MINUTES

FIFTH OPEN SESSION
Climate-smart Innovations as Game Changers for Cotton Production
MONDAY, 4 DECEMBER, 16:00 TO 18:00

Chair: Dr Keshav Kranthi, Chief Scientist, ICAC

The meeting began at 16:00.

Recent UN Climate Change Conferences have reaffirmed the commitment to emission reduction targets for 2030, aligning with the goal of achieving net-zero emissions by 2050 to limit global warming to 1.5 degrees or less. Cotton farming, like other crops, contributes to greenhouse gas emissions. However, recent studies reveal that climate-smart technologies can reduce emissions, enhance carbon sequestration, and improve sustainable crop productivity. These innovations not only bolster environmental sustainability, biodiversity conservation, and soil health, but also boost cotton productivity and profitability. For instance, a 2019 report (Cotton Leads) highlights that 'no-till cotton acreage actually stores 150 kg more atmospheric carbon than it emits during cotton production', making cotton's carbon impact net-negative.

The Technical Seminar featured seven renowned experts who shared the latest developments in climate-smart innovations poised to transform cotton production.

Ms Alexandra Perschau discussed climate-smart agronomy, emphasising the Aid by Trade Foundation's (AbTF) role in promoting sustainable raw materials. Climate-smart agriculture (CSA) aims to enhance agricultural productivity, build climate resilience, and reduce greenhouse gas emissions. Recently, there's been a focus on carbon sequestration and broader impacts beyond carbon measurement. ESG reporting rules, like the EU Corporate Sustainability Reporting Directive, require companies to disclose sustainability-related impacts, including climate and biodiversity. Voluntary initiatives such as Science-Based Targets for Nature (SBTN) are gaining prominence. Cotton traders are increasingly interested in land conditions and improvement efforts. Ms Perschau enlisted new scientific findings that highlight the instability of soil organic carbon (SOC) and the potential of mycorrhizal fungi for carbon removal. AbTF's approach to climate-smart agriculture involves remote sensing, in-field soil analysis, assessments of soil health, and climate projects. It focusses on evaluating soil based on colour, smell, texture, structure, and soil life, incorporating advanced technology like infrared soil scanners, and emphasising soil health and biodiversity in sustainable agriculture practices.

Dr YG Prasad discussed climate-smart cotton production technologies and their impact on yield. The Intergovernmental Panel on Climate Change (IPCC) reported mixed effects of climate change on cotton crops, including negative impacts on phenology, water status, and increased bollworm incidence. Temperature increases have some positive effects due to cotton's heat tolerance. Meta-analysis indicated that factors like temperature, precipitation, CO_2 levels, and adaptation measures significantly affect cotton yields. In India, estimating climate change effects on crop production is complex due to diverse cropping systems and technology adoption levels. Rainfed cotton cultivation, heavily reliant on monsoon rains, faces challenges due to onset delays, dry spells, and rainfall deficits. Dry Spell Index (DSI) analysis revealed significant cotton yield losses (50%-74%) in 44% of cotton-growing regions due to dry spells. A classification of cotton-growing districts showed that 67% of the area was rainfed and vulnerable to monsoon variability. Notably, irrigated north zone states like Punjab and Haryana experienced reduced cotton area, production, and productivity due to factors like pink bollworm resistance, whitefly, boll rot, and cotton leaf curl virus, except for Rajasthan, which showed a positive trend despite some recent issues.

Dr Marc Giband discussed the challenges faced by cotton growers in rainfed production areas due to factors like water availability, temperature fluctuations, and increased CO_2 concentrations. Water deficits during various growth stages can lead to severe yield losses and fibre quality issues. Breeding for drought tolerance has been a longstanding goal, but it's complex due to its quantitative nature, low heritability, and difficulty in characterisation. Dr Giband highlighted the use of various morphological and physiological traits associated with tolerance, such as stomatal conductance, transpiration, and photosynthesis, to address this challenge. He emphasised the existence of a high level of genetic variability for these traits in cultivated cotton and related species. Dr Giband presented the results of a study involving 269 genotypes, focusing on root system architecture (RSA) and aerial parts. The study revealed variations in plant growth parameters and physiological traits under different water regimes. The integration of data from root system analysis and plant growth parameters did not show correlations between root traits and above-ground characteristics. Dr Giband highlighted the importance of identifying genotypes with advantageous traits for stable biomass accumulation under water deficit conditions and a well-developed root system. He emphasised the need to transition from climate-smart plant breeding to breeding cotton for resilient cropping systems, considering factors like cycle duration, competition with other crops, adapted architecture, improved harvest index, and water use efficiency.

Dr Michael Bange discussed various aspects of cotton production in Australia and the projected impact of climate change on global crop productivity. He highlighted factors like soil nutrients, pests and diseases, heat stress, aridity, and ozone as key considerations in this context. Dr Bange also referenced the IPCC's specific findings on cotton and climate change, emphasising the negative impacts of temperature increases on yields and the proliferation of bollworm with warmer temperatures. He pointed out the risks to global cotton production, including temperature variations, water-related challenges like rainfall, flooding, and drought, as well as natural disasters like wind, wildfires, and landslides. Dr Bange explored the effects of climate change on cotton ecosystems, including elevated CO_2 levels, increased temperatures, changing water dynamics, and integrated effects of CO_2, temperature, and water. The potential impacts of climate change on cotton growth were discussed, including both positive and negative effects of elevated CO_2 and temperature. Dr Bange stressed the importance of water access and quantifying stress in different management systems. He also mentioned the significance of resilient cropping systems, the importance of integrated effects, regional assessments, and broader science policy engagement in addressing climate change's impact on cotton production and soil health.

Mr Mahesh Ramakrishnan highlighted the importance of climate-resilient innovations in rainfed cotton farming in sub-Saharan Africa, where agriculture is a vital livelihood source. He emphasised the significance of healthy, biodiverse soils in mitigating water scarcity risks, especially in arid regions. Soil organic carbon, comprising 58% of soil's organic matter, plays a crucial role in maximising soil health and crop production. Adequate soil organic carbon improves fertility, reduces erosion, enhances drought resistance, and lowers greenhouse gas emissions. Mr Ramakrishnan discussed several climate-smart practices for rainfed cotton farming, including improving water retention in soils, reducing soil compaction through organic matter addition, enhancing water infiltration by forming soil aggregates, increasing nutrient availability, and improving crop yield stability. He emphasised regenerative agriculture principles and practices, including biochar incorporation from cotton stalks, enriched compost like 'Bokashi', cover cropping, and conservation tillage. These practices promote soil health, carbon sequestration, and climate change mitigation while addressing challenges faced by smallholder farmers in sub-Saharan Africa.

Mr Ganesh Babu Krishnappa discussed the significance of digitising carbon farming to empower smallholder farmers and promote climate change mitigation in agriculture. Carbon farming involves adopting practices like no-till, conservation tillage, organic fertiliser application, optimized fertiliser usage, intercropping, crop rotations, and improved water management. Remote sensing technologies play a crucial role in this approach, enabling effective monitoring and management of agricultural landscapes, meeting global carbon standards' uncertainty requirements. Small-scale farmers can benefit from valuable insights into plant health, soil conditions, and carbon sequestration potential, financed through carbon finance. These practices can enhance carbon sequestration rates, ranging from 0.5 to 2 tonnes per acre per year, depending on crop and techniques. Capacity building and knowledge transfer programs are essential for widespread adoption, facilitating the dissemination of best practices and offering financial incentives. Overall, the integration of innovative measurement techniques, local partnerships, and policy support enhances the success of nature-based solutions like carbon farming, leading to reduced input costs, increased crop productivity, improved livelihoods, and food security.

Mr Rajeev Baruah discussed the potential of regenerative agriculture, zero budget natural farming (ZBNF), and organic cotton farming as climate change mitigation strategies. He emphasised the urgency of adopting sustainable agricultural practices in the face of climate change's devastating effects and the imminent breach of the 1.5-degree threshold. Mr Baruah highlighted four key practices that can reduce greenhouse gas (GHG) emissions and sequester carbon: reducing chemical fertiliser usage, implementing cover crops, practicing conservation agriculture, and converting cotton stalks into biochar. Notably, reducing chemical fertiliser usage emerged as a pivotal step in GHG mitigation, particularly in reducing nitrous oxide (N_2O) emissions. Addressing barriers to the adoption of these practices, including developing measurement and reporting systems for soil organic carbon and incentivising farmers to embrace sustainability, was deemed crucial. Organic farming and ZBNF, with their reduced reliance on chemical fertilisers, were recognised for their potential contributions to climate change mitigation. In conclusion, he asserted that organic, ZBNF, and regenerative agriculture can play pivotal roles in the global fight against climate change.

Dr Kranthi presented four topics for the 2024 Technical Seminar of the ICAC Plenary Meeting:

Blueprint for Carbon-Neutral Cotton Cultivation: Carbon-neutral farming aims to balance carbon emissions from agricultural practices with carbon dioxide absorption or mitigation on farms. This approach involves sustainable farming techniques, resource optimisation, and carbon offset measures. Experts presented strategies for cotton cultivation that reduce emissions and aim for carbon neutrality, contributing to climate change mitigation.

Cotton Farming in the Digital Era: Cotton farming is shifting towards data-driven precision agriculture through artificial intelligence and digital tools. These technologies optimise planting, irrigation, pest management, and disease prediction, enhancing sustainability, resource efficiency, and crop yields. Embracing digital innovations promises a more efficient and sustainable future for cotton farming.

Unveiling the Potential: Gene Editing in Cotton Farming: Gene editing, like CRISPR-Cas9, enables precise modification of cotton plant genetics. It offers benefits such as pest resistance, fibre quality improvement, and reduced pesticide use. While promising increased profitability, ethical and regulatory considerations are crucial for responsible implementation.

Advancing Sustainability with Nano Fertilisers and Nano Pesticides: Nanotechnologies, including nano-fertilisers and nano-pesticides, enhance nutrient delivery and pest control while improving crop yields and reducing environmental impact. Nano-fertilisers enhance nutrient absorption, while nano-pesticides offer controlled release, reducing environmental harm. These technologies improve soil health, reduce water consumption, and enhance resistance to environmental stressors, promoting sustainability in cotton farming and the supply chain.

The topic 'Unveiling the Potential: Gene Editing in Cotton Farming' received the highest number of votes.

The session ended at 18:00.