

Key highlights from papers presented in WCRC-7

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for Soil Survey and Land Use Planning and Maharashtra Academy of Sciences and is an EC member of ICRA. He received the ICAR Team Award (2005-06) for research on C sequestration and was deputed to Malawi and Uganda as expert under Cotton-Technical Assistance Programme for Africa 2014.

most heat tolerant one on the basis of multiple traits- another dehiscence, cell injury, stomatal conductance, transpiration rate, net photosynthesis rate and water use efficiency.



“Determination of Genetic Diversity for Yield and Fiber Quality Traits among Some Cotton Genotypes (*Gossypium barbadense*), Dr. Abdelmoghny presented the diversity among 30 genotypes using Genetic variation, PCA, cluster analysis and path

analysis. Biplot graphs showed significant positive relationship between yield and fibre quality (length, strength and uniformity). Path analysis indicated that seed cotton yield/plant was strongly influenced by boll weight and lint yield/plant.



“Development and characterization of *Gossypium hirsutum* × *Gossypium arboreum* hybrids and backcross derivatives for response to some biotic stresses” – Dr. Dharminder Pathak emphasized that two genes, either singly or in combination conferred jassid tolerance. Further SSR markers NAU 922

(Chromosome A5) and BNL 1705 (Chromosome A4) were associated with jassid tolerance.

Genotype × Environment Interaction and Sensitivity to Planting Date of Seed Cotton Yield in Senegal– Dr. Traoré ABDU, significant genotype, environment and GE interaction for various traits. The seed cotton yield realized varied from 1225 (CS 50) to 938 kg/ha (Alen 51-106). Further, high rainfall favoured good yield. He recommended cultivar IRMA Q302 for the Senegalese cotton basin due to its high and stable yield across environments.



“Heterosis and Combining Ability for Phenological, Yield and Fiber Traits of Cotton (*Gossypium Hirsutum* L.) Genotypes” Dr. Wajid A. Jat summarized the results of evaluation of 4 lines, 3 testers and their 12 hybrids in Sindh, Pakistan. The effects of genotypes, parents, crosses, parents vs crosses, lines

and testers and tester x line were significant for earliness traits, yield traits, yield/plant, 1000 seed weight, GOT and staple length.

COTTON GENETICS AND PLANT BREEDING

“CPD Index for Earliness Evaluation and an Algorithm for Estimation of Missed Experiment in Cotton Research” Dr. Hosseini proposed a new index Combined Picking and Day (CPD) to evaluate earliness. CPD captured the actual genetic effect, nullifying the influence of the environment.

“Adaptation of Advanced High-Yielding Cotton Lines to Subtropical Conditions In Argentina” Dr. Dileo P. Nahuel evaluated the stability and adaptability of advance lines developed by INTA and commercial varieties using the AMMI (Additive Main-effects and Multiplication Interaction) model and observed that significant GE interaction. The AMMI-PC1 could explain 84% of these interactions. SP1 and SP 41255 were the most stable and adaptive genotypes respectively.



“Coping for Sustainable Cotton Production through Developing of Climate Resilient Cotton Varieties in Mutant’s Background in Pakistan”

Dr. Manzoor Hussain described the mutation breeding efforts to develop genotypes that could withstand heat stress. The variety NAIB 878, was the

"Physical and Chemical Mutagenic Treatments for Cotton Improvement" Dr. Martin Winkler presented the effect of different mutagens at varied doses on the germination, growth, morphology and damages/abnormalities in seedlings in an elite variety Guazuncho 3 INTA. He concluded that Sodium azide @ 4 mM concentration was a relatively safe mutagen but its effect was pH dependent.



"Studies on Selection Efficiency, Performance Stability and Plant Type in Newly Developed Genotypes of Cotton (*Gossypium hirsutum*)" Dr. Rajesh Patil assessed the selection efficiency of planned crosses executed to arrive at plant types suitable for high

density planting system (HDPS) and robust plant types for high input situations. He developed a compact genotype, L9T4-8-1 with stable yield across environments for HDPS.

"Evaluation of Ten Egyptian Cotton Varieties and Experimental Lines for Yield, Quality and Bacterial Blight Resistance" – Dr. Maria Abdalla informed that the lines 94-B-2, 94-B-19 and 96-9 were early, produced high yield with good fibre quality and possessed tolerance to bacterial blight and hence could be recommended for extra fine count cotton production in Sudan.

"*Gossypium* diploid species genetics: Inheritance and linkage of bracteoles", Dr. D. V. Patil informed that *G. herbaceum* was dissimilar to *G. arboreum* for bracteole trait and this trait could be a phenotypic marker. It could be used at flower induction stage for maintaining the genetic purity of the parents.



"The Inheritance of Agromorphological and Fiber Quality Traits in Cotton (*Gossypium hirsutum* L.) Line × Tester Hybrids" Dr. Nafise Ozkan showed that in F1 crosses, the heterosis for plant height, monopodia, boll number and radiation use was positive whereas heterosis for days to boll opening and yellowness was negative.



"Genetic basis of blending breeding methods/steps spanning across mating system barriers to bring quick genetic gains in Cotton" Dr. S. S. Patil emphasized the need for systems approach in plant breeding. He presented with examples, the genetic basis for innovative modifications at all the three levels of varietal development viz. creation of variability, selection and stabilization of transgressive segregants.

"QTLs mapping linked with cotton leaf curl disease (CLCuD) resistance in cotton (*Gossypium hirsutum* L.) using microsatellite markers". Dr. Peng Chee described the use of 1350 DNA markers on a segregating population (ACC-55xS-12) to identify markers (NAU5418 and

JESPR158) in F2 and (JESPR158, NAU3377 and NAU5418) in F3 to be significantly associated with CLCuD.



"A Private/Public Sector Partnership to address *Fusarium oxysporum* f. sp. *Vasinfestum* race 4 (FOV4)", Dr. Don Jones, highlighted the outcome of a private-public partnership between Clemson University, O&A enterprises and Cotton Incorporated. The outcomes included-4 highly FOV4 resistant lines, 3 biparental RIL F8 populations, a unique phenotyping approach to predict spore density in the field and a protocol to study transcriptomics and metabolomics.



"Development, Production and Commercialization of Transgenic Extra Long Staple (ELS) Public sector Cotton Hybrid DCH-32 BG-II Bt in India" Dr. V. S. Sangam discussed the challenges for development, seed production and commercialization of public sector Bt hybrids. He concluded that the transgenic BGII version of DCH-32 was accomplished without compromising the yield and fibre quality.

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BIOTECHNOLOGY AND MOLECULAR BIOLOGY



"Molecular cloning and expression analysis of Chitin synthase A and B gene in *Helicoverpa armigera* of cotton" Dr. Raghavendra K.P. described the structural features of the Chitin synthase A and B protein coding sequence from the *H. armigera* strains of cotton. He described the alternative splice variants for chitin synthase, expression pattern of the CHS variants and differential structural features of the HaCHSA and HaCHSB genes.



"Spatio-Temporal Cry1Ac Protein Expression and Bioassay Studies of Stabilized Transgenic Cotton Events" Dr. Manjula Maralappanavar, summarised the development of transgenic events using two Cry1Ac constructs, the molecular characterisation and selection of the transgenic events. She presented the comparative evaluation data on spatio-temporal Cry1Ac protein expression and bioassay studies of event 32 and 78 with BGI and BGII checks.

"Cotton Biotech applied to cotton boll weevil control: Advances and Challenges" Dr. Maria Fatima Grossi described the application of transgenic cotton research for boll weevil management in Brazil to provide basic insights

on the approaches to produce stabilized dsRNA viz., expression of dsRNA in organelles, high stabilization of dsRNA through architecture modeling based on viroid genomes. Dr. Grossi presented the results of development and evaluation of transgenic cotton for management of cotton boll weevil through RNA interference of chitin synthase 2 and vitellogenin using stabilized dsRNA and over expression of entomotoxic proteins (Cry10Aa toxin).



"Cloning and characterization of Green Tissue specific Promoter from upland cotton (*Gossypium hirsutum* L. cv. Suraj)", Dr. G. Balasubramani, described the importance of tissue specific promoters in transgenic research. He highlighted the functional validation results depicting green tissue specific activity of promoter elements RUBISCO small subunit's (rbcs) gene through development of deletion constructs and transgenic events of tobacco, their histochemical analysis and quantification of gus activity were presented. The 643bp upstream sequence of the RUBISCO small subunit's (rbcs) gene recorded higher expression compared to other deletion variants of the promoter sequence tested.



"Evaluation of molecular markers linked to drought tolerance in Cotton" Dr. J. Amudha screened a recombinant Inbred Line (RIL) population (129 lines) derived from inter-specific cross of *G. hirsutum* (28 I) X *G. barbadense* (Suvin) using molecular

markers linked to the QTLs of osmotic potential and physiological parameters such as canopy temperature, chlorophyll content, relative water content and proline content.



"Comparative RNAi Efficiency in Cotton Sap Feeders through dsRNA Mediated Gene Knockdown" Dr. Satnam Singh, described the results of RNA interference (RNAi) knockdown of target genes in sucking pests such as jassid, whitefly, thrips and mealybug. The dsRNA mediated knockdown of target genes varied from 56.2 to 77.1

% (SNF7, IAP, AQP1 and vATPase genes), 93 % (SNF gene) and 36-67% (CAL gene) in jassid, whitefly and mealybug respectively.



"Identification and Characterization of a Zinc Finger Protein (Ghzfp) Gene Involved In Fungal Disease Resistance In *Gossypium hirsutum*" Dr. Upender Mahesh highlighted the role of a member of the Zinc Finger Protein (Ghzfp) gene family involved In Fungal Disease Resistance In

Gossypium hirsutum.

CROP PROTECTION-ENTOMOLOGY, PLANT PATHOLOGY AND NEMATOLOGY



Pink Bollworm (PBW).

"Development and Validation of an Adaptable IPM Module for Pink Bollworm (PBW) in BG-II Bt Transgenic Cotton" Dr. Sashikant Udikeri presented the details of an IPM module comprising of Profenofos (ovi-larvicidal insecticide), *Trichogramma bactrae* (egg parasitoid) and mass trapping (pheromone traps) for the management of



"Emerging Issues in Cotton Insect Pests Management in India and Way Forward" Dr. G. M. V. Prasada Rao elaborated the insect pest situation during the post-Bt era (2002 onwards). He highlighted the emergence of the American bollworm in Central and South India, whitefly in North India and the resistance development in PBW to Cry1Ac and Cry2Ab.



"Management of Pink Bollworm (PBW) Using Behavior Modifying Chemicals in Bt Cotton", Dr. S. B. Patil described the evaluation of SPLAT (Specialized Pheromone & Lure Application Technology) for the management of PBW. He concluded that

there was a reduction in PBW incidence in the trials with SPLAT that in turn led to yield improvement.

"Molecular Characterization of Local Strains of the Causal Agent of Cotton Bacterial Blight in Argentina" Dr. Lorenzini Gabriel informed that bacterial blight caused up to 35% losses in yield in Argentina. The authors collected 36 isolates of *Xanthomonas* sp from North Argentina and their molecular characterization indicated that 2 isolated belonged to *Xanthomonas citri* subsp. malvacearum. Further, phylogenetic analysis showed that these isolates group within the races 1,2,3,12 and 18. Dr Gabriel presented the use of molecular markers in resistance breeding.



"Radiation Biology of a Cotton Pink Bollworm *Pectinophora gossypiella* (Saunders) and Potential of Irradiation Mediated Inherited (F1) Sterility Technique for the Pest Suppression", Dr. S. G. Hanchinal highlighted the reproductive behaviour of PBW moths treated with gamma radiation. He recommended 150 Gy as the optimum dose administered to P1 males and this dose induced 60% sterility in the parent generation and 82-85% sterility in F1 generation.



"Within Plant Distribution, Dynamics and Ecocompatible Management of Thrips (Thripidae: Thysanoptera), an Emerging Pest of Cotton in India"

Dr. Rishi Kumar concluded that the population of thrips was more abundant on the leaves than other plant parts and the upper strata of the plant harbours more thrips than the lower strata. In

north India their peak population occurred between 29 and 31 Standard Met Weeks. Among botanicals, castor oil @ 7ml/l could effectively manage thrips.



"Using sulfur as a disinfecting agent for cottonseeds"

Dr. Ghorban Ali Roshani recommended sulphur as an inexpensive and safe fungicide for seed treatment. Sulfur could control storage pests and sulphur treated cotton seeds could be washed and safely fed to livestock.



"Interactive effects of abiotic factors on abundance of sucking pests on Bt cotton"

Dr. Poornima Matti examined the role of weather parameters in regulating the dynamics and abundance of sucking pests (aphids, jassids and thrips). She concluded that improved understanding of the role of maximum and minimum temperature on the

sucking pest complex would aid in developing forewarning systems for their management.



"Chemo-profiling of secondary metabolites from *Pochonia chlamydosporia* and identification of novel nematocidal biomolecule for the management of Reniform nematode, *Rotylenchulus reniformis*"

Dr. Gulzar Banu informed that the fungus, *Pochonia chlamydosporia* was a potential bio-nematicide. Chemo-profiling the ethyl acetate fraction of *P. chlamydosporia* yielded 38 fractions. Molecular docking of the virulent protein target of Reniform nematode and metabolites revealed lavendustin-C as a metabolite with nematocidal activity.

"Essential oils of *Ocimum gratissimum*, *Lippia multiflora*, *Cymbopogon citratus* and *Cymbopogon nardus* effective for the development of bio-insecticides in the context of organic cotton production". Dr. Christopher Kobenan tested bio-insecticides and concluded that nine essential oils extracted from aromatic plants, *Ocimum gratissimum*, *Lippia multiflora*, *Cymbopogon citratus* and *Cymbopogon nardus* were most effective against carposiphid pests (*H. armigera*, *P. gossypiella* and *T. leuotreta*) of cotton.



"Controlled Release Emission Mating Interruption Technique (CREMIT):

A novel and viable approach for area wide management of pink bollworm, *Pectinophora gossypiella* (Saunders) in Bt cotton ecosystem" Dr. A. G. Sreenivas described the CREMIT mating disruption technology for the management of PBW. CREMIT-PBW formulation applied @ 1250 g/ha, 750 g/ha and 500 g/ha effectively controlled PBW and provided seed cotton yield of 4.33 t/ha, 4.25 t/ha and 4.05 t/ha respectively as against 2.47 t/ha with conventional practice.



35. "Pink bollworm, *Pectinophora gossypiella* (Saunders) resistance and management strategies to transgenic cotton in India"

Dr. Chinnababu V Naik highlighted the spatial spread and temporal increase in the resistance level against Cry1Ac and Cry2Ab in

PBW. He suggested an IPM module and a resistance management module for controlling PBW.



"Management strategy against pink bollworm, *Pectinophora gossypiella* (Saunders) in Bt cotton – What next?"

Dr. Y. G. Prasad gave an overview of the PBW situation in India and informed that the yield loss estimated due to PBW was 20-30%. He elaborated various initiatives launched by the government and private sector for its management.

These include pest monitoring, crop window/ETL based management interventions, mass trapping and mating disruption for area wide management of PBW.



"Is Cotton Leaf Curl Virus Vectors by *Bemisia tabaci* sex-biased?"

Dr. Satnam Singh reported that the transmission of CLCuV by Asia II-I B race of *B. tabaci* was sex biased and females were more efficient in its transmission. He postulated that the higher density of endo-symbiont of *Aeronophonas* in females and higher expression of *Aeronophonas* produced CroEL protein genes in females may be responsible for the sex biased transmission.



"Changing Pattern of Cotton Whitefly Infestation Vis-à-Vis Climate Change in India"

Dr. M. Sabesh provided evidence to hypothesize that there has been an advancement of the peak incidence of whitefly in North India due to climate change. He also emphasized the role of maximum and minimum temperatures in influencing whitefly

infestation and outbreaks.

"Seasonal population dynamics of whitefly, *Bemisia tabaci* (Gennadius) and abundance of their natural enemies in Bt transgenic and non-transgenic cotton" Dr. Kedar identified 25 natural enemies of whitefly including 23 predators, 1 parasitoid, and 1 entomopathogenic fungi in the cotton ecosystem. The parasitoid (*Encarsia lutea*) and Coccinellid predators were the most abundant.



"Genetics and Pattern of Inheritance of Cotton Leaf Curl Disease Resistance Genes in Upland Cotton (*Gossypium hirsutum* L.)" Dr. Ghulam Sarwar described the major possible reasons for breakdown in resistance among cotton varieties to the cotton leaf curl virus CLCuV. He concluded that a single dominant gene/gene cluster of tightly linked resistance genes control CLCuV resistance but their expression is modified by suppressors.



"Geographical distribution of the main cotton pests in six West African countries during the period 2019-2021" Dr. Malanno Kouakou studied the geographical distribution of cotton pests in West Africa and concluded that the main pests in Benin

were *Helicoverpa armigera*, *Earias* spp, *Diparopsis waterisi*, *Spodoptera littoralis* and *Plyphagotarsonemus latus*. In Mali and Senegal the main pests were *Jacobiella fascialis*, *Bemisia tabaci*, *Anomis flava*, *Dysdercus* spp and *Haritalodes derogata*. In Cote d'Ivoire and Togo the dominant pests were *Thaumatotibia leucotreta*, *Pectinophora gossypiella* and *Aphis gossypii*.



"The Development of Bollworm Resistance and Its Influence on Variety Performance and Profitability" Dr. Guy Collins observed that there was no conclusive evidence from trials to prove that 3-gene Bt-varieties provided sufficient yield advantage and economic returns compared to the yield obtained with 2-gene Bt-varieties plus the cost of spraying diamides for the control of bollworms.

"Investigating the natural mortality of *Aphis gossypii* (Hemiptera: Aphididae) on cotton crops in tropical regions using ecological life tables" Dr. António Chamuene conducted life table analysis and found that biotic and abiotic factors caused 94.3% mortality in aphid populations, amongst which rainfall and predation were the key mortality factors. Further, conservation of natural enemies hold the key for regulating aphid population.

"Effects of Ecological Approach on the Management of Cotton aphid, *Aphis gossypii* (Glov) in Selected Cotton Genotypes, Gezira State, Sudan" Dr. A. M. A. Rudwan recommended an ecological approach to manage aphids. He observed a density dependent pattern between natural

enemies and population of aphids. Tolerant varieties (Senil and Brazili) and late planting were recommended to manage aphids.

"Effects of some Cultural Practices on the Management of the African Bollworm, *Helicoverpa armigera* Hun, Gezira State, Sudan" Dr. Elmubarak highlighted the interaction between cultivar, sowing date, spacing and pest damage and suggested cost effective, environmentally benign strategy to manage African Bollworm. For reducing the incidence and damage due to African bollworm he suggested sowing of Senil cultivar during 3rd week of June.

"Effects of Ecological Approach on the Management of Cotton Mealybug, *Phenacoccus solenopsis* (Tinsley), in Selected Cotton Genotypes, Gezira State, Sudan" Dr. A. E. M. Hassan observed that the introduction of Genetically Modified (GM) cotton to control bollworms, resulted in the reduction of insecticide usage that led to an increase in the abundance of natural enemies which in turn controlled cotton mealybugs without insecticidal intervention.

"Pathogenic Variability of *Rhizoctonia Solani* Isolates Associated With Cotton Seedlings in Bangladesh" Dr Sima Kundu and Dr Kamrul Islam depicted the genetic divergence of *Rhizoctonia solani* associated with the damping-off in cotton seedlings. They classified the 50 isolates of *R solani* based on pathogenicity using multivariate analysis into 5 clusters and concluded that the isolates from the hill regions were more pathogenic than those isolated from the plains.

CROP PRODUCTION-AGRONOMY, PHYSIOLOGY AND SOIL SCIENCE

"Cotton Yield Under Different Nitrogen Rates and Sources Following Soybean Harvest In The Brazilian Cerrado" Dr. Thais Crazor concluded that cotton grown after soybean on Typic Haplaustox of Mato-Grosso responded to higher N rates (144 and 192 Kg N/ha). For higher yield and better Nitrogen use efficiency he recommended Yara Bela Calcium ammonium nitrate @ 144 kg N/ha.



"Effect Of Nitrogen Rate On Cotton Crop Growth, Yield And Fibre Quality" Dr Kamrul Islam highlighted that the optimum nutrient index for CB-15 cotton variety was different at different locations. The optimum N dose for Sreepur (Gazipur), Jahangirpur (Jashore) and Sardarpur (Dinapur) were 160 kg, 200 kg and 160 kg N/ha. N doses positively improved fibre strength.

"Effect Of Timing Of Last Irrigation On Growth, Yield And Water Productivity In Cotton Under Gezira Conditions" Dr Bashir Ahmed conducted experiments for two years and found that excess irrigation did not contribute to yield, fibre quality or water productivity. Further, the last irrigation must be applied at 21 weeks after planting.



"Enhancing Nitrogen Use Efficiency in Bt-cotton" Dr. S. S. Hallikeri examined the interaction between yield, soil fertility and economics. Based on the results, he suggested a fertiliser schedule comprising of 75% recommended dose of N applied in 4 splits (sowing, squaring, flowering, boll development), 3 foliar sprays of 1% Urea

and incorporation of intercropped sunhemp at 35-40 days after sowing.



"Seedling Age Effect on Yield and Lint Quality of Cotton" Dr. Akhteruzzaman reported the results of transplantation trials conducted at Sreepur (Gazipur). He recommended that to obtain better benefits, farmers can raise cotton seedlings on seed bed and transplant them at the age of 25 days.

"Soil Fertility In Cotton-Based Cropping Systems In Côte d'Ivoire" Dr. Emmanuel Goran highlighted the soil fertility status of farms belonging to 4 major companies. Majority of the 150 soils were sandy, slightly acidic to neutral in pH, very low in organic matter, total N, P, K, Ca and CEC. The soils of SECO and CIDT companies were similar in characteristics and these were different from those of Ivoire coton and COIC companies.



"Effect of sowing time and foliar application of potassium on seed cotton yield and fibre quality of ELS cotton" Dr. Sankaranarayanan highlighted the production technology for extra-long staple (ELS) cotton hybrid (MRC 7918 BG II). For high yield, enhanced fibre quality and economic returns in Coimbatore, south India, he suggested planting on 4th August and foliar application of KNO₃ at 75, 100 and 125 days stage.



"Ginning traits, fiber and seed quality of cotton as influenced by foliar application of nitrogen, potassium and boron" Dr. Tasdiqur Rahman found that foliar application of N:K:B @ 7.5:50:1 g/l significantly improved yield, fibre quality and seed quality on silty clay soils of Sreepur (Gazipur).



"Effect of cotton residue incorporation with conservation tillage and integrated nutrient management on yield attributes and yield of Bt cotton (*Gossypium hirsutum* L.)" Dr. W. N. Narkhede pointed out that on rainfed Vertisols, the bulk density and infiltration rates were higher in conventional tillage but organic Carbon improved under zero tillage. He recommended

conventional tillage + 100% Recommended dose of fertilizers (RDF) + Cotton residue at 3t/ha + 12 kg dry mycorrhiza/ha to enhance yields.



"Source-Sink Manipulation to Induce Reproductive Synchrony and Enhance Productivity in Cotton by Plant Growth Regulators" Dr. A. H. Prakash suggested that deliberate shedding of initial squares would manipulate source-sink relations favourably, to shorten the fruiting window,

induce compactness, increase yield, monetary returns and input use efficiency. To achieve this he suggested foliar spray of Ethrel @ 8.5μ moles at square initiation followed by a spray of Maleic Hydrazide @ 500ppm at 80 days stage.



"Influence of Micronutrients on Morpho-Physiological and Biophysical parameters for enhancing the Productivity in Bt Cotton through Foliar Application" Dr. K. N. Pawar highlighted the importance of secondary and micronutrients in cotton nutrition. He concluded that foliar application MgSO₄ (%) + ZnSO₄(0.5%)

at 70 and 90 days stage improved physiological parameters (Photosynthesis rate, transpiration rate and relative water content), biochemical constituents (chlorophyll and protein) and increased seed cotton yield.

"Influence of harvest splitting on the technological characteristics of cotton fiber and seed", Dr. Kouakou Julien suggested split harvesting of cotton when 50% of the bolls are open in order to preserve the quality of cotton fibres and cotton seed.



"Spectral characterization and mitigation of leaf reddening in Bt cotton genotypes through proximal sensor based nitrogen management", Dr. Milind Potdar highlighted proximal sensor based Nitrogen management to manage leaf reddening and improve yield. He suggested Nitrogen supplementation at 1.1 – 1.5 RI (Response ratio-

ratio of NDVI in a N-rich strip and the test plot) and 81 – 90 % SI (sufficiency index-ratio of SPAD) for best results.



"Energy Use Efficiency for Cotton Production in the Mechanized Rainfed Areas Eastern Sudan" Dr. Lotfie Yousif analysed the energy input-output and energy use patterns for cotton production in mechanized rainfed eastern Sudan. The total energy input for cotton production was 2234.62 MJ ha⁻¹. Total energy output was

7802.10 MJ ha⁻¹. Average net energy, energy productivity, and specific energy was 5567.48 MJ ha⁻¹, 0.3 kg MJ⁻¹ and

3.38 MJ kg⁻¹, respectively. Herbicide energy input was the highest among energy input items.



"Ecosystem level CO₂ exchanges from a rainfed cotton production system using eddy covariance technique" Dr. M. V. Venugopalan concluded that rainfed cotton in Central India was a net sink for atmospheric CO₂. Around 2.14 tonnes of Carbon ha⁻¹ was sequestered during 2021-22 season. The temporal and phenophasic C

fluxes were influenced by phenological stage and the prevailing weather. Throughout the season (180 days), the cumulative GPP was 803.4 gC m⁻², NEE was -213.8 gC m⁻² and Ecosystem Respiration (Reco) was 589.7 gC m⁻².

"Improving Resource Use Efficiency and Soil Health by Integrating Rice Crop in Cotton", Dr. Fiyaz Ahmad concluded that planting of cotton in rows 75 cm apart with 30 cm between plants in a row and intercropped with transplanted rice (in 3 lines spaced 15 cm apart with plant-to-plant distance of 10 cm) was more resource efficient and economical for farmers over other inter cropping configurations.

"Soil Fertility Management in Cotton Growing Areas of PR-PICA Countries: Assessment and Prospects" Dr Traore Amadow informed that the soils of cotton basins in PR-PICA countries were acidic and low in organic Carbon. He recommended a low acidifying Ca containing fertilizer formulation (14-18-18 + 6S + 1B + 2,5 CaO) along with localized application of 2t/ha of organic manure for improving cotton yields. Granulated rock phosphate and dolomite application also improved yields.



"Recycling textile waste to develop Cellulosic Superabsorbent Polymer (C-SAP) and analyzing its impact in cotton cultivation", Dr. S. S. Patil highlighted a product- Cellulosic sulphur absorbent polymer (C-SAP) obtained from recycled polyester cotton blends, that could absorb and retain soil moisture 20 times its own mass.

This product had enormous potential to improve soil moisture status and enhance dryland cotton yield.

"Remotely detecting cotton nitrogen (N) status in mid-south region of USA" Dr. Tyson Raper pointed out that both active and passive narrow wavelength sensors were capable of detecting N stress. However early detection of N stress would be the key for N management.

"Nitrogen and plant population effects on cotton yield and fiber quality" Dr. Fábio Rafael Echer (Brazil) indicated that best yields occurred under low plant population (6.6 plants m⁻²) combined with 120 kg ha⁻¹ of N or with high plant population (9.9 plants m⁻²) and low N rate. Increasing N rates results increased short fibers and decreased micronaire. The right combination of N rate and

plant population can increase earliness through increased setting of bolls in lower fruiting nodes.



"Effects of calcium sources and rates on cotton yield" Dr. Fábio Rafael Echer described the importance of making calcium available and in the appropriate rate to cotton in order to avoid yield penalty. Ca availability in soil solution and uptake by cotton plants depends on the type of sources and their solubility. Both calcium sulfate and calcium nitrate applied at the rate of 30 kg ha⁻¹ increased seed cotton yield.

"Cotton yield as affected by cover crops and potassium and nitrogen fertilization" Dr. Fábio Rafael Echer showed that cotton yield was affected by cover crops and potassium and nitrogen fertilization. Highest yields were achieved when K@140 kg ha⁻¹ K₂O was applied at pre-planting in ruzigrass or post-planting after termination of ruzigrass + *Azospirillum* + *Mucuna* at 80 kg ha⁻¹ of N

"High cover crops diversity and controlled-released urea increase soil nitrogen and cotton fiber yield under moderate nitrogen rate" Dr. Fábio Rafael Echer indicated that highest fiber yield was achieved in the mix of cover crops with 100 kg ha⁻¹ of N (1400kg ha⁻¹), and yield decreased in the highest N rate applied. Controlled-release urea (40% N + 8% S) can reduce the N applied rate by 30% under cropping systems of high cover crop diversity (MIX) as an effect of the increase in soil N availability.

SOCIAL SCIENCES-ECONOMICS AND EXTENSION

"Cotton Farming Typology as a Guide for actions In Cote d'Ivoire and Beyond" Dr Kone Siaka drew a typology of cotton farms in Cote d'Ivoire using a single criterion of cattle possession in relation with the tradition of hoarding. This typology could differentiate four types of farms according to their technical and financial performance in cotton production, the characteristics of farmers, that of their families as well and as their well-being through the possession of some durable goods.



"Sustainable Cotton Production in Argentina: Addressing The Innovations and Challenges" Dr. Marcelo Paytas highlighted various innovations (mechanisation agronomy) in sustainable rainfed cotton production. He stated that the challenges ahead include germplasm improvement, implementation of sustainability indicators and new institutional organizational actions.

"Issues and challenges in the Cotton Supply Chain and Way forward: An Indian Perspective", Dr. Subhashree Sahu discussed various technical, social and economic challenges experienced by the cotton supply chain and suggested remedies to overcome them.



"Cotton Small-holders' Innovation in Agribusiness Organization and Management to Increase Productivity, Case of Taiyiba in Sudan Gezira Scheme" Dr. Nageeb Bakheit narrated the difficulties of cotton growers following the withdrawal of government support in Taiyiba Block Sudan, the main centre of irrigated ELS

cotton. Later, innovative agribusiness solutions, including integrated farming systems, by small farmers groups led to increase in cotton yields and profitability.



"Integrated Extension Management Module for Bridging up the Yield and Knowledge Gaps among Indian Cotton Growers" Dr. Usha Rani discussed the yield gap through the analysis of data from frontline demonstrations. She concluded that knowledge gap was the main reason for yield gap

and presented an "integrated extension management module" for bridging the yield gap.

"Status and Implications of Seed Purity Seven Years After Bt Cotton Use In Burkina Faso" Dr Larbouga Bourgou analysed the purity of seeds in producers' fields. He concluded that two factors viz contamination of Bt genes in conventional varietal seeds due to failure of seed production schemes and lack of purity in the original Bt seeds were the mainly responsible for the present situation of low yields.



"Women's Wealth Status and Factors on Cotton Farms In West Africa" Dr. Aboudou Faridath analysed the condition of women in cotton farms vis-a-vis their husbands who owned the farm in Burkina Faso, Benin and Togo. She concluded that the economic situation of women was generally weak but it was better in Benin, particularly in terms of

animal assets. Further, men-women synergy in wealth accumulation was a visible sign of positive evolution.



"Climate Smart Initiatives for Doubling Seed-Cotton Yields of Smallholder Cotton Farmers in Zambia" Mr Martin Simasiku discussed the initiatives introduced by ICAC, ITC and EU focussing on - (i) Seed health, (ii) High density planting (iii) Integrated Pest Management and (iv) Soil health.

He concluded that over 60% of the demo plots obtained more than 1500kg/ha where as more than 70% of control farmers' obtained less than 500kg/ha. Number of effective sprays was reduced by half in the demo plots as compared to control.

"Are farmers in Cote d'Ivoire technically conservative

in growing cotton?" Dr. Tehia K. E. used an experiential action on transplanting to improve plant stand to verify whether farmers were technically conservative in adopting new techniques. He concluded that farmers were not technically conservative but were suffering from a lack of information due to inadequate technical assistance.



"Using Technology and Training to help farmers grow clean cotton while reducing cost of inputs". Dr

Saqib Sohail elaborated the role of 'Artistic Milliner Cotton Initiative' in imparting traceability in the cotton supply chain. He concluded that by ensuring clean cotton practices in the field and arranging continuous trainings, it was possible to retain best agricultural practices.

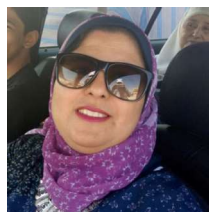
POST HARVEST PROCESSING AND BY-PRODUCT UTILIZATION



"Status of Current Cotton Fibre Quality Parameters in South Africa"

Dr Mathilda Westhuizen presented the fibre quality parameters of 4 commercial cultivars- DP1240 B2RF, DP1541 B2RF, Candia BGRF and PM 3225B2RF across 6 locations. She concluded that environment strongly influenced both yield and quality, DP1240 B2RF possessed the highest fibre strength and the quality of all the varieties was within the acceptable limits.

"Fire Retardancy of Cellulosic Materials by using Waste Plant Bio-macromolecules" Dr. Santhanu Basak introduced the idea of using bio-products (Banana pseudo stem and pomegranate rind extract) for imparting fire retardancy in cellulosic textiles. He also discussed the mechanism behind the thermal stability of the treated materials.



"Fiber and yarn quality parameters of Some Giza Egyptian Cotton Varieties"

Dr Suzan Sanad described the fibre and yarn quality of new Egyptian cotton varieties-Giza 94, Giza 95 and Giza 96. She highlighted that Giza 96 could be spun at 100-120s counts.



"Plastic Imaging, Detection, and Ejection System (PIDES) for Cotton Gins: Results from Commercial Testing and System Updates" Dr.

Greg Holt elaborated the PIDES system which when installed before the ginning process could remove plastic contamination to the extent of 80-97% depending on the size and colour of the contaminant.

"Valuable and Exploitable Bioactivities Of Gossypol: A Multifunctional Compound From Cotton" Dr. Manoj

Kumar described the various bioactivities of gossypol that can be exploited in the field of pharmaceuticals, medicine (anti-cancerous, anti-oxidant, anti-fertility, anti-parasitic anti-microbial and anti-viral) and health sector.

"Dyeing performance of super-Giza 97 Egyptian cotton yarns", Dr. Shereen Bahlool stressed that using natural dyes extracted from onion skin was economical and has positive environmental impact since an agricultural waste was being used for dyeing.



"Development of Reference Materials for Checking the Micro-Ginning Machines for their Fiber Quality Preservation Performance"

Dr. Bruno Bacheller emphasized the need to develop standard seed cotton reference material with known fibre traits for performing periodical checks of micro-gins. Further, the reference material that the authors developed was found to be suitable for micro-gins employed to measure fibre quality.

"Evaluation of Reactive Groups of Reactive Dyes on Dyeing of Egyptian cotton Fabrics", Dr. Haana Saad tested reactive groups of reactive dyes and found that Procion Mx dye had the reactive group structure Di-chlorotriazine that offers higher reactivity at optimum conditions of 30°C at 60 mins. The highest dye fixation (%) was about 85% for all reactive dyes used. The fastness properties of cotton fabric for all reactive dyes used were good to excellent at the optimum dyeing process.

"Effect of blending between upland and combing waste on cotton fiber and yarn quality" Dr. Eman EL-Sayed concluded that the physical and mechanical properties of yarns produced from Giza95 were better than 100% upland cotton, 100% combed cotton waste and the other blended yarns.



"Rotobar (Rotary Knife Roller Gin), A Boon to Long & Extra-long Staple Cotton", Dr. Pravin Bhakte found that Rotobar Ginning (Rotary Knife Roller Gin) was the best ginning technology for long and extra-long cotton. USA, China and Egypt have understood the benefits of this technology and new ultra-modern ginning plants based on

Rotobar Ginning technology have been established.



"Isolation of gossypol degrading bacteria from *Spodoptera litura* and optimization of culture conditions for solid state fermentation of cottonseed meal", Dr. S. M. D. Akbar reported that bacteria from isolated from the gut of *Spodoptera litura*, identified as *Lysinibacillus fusiformis* (L13) and *Bacillus xiamenensis* (L19) by 16S rRNA sequencing and phylogenetic analysis, were able to utilize

gossypol as sole carbon source and thus can be used for biodegradation gossypol in cotton seed.



"Developing HVI calibration standards for elongation measurements"

Dr Eric Hequet stressed on the importance of developing genetic stocks with improved tensile properties. He presented a protocol to produce HVI elongation calibration standards that showed stable elongation measurements for all HVIs tested.

"Odour control in cotton fabrics treated with silver nanoparticle in aqueous extract from banana peel", Dr. Salah Saleh presented an innovation-biosynthesis of nano particles in combination with natural plant extracts from banana peel. This composite had microbial resistance and could be treated on cotton textiles for odour control.

"Cotton, more than what you wear: cottonseed oil and human health", Dr. Susan Jaconis reiterated the culinary benefits of cotton seed oil. She also summarized the research being undertaken by Cotton Incorporated in collaboration with health experts to build robust evidence on the health benefits of cotton seed oil.

