dr. Chandrashekhar N	Kosambi International Webinar - Plant Genomics, Savitri Phule Pune University, Pune, 31July to 02 August 2020
Dr. M. Sabesh	Integrated Insect Pests and Nematodes Management in Banana by ICAR-NRC Banana, Trichy on 04-08-2020
Dr. V Chinna Babu Naik	Ensuring Food Safety, Security and Sustainability, Bihar Agricultural University Sabour,, 05 -06 Aug. 2020
Dr. K. Rathinavel	Innovative Approaches on Seed Quality Maintenance for Successful Entrepreneurship, UAS, Dharwad on 07 Aug. 2020
Dr. M. Sabesh	Planting Material in Banana: Present and Next Generation Technologies,y ICAR-NRC Banana, Trichy, 07 Aug 2020
Dr. Savitha Santosh Dr. Chanashekhar N Dr. K Velmourougane	Bioinformatic Analysis on Soil Microbial Community Sequence Data" by World Bank-NAHEP-ICAR Centre for Advanced Agricultural Science and Technology "Genomics-Assisted Crop Improvement and Management" 12-13 Aug. 2020
Dr. Sunil S Mahajan Dr. Saravanan M	Mainstreaming Biodiversity into Agriculture sector: Linkages among agrobiodiversity, nutrition, sustainable livelihoods & business opportunities, National Biodiversity Authority and MSSRF, Chennai on 18 Aug2020
Dr. Sunil S Mahajan	"Biological Diversity Act 2002: Part II" by NBA-UNDP National Diversity Authority 19 Aug. 2020
Dr. D. Kanjana	Role of Nanotechnology in Food and Agriculture by Centre for Nanotechnology, UAS, Raichur, Karnataka during 20 to 29 Aug. 2020
Dr. Rachna Pande	Biocontrol of Parthenium, Society for Biocontrol Advancement & ICAR- NBAIR, Bengaluru, 21 Aug. 2020
Dr. Dipak T. Nagrale	RNAi: Big Bang of Silence by DBT-NECAB, AAU, Jorhat, 26 Aug. 2020
Dr. M. Sabesh	Advancing Climate and water resilience for Cotton and textile industry, SIWI - ICRW on 26 Aug. 2020
Dr. R Raja, Dr. Pooja Verma, Dr. M. Sabesh Dr. Debashis Paul	Abiotic Stress in Agriculture: Geospatial Characterization and Management Options by ICAR-NIASM, Baramati, 27 Aug. 2020
Dr. Pooja Verma	"Future Perspectives in Agricultural Education" by NAHEP (ICAR)- CAAST, IARI on 05 Sept. 2020
Dr. M. Sabesh	State of Organic and Natural Farming in India: Challenges and Possibilities by Centre for Science and Environment, 08 Sept. 2020
Dr. V. S. Nagrare Er. G. Majumdar Dr. D. T. Nagrale Dr. S. P. Gawande Dr. B. Bhargavi, Dr. R Raja, Dr. Pooja Verma	Remote Sensing in Agriculture by Indian Society of Agrophysics and Division of Agricultural Physics, ICAR-IARI, New Delhi, 09 Sept. 2020
Dr. S S Mahajan,Dr. Santhy V, Dr. K. Rathinavel, Dr. P. R. Vijaya Kumari	National Webinar on Contemplative Perspectives on Seed: Conservation, Quality Assurance and Supply System by ICAR-IISS, MAU,10 Sept. 2020
Dr. K Shankarganesh	National webinar 'Conservation Biological Control and Bio-pesticides in Agriculture' by C.C.R. (PG) College, Muzaffarnagar on 13.09.2020
Dr. P Valarmathi Dr. S.K Sain , Dr. N. S Hiremani	'Advances in Plant Pathology with special reference to Diagnosis and Management' by Plant Protection Advisory Cell, YSR Horticultural University, VR Gudem, AP, 16 Sept. 2020
Dr. Satish Kumar Sain Dr. J. Annie Sheeba Dr. B. Bhargavi	National Webinar on Climate-Smart Integrated Farming System by ICAR-NIASM, Baramati on 18-09-2020

Dr. Sunil S Mahajan Dr. Saravanan M	"Biodiversity and Biological Diversity Act 2002" by NBA-UNDP National Diversity Authority on 23-09-2020
Dr. Saravanan M Dr. Raghavendra KP	Capillary Electrophoresis for Sanger Sequencing and Genotyping Applications in Agricultural Research by Thermo Fisher Scientific on 24-09-2020
Dr. M. Amutha	Check-for-Plag by Infokart India Pvt. Ltd, New Delhi on 25-09-2020
Dr. M. Amutha	Entomofauna, Ecosystem and Economics by ICAR-IARI, New Delhi on 28-09-2020
Dr. Raghavendra KP	CGIAR Global Webinar Series on Genome Editing in Agriculture: Innovations for Sustainable Production and Food Systems- Applications of Genome Editing in Agriculture by CGIAR on 29-09-2020
Dr. Satish Kumar Sain Dr. J Annie Sheeba Dr. Savitha Santosh	National Webinar on Halophytes for Alleviating Salinity Stress in Agriculture: Potentials and Problems by ICAR-NIASM, Baramati, Pune on 30-09-2020
Dr. D.Kanjana Dr. Amarpreet Singh Dr. Ramkrushna G.I.	International webinar on Soil Spectroscopy:An emerging technique for rapid soil health assessment by ICAR- IISS, Bhopal & ICRAF, Nairobi, Kenya on 01-10-2020
Dr. M. Sabesh	Vaishvik Bhartiya Vaigyanik summit by Deptt of S&T, DRDO on 02-10-2020
Dr. M. Amutha	Biopesticides - Registration and Quality Control: Issues - Way Forward by ICAR-NBAIR on 06-10-2020
Dr. MV Venugopalan Dr. A. H. Prakash	World Cotton day Celebration by PDKV Akola, 07- 09-10-2020
Dr. P. R. Vijaya Kumari	Contemplative Perspectives on Seed: Conservation, Quality Assurance and Supply Systems' by IISS, Mau, 09 Oct. 2020
Dr. Raghavendra KP	Translating Physiology into Techniques for Abiotic Stress Tolerance by ICAR-NIASM, Baramati; SARAS & ISPP, New Delhi on 09-10-2020
Dr. Santhy V., Dr. Amudha.J, Dr. G. Balasubramani	Global Impact of Biotech Crops: Economic and Environmental Effects, 1996-2018 Confirmation by ISAAA,15 Oct. 2020
Dr. V. S. Nagrare	Invasive and migratory pest management: Challenges and Way forward by ASSOCHAM on 23-11-2020
Dr. K. Baghyalakshmi	Advances and Future Outlook in Biotechnology and Crop Improvement for Sustainable Productivity by College of Horticulture, Bengaluru on 24-11-2020
Dr. Satish Kumar Sain	Precision Agriculture using IOT technology,Principal Scientific Adviser's Office, GoI, 24 Nov. 2020
Dr. Ramkrushna G.I	"Impact of water stress on crop productivity: its mitigation and adaptation strategies" by RPCAU, Bihar and NHEP (ICAR) during 24-11 Nov. 2020
Dr. J.Amudha	International Colloquium -- Crop Physiology, TNAU, Coimbatore, 26-27, Nov. 2020
Dr. K. Baghyalakshmi Dr. A Manivannan	Genomics Strategies for Improvement of Abiotic Stress Tolerance in Crop Plants, ICAR-NIASM, Baramati, on 27 Nov. 2020

Workshops:

Name of Scientist	
Dr. A R Reddy	ICAR-KRISHI Geoportal-Challenges and Way Forward, ICARNBSS&LUP, Nagpur, 09 Jan. 2020
Dr. P Valarmathi	Dissemination of Pink Bollworm Management Strategies, ICAR-CICR, RS, Coimbatore, 10 Mar. 2020
Dr. Rishi Kumar	Workshop "Mnagement strategies for sucking pest" Dept. of Agriculture, Raj. Hanumangarh on 22 July 2020
Dr. P Valarmathi	ABC of scientific writing, ICAR-NRRI, Cuttack during 18-08-2020 to 02-09-2020

Dr. J.Gulsar Banu	Identification of New Dimensions for Preparing National/Global Level Database on Women in Agriculture, ICAR-CIWA, Bhubaneswar, 28 Aug 2020
Dr. Neelakanth S Hiremani	'Microbial intervention in plant health and nutrition' NAU Navsari, 25-26 Aug. 2020
Dr. MV Venugopalan	India Drought Monitor, ICAR-CRIDA Hyderabad and IWMI Colombo, 10 Dec. 2020
Dr. Rachna Pande	Swachhta Abhiyan by ICAR-IISS, Bhopal, 21 Dec 2020

10.7: Distinguished Visitors

Parliamentary Standing Committee on Agriculture

ICAR-CICR, Nagpur served as the Nodal Institute for co-ordinating the two day study visit of the Parliamentary Standing Committee on Agriculture comprising Hon'ble members of both houses of Parliament to Nagpur during 23-24th January 2020.

Members of Parliamentary Standing Committee on Agriculture along with Director and staff of of ICAR-CICR, Nagpur during their visit to the Institute on 24th January, 2020

The team comprised 11 Parliamentarians from Lok Sabha and Rajya Sabha along with five officials from Secretariat. Shri. Parvatagouda Gaddigoudar elected member of current Lok Sabha from Karnataka was the Chairman of the committee. The other members of Loksabha were, Shri. Afzal Ansari from Uttar Pradesh, Shri. A.Ganeshamurthi from Tamil Nadu, Shri. Kanakmal Katara from Rajasthan, Shri. Bhagwanth Khuba from Karnataka, Shri. Devji Patel from Rajasthan, Smt. Shardaben Anilbhai Patel from Gujarat, Smt. Navneet Ravi Rana from Maharashtra and Shri. Ram Kripal Yadav from Bihar. The two Rajya Sabha members

were Shri. Kailash Soni from Madhya Pradesh and Smt. Chhaya Verma from Chhattisgarh. They interacted with farmers, State officials and officials of crop insurance companies involved in Pradhan Mantri Fasal Bima Yojana (PMFY) on the first day. A study visit to three ICAR Institutes including ICAR- National Beaurau of Soil Survey and Land use Planning, ICAR- Central Citrus Research Institute and ICAR-Central Institute for Cotton Research was arranged on 24th January 2020. The team had detailed discussion on major cotton research achievements and various farmers outreach activities. Dr. R. K. Singh, Assistant Director General (CC), ICAR, New Delhi, Dr. W. S. Dhillon, Assistant Director General (Horticulture) and Dr. M. S. Ladaniya, Director, ICAR-CCRI were present in the interactive meet. An exhibition was also arranged at the Institute showcasing the technologies developed by the Institute for Vidarbha cotton farmers. Saplings were planted by the delegates at the Institute premise.

Visit of Hon'ble Shri Sunil Kedar, Cabinet Minister, Government of Maharashtra

Shri Sunil Kedar, Cabinet Minister for Animal Husbandry, Dairy Business Development, Sports and Youth Welfare, Maharashtra state visited ICAR-Central Institute for Cotton Research, Nagpur along with Shri Manohar Kumbhare, Vice-Chairman, Zila Parishad, Nagpur and Chairman, Constructions and Health Committee, Shri Tapeshwar Vaidya, Chairman, Agriculture and Animal Husbandry, Zila Parishad Nagpur and 20 progressive cotton farmers. Shri Ravindra Bhosale, Divisional Joint Director Agriculture, Nagpur division and Shri Milind Shende, District Superintendent Agriculture Officer, Nagpur were also present during the visit on 24 August 2020. Dr Vijay Waghmare, Acting Director, ICAR- CICR, Nagpur welcomed the minister and made presentation on research and development activities being carried out at the institute. Dr Vishlesh Nagrare, Principal Scientist (Entomology) delivered talk about 'Pest management in Cotton' and answered the queries raised by the participants. Minister appreciated the work being carried out at the Institute and expected cooperation from ICAR-CICR on guidance to the farmers and suggested meetings/programs to be organized to farmers in collaboration with Zila Parishad, APMC and Agriculture department. Minister also visited 'Biotechnology' and 'Resistance monitoring' laboratories. ICAR-CICR Scientists Dr Nandini Gokte-Narkhedkar, Dr Siddharth Wasnik, Dr M. V. Venugopalan, Dr Chinna Babu Naik, Dr Dipak Nagrale, Dr Vivek Shah, Dr Rachna Pande also participated in the delebration.

Visit of Hon'ble MP Dr.Vikas Mahatme

Padmashri Dr. Vikas Mahatme, Hon'ble Member of Parliament (Rajya Sabha) visited ICAR-CICR, Nagpur. During the visit he discussed with Director and Scientists of the Institute regarding organization of various awareness programme for farmers on Farm Laws, 2020.

10.8: Personnel

Director

Dr. Y. G. Prasad Director from 12/10/2020

Dr. V N Waghmare, Director (Acting) up to 11/10/2020

Project Coordinator (Cotton)

Dr. AH Prakash, PC (Cotton) & Head (Acting)

CROP IMPROVEMENT DIVISION

Genetics & Plant Breeding

Nagpur

Dr. V N Waghmare, Head
Dr. (Mrs.) Sumanbala Singh, Pr. Scientist
Dr. T R Loknathan, Pr. Scientist **(Retired on 29.02.2020)**
Dr. S M Palve, Pr. Scientist
Dr. (Mrs.) Vinita Gotmare, Pr. Scientist
Dr. DV Patil, Sr. Scientist
Sh. M Saravanan, Scientist
Dr. H B Santosh, Scientist

Coimbatore

Dr. (Mrs.) KPM Dhamayanthi, Pr. Scientist **(Retired on 31.12.2020)**
Dr. S Manickam, Pr. Scientist
Dr. Manivannan A, Sr. Scientist
Dr. (Mrs.) K Bhagyalakshmi, Scientist

Sirsa

Dr. OP Tuteja, Head(Acting) and Pr. Scientist
Dr. SK Verma, Pr. Scientist

Agril. Biotechnology

Dr. G Balasubramani, Pr. Scientist
Dr. (Mrs.) J Amudha, Pr. Scientist
Dr. KP Raghavendra, Scientist
Mr. Joy Das, Scientist
Mr. Rakesh Kumar, Scientist (Study Leave w.e.f.27.12.18)
Dr. Chandrashekar N, Scientist

Seed Science &Technology

Nagpur

Dr. (Mrs.) PR Vijayakumari, Pr. Scientist
Dr. (Mrs.) V Santhy, Pr. Scientist
Dr. SS Mahajan, Pr. Scientist

Coimbatore

Dr. K Rathinavel, Pr. Scientist

Sirsa

Dr. Debashis Paul, Scientist

CROP PRODUCTION DIVISION

Agronomy

Nagpur

Dr. Blaise Desouza, Pr. Scientist & Head (Acting)
Dr. MV Venugopalan, Pr. Scientist
Dr. AR Raju, Pr. Scientist
Dr. Ramkrushna I Gandhiji, Senior Scientist
Dr. B. Bhargavi, Scientist

Coimbatore

Dr. (Mrs.) P Nalayani, Pr. Scientist
Dr. K Shankaranarayanan, Pr. Scientist
Dr. R Raja, Pr. Scientist

Sirsa

Dr. Amarpreet Singh, Scientist

Soil Science

Nagpur

Dr. A Manikandan, Scientist

Coimbatore

Dr. (Mrs.) D Kanjana, Scientist

Farm Machinery & Power

Nagpur

Mr.Er. G Majumdar, Scientist

Plant Physiology

Nagpur

Dr. JH Meshram, Pr. Scientist

Coimbatore

Dr. AH Prakash, Pr. Scientist & Head (Acting) RS Coimbatore
Dr.(Mrs.) Annie Sheeba, Scientist

Plant Biochemistry

Dr. (Ms.) Pooja Verma, Scientist

Agricultural Microbiology

Nagpur

Dr. K Velmourougane, Senior Scientist
Dr. (Mrs.) Savitha Santosh, Scientist

Agricultural Extension

Nagpur

Dr. SM Wasnik, Pr. Scientist

Coimbatore

Dr. (Mrs.) Usha Rani, Pr. Scientist

Dr. C Karpagam, Sr. Scientist **(Transferred to ICAR-NRCB, Tiruchirappalli on 05.11.2020)**

Agricultural Economics

Nagpur
Dr. AR Reddy, Pr. Scientist
Coimbatore
Dr. (Mrs.) Isabella Agarwal, Pr. Scientist

Computer Application in Agriculture

Coimbatore
Dr.M Sabesh, Sr.Scientist

CROP PROTECTION DIVISION

Agricultural Entomology
Nagpur
Dr. (Mrs.) Sandhya Kranthi, Pr. Scientist & Acting, Head **(VRS on 26.03.2020)**
Dr. V S Nagrare, Pr. Scientist
Dr. Chinna Babu Naik V, Sr. Scientist
Dr. (Mrs.) Rachna Pande, Sr.Scientist
Dr. Babasaheb Fand, Scientist
Mr. Prabhulinga Tenguri, Scientist (Study leave w.e.f. 27.08.18)
Mr. Madhu TN, Scientist (Study leave w.e.f.11.09.18)
Dr. Shah Vivek Hanskumar, Scientist
Coimbatore
Dr. (Mrs.) Dhara Jothi, Pr. Scientist **(Retired on 30.04.2020)**
Dr. K Rameash, Sr. Scientist
Dr. (Mrs.) M Amutha, Sr. Scientist
Dr. K Shankarganesh, Scientist
Sirsa
Dr. Rishi Kumar, Pr. Scientist

Plant Pathology

Nagpur
Dr. SP Gawande, Scientist
Dr. DT Nagrale, Scientist
Dr.Neelakanth Hiremani, Scientist
Coimbatore
Dr.. A Sampath Kumar, Scientist
Dr. P Valarmathi, Scientist
Sirsa
Dr. Dilip Monga, Pr.Scientist & Head (Acting) **(Retired on 29th February 2020)**
Dr. Satish Kumar Sain, Sr. Scientist

Nemotology

Nagpur
Dr. (Mrs.) N Narkedhkar, Pr. Scientist & Head (Acting)
Coimbatore
Dr. (Mrs.) J Gulsar Banu, Pr. Scientist

KVK

Dr. S. M. Wasnik, Principal Scientist & I/c Coordinator
Dr. S. S. Patil, SMS (Extension)
Dr. U. V. Galkate, SMS (Vet. Science)
Smt. Sunita Chauhan, SMS (Home Science)

ADMINISTRATION

Sh. A. A. Goswami, Sr. Administrative Officer
Sh. Yashwant Sorte, Finance & Accounts Officer (Additional Charge from 23.07.2019)

10.9: Other Information

10.9.1: Mera Gaon Mera Gaurav

Distribution of Seeds of ICAR-CICR Bt varieties to farmers under MGMG

Each of the scientists team under MGMG visited the adopted villages of various clusters under Mera Gaon Mera Gaurav during 2nd to 3rd week of June for distributing seeds of *Bt* cotton varieties (Suraj *Bt* and Rajat *Bt*) developed by ICAR-CICR, Nagpur to cotton farmers. The technical bulletins having complete package of practices was also supplied. The teams advised the farmers to adopt management strategies suggested by ICAR-CICR, Nagpur. During interaction with farmers, the team explained the farmers about benefits of using varietal seeds over hybrids and urged the farmers to take up timely sowing at the recommended spacing for better returns.

10.9.2: Schedule Castes Sub Plan

Annual Report of "Development Action Plan for Scheduled Caste (DAPSC) (formerly Scheduled Caste Sub Plan SCSP)" Scheme(2020-21)

A central government sponsored, "Development Action Plan for Scheduled Caste (DAPSC) (formerly Scheduled Caste Sub Plan SCSP)" was implemented by the ICAR-CICR, Nagpur and its Regional Research Stations located at Sirsa (Haryana) and Coimbatore (Tamilnadu). The team consists of Dr. S. M. Wasnik, Principal Scientist (Extension) & I/C KVK ICAR-CICR, Nagpur as Nodal Officer and Dr. Sunil Mahajan, Principal Scientist (Seed technology), Dr. S. P. Gawande, Scientist (Plant Pathology), Dr. Pooja Verma Scientist (Plant Biochemistry), Mr. R. V. Salame (Technical Officer), SAO & FACO as members for programme execution. The objective of the scheme was to increase the income levels of the target population through various income generating schemes, skill development and infrastructure development. The scheme was implemented in the selected PMAGY

and MGMG adopted villages. Various agricultural related inputs were provided to the poor targeted families by the Institute. Technology dissemination, technological interventions, capacity building, showcasing technologies, exposure visits, interface meetings and trainings, skill up gradation, timely solutions of the farmers problems, cleanliness of public premises, sanitization and providing information of various schemes implemented by state agricultural department were the highlights of this programme.

During 2020-21, various activities were carried out in the adopted villages. These include, organization of skill development programmes, trainings and workshops, distribution of vegetable kits, food kits, ICAR-CICR cotton picking bags, pesticides and protection kits, improved cotton seed for sowing, pheromone traps & lures, bio-fertilizer, soil health cards, power weeder and printed cotton cultivation practices. The farm women were sensitized on round the year nutri-vegetable gardening and its scientific cultivation, off season vegetable production.

10.9.2.1 The details of various programmes carried out under the SCSP schemes:

SN o.	Name of programme	Venue and Date	No of SC beneficiaries	Input distributed/ skill imparted/ Activity
1.	Training program	Dr. Ambedkar College, Deekshabhumi, Nagpur 1st February 2020	200	• Recent innovation in Agri-biosciences in strengthening Indian economy
2.	Agribusiness Entrepreneurship workshop	Godhani village, Nagpur 3rd March 2020	300	• Empowering Scheduled Cast Unemployed Rural Youth for Developing Agribusiness and Entrepreneurship
3.	Ration kit distribution	Khursapar-28 April 2020 & Khapari-30 April 2020	120	• Essential items including pulses, sugar, flour, oil etc were distributed
4.	Demonstrations of ICAR-CICR Bt varieties.	Cluster-Samudrapur, Sarandi, Parseoni,Hingna,Nandura, Kalmeshwar, Navegaon, Dongarga Tivsa- Amravati on June 2020	108	• Seeds of ICAR-CICR Suraj Bt and ICAR-CICR Rajat Bt variety were given to farmer
5.	Soil health card (SHC) Distribution	Khursapar, Godhani, Lohara 30 June 2020	54	• Collected and analyzed soil samples, Soil Health Card distributed to SC farmers.
6.	Skill upgradation programme on improved Methods of vegetable cultivation.	Godhani, Thombara, Tekri, Dongargaon, Amboli, Dhurkheda, etc. June & July 2020	500	• Scientific management of vegetable crops and off-season vegetable production, drudgery reducing farm tool. • Distribution of seeds of various vegetables like cucumber, hybrid bottle gourd, hybrid brinjal, cowpea, cluster bean, chilli, ridge gourd and other

				critical inputs.
7.	Bio-fertilizer Kit Distribution	Godhani, Thombara, Tekri, Dongargaon, Amboli, Dhurkheda, etc. June & July 2020	500	• Bio-fertilizer Kit Contain 3 items namely Rhizobium, PSB- Phosphate Solubalizing Bacteria and *Trichoderma* were distributed
8.	Pheromone Traps & Lure Distribution	Welsakhra, Amboli, Dhurkheda, Godhani, Thombra, Kavtha, Durgada, Pipmalgaon Lute, Dhondgaon November 2020	686	• Two pheromone traps and two pair of lure given to each farmer for monitoring of PBW Important tool of IPM in PBW management.
9.	Trichocash (*Trichoderma harzianum*) talc based formulation distribution	Welsakhra, Amboli, Kavtha, Dhondgaon November 2020	150	• 500gm Trichocash (*Trichoderma harzianum*)) given to each farmer for management of soil born diseases..
11.	Pesticide protection Kit distribution	-	1150	• Kit contains mask, helmet, gloves, gumboot, goggles, apron. Useful for safe handling of pesticides in agriculture
12.	Power Weeder	Godhani Grampanchayat, Teh. Umred, Dist. Nagpur	60	• Helpful to the scheduled cast farmers of the village in community basis.
13.	Insecticide	Welsakhra, Amboli, Dhurkheda, Godhani, Thombra, Kavtha,	500	• Insecticide input for management of insects pest as a part of IPM.
14	Cotton Picking Bag	Godhani, Thombara, Tekri, Dongargaon, Amboli, Dhurkheda, etc. -	1000	• Useful in clean and easy way of cotton picking by SCSP labours engaged in cotton picking.

Training programme at Dr. Ambedkar College Deekshabhumi, Nagpur.

Distributed cotton Picking bags to cotton farmers under SCSP


Ration kit Distribution to the beneficiaries under SCSP scheme at Khapri, Dist. Nagpur during Lockdown due to COVID -19 pandemic.

Cotton Seed distribution to farmers under SCSP scheme

Soil Health Card distribution to farmer under SCSP


Vegetable seed kit distribution to farmers under SCSP

SCSP beneficiary with Vegetable Crop


Bio fertilizer kit distribution to farmers under SCSP


Trichoderma distribution to farmers under SCSP

Pheromone Traps distribution to farmers under SCSP scheme

10.9.3: Tribal Sub Plan

Annual Report of Tribal Sub Plan (TSP) (2020-21)

A programme "Tribal Sub Plan" run by the Government of India, with the main objective to promote Scheduled tribes economic development through family-oriented schemes by providing resources to the Scheduled tribes family.

The activities carried out during 2020 include, capacity building on improved methods of Cotton and paddy cultivation, skill up gradation programmes, drudgery reducing farm tools, nutri-gardens, vegetable cultivation, personal protection while spraying. The farmwomen from ST families were sensitized on some of the horticultural interventions like round the year vegetable cultivation and scientific management of vegetable crops. As part of the TSP programmes, inputs like seeds of improved cotton and paddy varieties, Vegetable seeds (kit), Bio-fertilizers (seed and soil treatment kit), CICR KVK cotton picking Bags were also distributed to the ST beneficiaries from the project areas and adopted villages under TSP programme.

10.9.3.1 The details of various programmes carried out under the TSP schemes are given in the following table.

Sr.No.	Name of programme	Venue and Date	No of ST beneficiaries	Input distributed/ skill imparted
1.	Training program on "Improved Cotton Production Techniques and tribal women empowerment"	KVK, Sonapur, Gadchiroli 3rd March, 2020	450	• One day training cum farmers meets on "Improved Cotton Production Techniques". • Pheromone traps and lures, Flonicamid 50 WG (60 g), leaflets on IPM of pink bollworm of cotton and "safe handling of pesticides"
2.	Distribution of citrus seedlings (Kagzi lime)	District Gadchiroli, June, 2020,	100	• Distribution of 10 kagzi lime seedlings to each ST beneficiaries.
3.	Distribution of vegetables seeds kit and seed/soil treatment kit	Arvi (Taluka-Samudrapur) July, 2020	15	• Distribution of seed/soil treatment kits
4.	Farmers field workshop and Distribution of vegetables seeds kit and seed/soil treatment kit	Murzadi, Khairi Bk, Jamhalapani, Bothali, Bendoli, Sindi Vihari, Bhivgad, Muradpur (Taluka-Umred) June, 2020 and Salaimendha (Taluka-Hingna) July, 2020	54	• Distribution of vegetables seeds kit
5.	Distribution of critical inputs for cotton, paddy and vegetables production	District Gadchiroli June, 2020	269	• Paddy seed, vegetable seed kit and seed/ soil treatment kits distributed to tribal farmers
6.	Distribution of CICR KVK Cotton Picking Bag	Dist.-Gadchiroli December, 2020	100	• Cotton picking bags were distributed to farmers


जागतिक महिला दिन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ICAR-CENTRAL INSTITUTE FOR COTTON RESEARCH, NAGPUR


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Longitude: 79.98511
Elevation: 216.3m
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10.9.4:Library

In the year 2020, the Library purchased 21 new books and 7 Hindi books. The Library also subscribed to 13 Indian Journals. During the COVID lockdown period off-campus activation was done for all E-books and journals for scientists . Off campus activation of CeRA was also made in this period. Annual Report and CICR Newsletter was distributed to ICAR Institutes and dignitaries. Webinars were also conducted for scientists regarding anti-plagiarism software.

DOCUMENTATION SERVICES

- Library has developed computerized bibliographic database on Cotton to provide comprehensive and updated information on cotton. About **5237** bibliographic 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, two issues of COTTON RESEARCH ABSTRACTS (V34, January – December 2020) 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 science 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 WebOPAC 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://cicrslim/w27/

10.9.5: Progressive Use of Hindi

राजभाषा (हिंदी) : प्रचार–प्रसार

भा.कृ.अनु.प.– केन्द्रीय कपास अनुसंधान संस्थान, नागपुर में वर्ष 2020 के अंतर्गत भारत सरकार, गृह मंत्रालय, राजभाषा विभाग एवं भारतीय कृषि अनुसंधान परिषद, नई दिल्ली से प्राप्त निर्देशानुसार संस्थान में राजभाषा (हिंदी) के सक्रिय प्रचार–प्रसार हेतु राजभाषा (हिंदी) संबंधित विभिन्न गतिविधियों का आयोजन किया गया जिसका संक्षिप्त विवरण निम्नानुसार हैं।

राजभाषा कार्यान्वयन समिति की त्रैमासिक बैठक का आयोजन

संस्थान में राजभाषा हिंदी के सक्रिय प्रचार–प्रसार के हेतु राजभाषा कार्यान्वयन समिति (वित्तीय वर्ष 2020) की त्रैमासिक बैठकों का आयोजन निम्नानुसार किया गया।

राजभाषा कार्यान्वयन समिति की बैठकों की तिथि :

क्र.	दिनांक	विषय
1	08 जनवरी, 2020	वर्ष–2020 राजभाषा कार्यान्वयन समिति की प्रथम बैठक
2	27 जून, 2020	वर्ष–2020 राजभाषा कार्यान्वयन समिति की द्वितीय बैठक
3	25 अगस्त, 2020	वर्ष–2020 राजभाषा कार्यान्वयन समिति की तृतीय बैठक
4	04 दिसंबर, 2020	वर्ष–2020 की राजभाषा कार्यान्वयन समिति की चतुर्थ बैठक

हिंदी सप्ताह समारोह (दिनांक : 14 – 21 सितंबर, 2020)

भा.कृ.अनु.प.–केन्द्रीय कपास अनुसंधान संस्थान, नागपुर में बड ही उत्साह पूर्ण वातावरण में 'हिंदी सप्ताह समारोह' का विधिवत उदघाटन दिनांक : 14 सितम्बर, 2020 को डॉ. ब्लेज डिसूजा, प्रभारी निदेशक, भा.कृ.अनु.प.–केन्द्रीय कपास अनुसंधान संस्थान, नागपुर के शुभहस्ते दीप प्रज्ज्वलित कर किया गया। कार्यक्रम का संचालन करते हुए डॉ. महेंद्र

कुमार साह, सहायक मुख्य तकनीकी अधिकारी (रा.भा.) ने इस सुअवसर पर उपस्थित अधिकारियों एवं कर्मचारियों का संस्थान की राजभाषा कार्यान्वयन समिति की ओर से हार्दिक स्वागत करते हुए उन्हें 'हिंदी सप्ताह समारोह' के अंतर्गत आयोजित किए जाने वाली विभिन्न हिंदी प्रतियोगिताओं (*हिंदी निबंध प्रतियोगिता, चित्र आधारित कहानी लेखन प्रतियोगिता, शब्दानुवाद प्रतियोगिता, एवं सामान्य ज्ञान प्रतियोगिता*) की जानकारी अधिकारियों एवं कर्मचारियों को देते हुए उनसे यह आग्रह किया कि वे इन विभिन्न हिंदी प्रतियोगिताओं में अधिक–से–अधिक की संख्या में भाग लेकर इस आयोजन को सफल बनाएं ।




हिंदी सप्ताह उद्घाटन समारोह का कुशल संचालन डॉ. महेंद्र कुमार साहू ने किया और आभार श्री अ. अं. गोस्वामी, वरिष्ठ प्रशासनिक अधिकारी, भा.कृ.अनु.प.–केन्द्रीय कपास अनुसंधान संस्थान, नागपुर ने माना।

समापन समारोह

'हिंदी सप्ताह : समापन समारोह' का आयोजन दिनांक : 24 सितम्बर, 2020 को किया गया। इस कार्यक्रम की अध्यक्षता का पदभार संस्थान की राजभाषा कार्यान्वयन समिति के अध्यक्ष डॉ. विजय नामदेव वाघमारे, निदेशक, भा.कृ.अनु.प. –केन्द्रीय कपास अनुसंधान संस्थान, नागपुर ने संभाला और साथ ही इस अवसर पर डॉ. ब्लेज डिसूजा, विभाग प्रमुख, फसल उत्पादन विभाग, डॉ. सिद्धार्थ वासनिक, प्रधान वैज्ञानिक एवं प्रभारी कृषि विज्ञान केंद्र, श्री अ. अं. गोस्वामी, वरिष्ठ प्रशासनिक अधिकारी एवं डॉ. महेंद्र कुमार साहू, सहायक मुख्य तकनीकी अधिकारी (रा.भा.) भा.कृ.अनु.प. –केन्द्रीय कपास अनुसंधान संस्थान, नागपुर प्रमुख वक्ता के रूप में सादर मंचासीन थे।

इस समारोह के कार्यक्रमाध्यक्ष ने अपने सम्बोधन में कहा की हिंदी हमारे लिए केवल एक भाषा ही नहीं अपितु राष्टोय अस्मिता की प्रतीक है जिसे राष्ट्र हित में मजबूत करना हम प्रत्यक भारतीय नागरिकों का कर्तव्य है। अतः इस दृष्टिकोण से राष्ट्रीय हित में अपने कार्यालयोन कार्यों में राजभाषा (हिंदी) का अधिक–से–अधिक उपयोग करना हमारा संवैधानिक उत्तरदायित्व है।

संस्थान को राजभाषा हिंदी के क्षेत्र में उल्लेखनीय कार्य करने हेतु पिछले दो वर्षों से लगातार परिषद का प्रतिष्ठित "राजर्षी टंडन राजभाषा पुरस्कार (प्रथम)" प्राप्त हुआ जो की संस्थान के हिंदी अनुभाग के लिए ही नहीं अपितु संस्थान के लिए गौरव की बात हैं।

तदोपरात इस समारोह के कार्यक्रमाध्यक्ष के शुभहस्ते संस्थान में हिंदी सप्ताह समारोह –2020 के अंतर्गत आयोजित हिंदी संबंधित विभिन्न प्रतियोगिताओं के विजयो प्रतिस्पर्धी अधिकारियों एवं कर्मचारियों को नकद पुरस्कार वितरित किए गए।




राजभाषा हिंदी कायनिरीक्षण / मार्गदशन

डॉ. विजय नामदेव वाघमारे, निदेशक, भा.कृ.अनु.प. – केन्द्रीय कपास अनुसंधान संस्थान, नागपुर की अध्यक्षता में क्षेत्रोय केंद्र, कोयबटूर का हिंदी कायनिरीक्षण/मार्गदशन

दौरा दिनांक : 8 जनवरी, 2020 को पूर्वाहन 10.00 बजे संपन्न हुआ। समिति की इस बैठक में राजभाषा हिंदो कार्यनिरीक्षण/मार्गदशन समिति, भा.कृ.अनु.प.– केन्द्रीय कपास अनुसंधान संस्थान, नागपुर द्वारा भारत सरकार, राजभाषा विभाग/परिषद की राजभाषा नीति एतत्सम्बन्धी सांविधिक प्रावधानों का अनुपालन सुनिश्चित करने हेतु क्षेत्रोय केंद्र, कोयबटूर का हिंदी कायनिरीक्षण एवं मार्गदशन किया गया।

डॉ. अ. हि. प्रकाश, परियोजना समन्वयक एवं अध्यक्ष, केन्द्रीय कपास अनुसंधान संस्थान, क्षेत्रोय केंद्र, कोयबटूर ने समिति की इस बैठक में केंद्र का प्रतिनिधित्व किया और साथ ही समिति इस बैठक में केंद्र की राजभाषा कार्यान्वयन समिति के पदाधिकारीगण भी उपस्थित थे। समिति की इस बैठक में केंद्र में राजभाषा हिंदी के सक्रिय कार्यान्वयन एवं 'ग' क्षेत्र हेतु निर्धारित विभिन्न कायक्रमों पर विस्तृत रूप से विचार–विमर्श किया गया, ताकि केंद्र में सही अर्थों में राजभाषा हिंदी का सक्रिय प्रचार–प्रसार हो सके। केंद्राध्यक्ष को मार्गदर्शन स्वरूप कुछ सुझाव समिति द्वारा दिय गए जिन पर केंद्र द्वारा यथाशीघ्र कार्रवाई की जानी अपेक्षित हैं।

कार्यशाला

क्षेत्रीय केंद्र, कोयंबटूर

भा.कृ.अनु.प.– केन्द्रीय कपास अनुसंधान संस्थान, क्षेत्रीय केंद्र, कोयबटूर में 'प्रशासनिक/तकनीकी संवर्ग' के कार्मिकों हेतु 'एक दिवसीय (दिनांक : 08 जनवरी, 2020) हिंदी कार्यशाला' का आयोजन बड ही उत्साहपूर्ण वातावरण में डॉ. अ. हि. प्रकाश, प्रमुख, भा.कृ.अनु.प.– केन्द्रीय कपास अनुसंधान संस्थान, क्षेत्रीय केंद्र, कोयबटूर की अध्यक्षता में तथा अतिथि वक्ता डॉ. महेंद्र कुमार साहू, सहायक मुख्य तकनीकी अधिकारी(रा.भा) एवं श्री अ. अं. गोस्वामी, वरिष्ठ प्रशासनिक अधिकारी, केन्द्रीय कपास अनुसंधान संस्थान, नागपुर की मुख्य उपस्थिती में केंद्र में किया गया। इस हिंदी कार्यशाला का संचालन केंद्र की श्रीमती के. एस. सुभाश्री, वरिष्ठ तकनीकी अधिकारी ने किया और इस हिन्दी कायशाला में प्रशासनिक/तकनीकी संवर्ग के लगभग 28 अधिकारियों एवं कर्मचारियों ने सहभागी होकर इस आयोजन को सफल बनाया। कायक्रम के अंतिम बिन्दु पर इस कायशाला में सहभागी समस्त हिन्दी प्रेमी अधिकारियों/कर्मचारियों का आभार केंद्र की प्रभारी अधिकारी (हिन्दी) श्रीमती के. एस. सुभाश्री ने माना।

नागपुर

भा.कृ.अनु.प.– केन्द्रीय कपास अनुसंधान संस्थान, नागपुर में 'प्रशासनिक संवर्ग' के कार्मिकों हेतु एक दिवसीय (दिनांक : 30 जून, 2020) हिंदी कार्यशाला' का आयोजन किया गया। इस कार्यशाला का आयोजन डॉ. विजय नामदेव वाघमारे, निदेशक, भा.कृ.अनु.प.– केन्द्रीय कपास अनुसंधान संस्थान,

नागपुर की अध्यक्षता में किया गया तथा इस अवसर पर अतिथि वक्ता डॉ महेंद्र कुमार साहू, सहायक मुख्य तकनीकी अधिकारी(रा.भा), श्री अ. अं. गोस्वामी, वरिष्ठ प्रशासनिक अधिकारी, एवं श्री रजनी कांत चतुर्वेदी, सहायक मुख्य तकनीकी अधिकारी प्रमुख रूप से उपस्थित थे।

हिंदी कार्यशाला के उदघाटन सत्र को कार्यक्रमाध्यक्ष ने संबोधित करते हुए–कहां कि आज की यह हिंदी कार्यशाला बड़े ही समसामायिक विषय "कोविड–19 महामारी सतर्कता एवं अनुपालन" पर आयोजित की जा रही है। आज इस माहमारी से पूरा विश्व प्रभावित हैं। इस महामारी से बचने के लिए हमें कई सावधानियां बरतनी होगी और साथ ही साथ इस महामारी से लड़ने के लिए हमें अपने शरीर की प्रतिरोगात्मक शक्ति को बढ़ाना होगा।

हिंदी कार्यशाला के मुख्य अतिथि वक्ता डॉ महेंद्र कुमार साहू ने इस अवसर पर सभा संबोधित करते हुए बताया कि हमारा देश वर्तमान समय में कोरोना महामारी से जुझ रहा है और इस स्थिति में हमें अपना कार्यालयीन कार्य करना है तथा हमे अपने आपको बचाना भी हैं। इस संदर्भ में इन्होंन बताया कि हमे भारत सरकार द्वारा जारी किए गये

दिशानिर्देशों का अनुपालन करना आरोग्य सेतु ऍप को अवश्य अपने मोबाईल मे डाउनलोड करना है तथा ब्लूटूथ व लोकेशन को हमेशा ऑन रखना है, हाथ को साबून से बार–बार धोना है तथा हाथों को सेनेटाइज भी करते रहना है और सर्वोपरि सोशन डिस्टेंसिंग का पालन करना है।

हिंदी कार्यशाला के द्वितीय सत्र में प्रमुख वक्ता के रूप में श्री अ. अं. गोस्वामी एवं श्री रजनी कांत चुतुर्वेदी ने कोविड–19 महामारी के विषय में वैज्ञानिक एवं तकनीकी दृष्टिकोण से प्रकाश डालते हुए कहां कि आज हम एक अदृश्य वायरस से लड़ रहे है। आज इस महामारी के संक्रमण से बचने के लिए हमें अपने आप को कई तरह कि सावधानी बरतते हुए खुद को बचाना होगा।

इस हिंदी कार्यशाला के का कुशल संचालन डॉ. महेंद्र कुमार साहू, ने किया और आभार श्री रजनी कांत चतुर्वेदी ने माना।

नागपुर

भा.कृ.अनु.प.– केन्द्रीय कपास अनुसंधान संस्थान, नागपुर कार्यालय में 'प्रशासनिक/तकनीकी संवर्ग' के कार्मिकों हेतु एक दिवसीय (दिनांक : 12 सितम्बर, 2020) हिंदी कार्यशाला' का आयोजन बड़े ही उत्साहपूर्ण वातावरण में डॉ. सिद्धार्थ वासनिक, प्रधान वैज्ञानिक एवं प्रभारी, कृषि विज्ञान केंद्र, भा.कृ.अनु.प.– केन्द्रीय कपास अनुसंधान संस्थान, नागपुर की अध्यक्षता में एवं अतिथि वक्ता डॉ महेंद्र कुमार साहू, सहायक मुख्य तकनीकी अधिकारी(रा.भा) की मुख्य उपस्थिती में किया गया।

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"सतर्क भारत, समृद्ध भारत" विषय पर आयोजित एक दिवसीय (दिनांक : 27, अक्टूबर, 2020) हिंदी कार्यशाला / व्याख्यान सत्र।

भा.कृ.अनु.प.– केन्द्रीय कपास अनुसंधान संस्थान, नागपुर कार्यालय में बड़े ही उत्साहपूर्ण वातावरण में डॉ. वाय. जी. प्रसाद, निदेशक, भा.कृ.अनु.प.– केन्द्रीय कपास अनुसंधान संस्थान, नागपुर की अध्यक्षता में एवं डॉ. नंदिनी गोकटे नरखेडकर, विभाग प्रमुख, फसल संरक्षण विभाग, श्री अ. अं. गोस्वामी, वरिष्ठ प्रशासनिक अधिकारी तथा अतिथि वक्ता डॉ. महेंद्र कुमार साहू, सहायक मुख्य तकनीकी अधिकारी (रा.भा) की गणमान्य उपस्थिती में संस्थान में "सतर्क भारत, समृद्ध भारत" विषय पर एक दिवसीय (दिनांक : 27, अक्टूबर, 2020) हिंदी कार्यशाला / व्याख्यान सत्र का सफलता पूर्वक आयोजन किया गया।

हिंदी कार्यशाला के उदघाटन सत्र को संबोधित करते हुए डॉ. वाय. जी. प्रसाद ने कहां कि आज की यह हिंदी कार्यशाला बड़े ही समसामायिक विषय "सतर्क भारत, समृद्ध भारत" पर आयोजित की जा रही है। आज भ्रष्टाचार को मिटाना हमारे लिए एक चुनौतीपूर्ण कार्य है। अतः हमें अपने कार्य प्रणाली में पूर्णरूपेन इमानदारी एवं पारदर्शिता के साथ कार्य करते हुए देश के विकास को गति प्रदान करना है।
इस सुअवसर पर कार्यक्रमाध्यक्ष डॉ. वाय. जी. प्रसाद के शुभहस्ते संस्थान द्वारा प्रकाशित वार्षिक हिंदी गृह पत्रिका 'श्वेत स्वर्णिमा 2019–20' का लोकार्पण किया गया। तदउपरांत 'सतर्कता जागरूकता सप्ताह – 2020' के उद्घाटन सत्र में सहभागी समस्त अधिकारियों एवं कर्मचारियों को डॉ. महेंद्र कुमार साह् द्वारा हिंदी में तथा श्री अ. अं. गोस्वामी द्वारा अंग्रेजी में सत्यनिष्ठा की प्रतिज्ञा दिलवाई गई।

हिंदी कार्यशाला के मुख्य अतिथि वक्ता डॉ. साहू ने इस अवसर पर सभा को संबोधित करते हुए कहा कि हमारा देश भ्रष्टाचार जैसी गंभीर समस्या से जूझ रहा है और जिसके परिणामस्वरूप देश की प्रगति एवं विकास में बाधा उत्पन्न हो रही हैं। अतः एक राष्ट्रवादी नागरिक होने के नाते हमारा यह नैतिक उत्तरदायित्व बन पड़ता हैं कि हम अपनी कार्यशैली एवं कार्य व्यवहार में इमानदारी एवं पारदर्शिता को अपनाकर देश के विकास को गति प्रदान करें।

10.10: Weather

Nagpur

Month	Temperature (⁰C)		Relative Humidity (%)		Rain fall (mm)	No. of Rainy Days
	Max	Min	Max	Min		
January, 2020	25.81	12.82	72.22	51.38	36.6	3
February, 2020	28.96	14.13	62.15	42.58	17.4	3
March, 2020	33.84	19.18	62.91	42.06	23.60	4
April, 2020	40.52	22.05	56.67	30.95	11.2	5
May, 2020	42.75	25.08	53.58	37.25	36.80	9
June, 2020	33.91	24.05	79.26	61.63	234.2	18
July, 2020	32.46	24.22	81.34	69.22	305.30	16
August, 2020	29.69	23.49	84.50	77.47	515.20	24
September, 2020	33.00	24.19	84.26	67.46	201	15
October, 2020	32.81	22.30	84.54	55.37	85.80	5
November, 2020	31.11	15.34	75.53	49.45	16.8	1
December, 2020	29.03	19.08	79.21	65.12	0.4	1
Total					**1484.3**	**104**

Coimbatore

Month	Temperature (°C)		Relative Humidity (%)		Evaporation (mm)	Rainfall (mm)	Rainy days	Sun shine (hours)	Solar radiation (cal/cm2/day)
	Max.	Min.	Morn.	Even.					
June, 2020	32.6	24.1	81.4	54.6	6.8	10.3	3	5.3	337.06
July, 2020	31.7	23.2	84.2	59.2	6.0	20.3	8	5.2	293.75
August, 2020	30.4	23.3	70.2	58.6	6.0	38.5	6	5.2	516.3
September, 2020	30.1	22.9	76.4	57.8	5.8	141.0	11	5.3	479.4
October, 2020	31.4	22.5	69.4	53.2	5.7	38.5	2	5.3	508.1
November, 2020	31.2	22.5	70.1	53.4	5.9	37.0	3	5.2	477.3
December, 2020	29.3	20.7	71.0	54.3	5.5	46.0	3	5.3	488.2
Total	-	-	-	-	-	**331.6**	**37**	-	-

Sirsa

Month	Temperature (°C)		Relative Humidity (%)		Rain fall (mm)	No. of Rainy Days
	Maximum	Minimum	Maximum	Minimum		
April, 2020	35.6	22.7	61.4	31.8	3.0	1.0
May, 2020	39.8	24.8	59.0	27.0	60.8	3.0
June, 2020	39.5	28.4	65.2	47.2	33.4	3.0
July, 2020	36.7	27.4	78.5	54.3	154.5	5.0
August, 2020	35.5	26.5	81.3	63.1	36.5	5.0
September, 2020	35.9	26.3	77.3	53.3	42.8	3.0
October, 2020	34.1	20.2	68.2	33.5	0.0	0.0
November, 2020	26.8	11.6	72.9	34.6	18.2	2.0
				Total	**349.2**	**22**

10.11: Cotton Scenario

Area: in Lakh Hectares
Production: in Lakh bales of 170 kg.
Yield: Kg per hectare

State	Area		Production*		Yield	
	2019-20	2020-21	2019-20	2020-21	2019-20	2020-21
Punjab	3.92	5.01	9.50	12.00	411.99	407.19
Haryana	7.23	7.37	26.50	25.00	623.10	576.66
Rajasthan	7.61	6.72	29.00	27.00	647.83	683.04
Total North Zone	**18.76**	**19.10**	**65.00**	**64.00**	**589.02**	**569.63**
Gujarat	26.53	22.73	89.00	90.50	570.30	676.86
Maharashtra	44.31	41.84	87.00	86.00	333.78	349.43
Madhya Pradesh	6.50	6.44	20.00	21.00	523.08	554.35
Total Central Zone	**77.34**	**71.01**	**196.00**	**197.50**	**430.82**	**472.82**
Telangana	21.27	23.73	54.00	60.00	431.59	429.84
Andhra Pradesh	6.54	5.24	18.00	18.00	467.89	583.97
Karnataka	6.37	7.21	20.00	20.00	533.75	471.57
Tamil Nadu	1.70	1.55	6.00	5.00	600.00	548.39
Total South Zone	**35.88**	**37.73**	**98.00**	**103.00**	**464.33**	**464.09**
Odisha	1.70	1.68	4.00	4.50	400.00	455.36
Others	0.05	0.05	2.00	2.00		
All-India	**133.73**	**129.57**	**365.00**	**371.00**	**463.99**	**486.76**

Source: Cotton Advisory Board, Ministry of Textile, Govt. of India.
* Provisional as estimated by CAB in its meeting held on 25.01.2021

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