Technology Innovations and Strategies to Boost Cotton Productivity

Dr. Y.G. Prasad, Director, ICAR-Central Institute for Cotton Research (CICR), Nagpur

Cotton is the major cash crop of India and contributes 60% of the fibre used in the domestic textile industry. Cotton supports the livelihood of nearly 6 million farmers and another 40-50 million people engaged in cotton processing and trade. India leads globally in cotton area (~13 million hectares, 40% share) and is the second largest consumer of cotton in the world (5.29 million metric tonnes, 22.2% share). A small quantity (0.51 million MT) is exported but ELS cotton is imported which accounts for 10% of its consumption.

Earlier, Government of India supported the Technology Mission on Cotton (TMC) during the first decade (2000-01 to Dec., 2010) which comprised of four mini-missions on (1) research, (2) technology transfer (3) modernisation of marketing (4) upgrading of ginning and processing establishments. Driving on the game changing Bt cotton technology introduced in 2002, the country witnessed significant jump in cotton area, productivity and production. About 246 market yards were modernized and 859 G&P factories were upgraded.

Now the biggest challenge is stagnation/decline in average cotton productivity (<450 kg lint/ha) mainly due to increasing frequency of extreme weather events impacting adversely cotton production in the 67% rainfed area; pest and disease outbreaks (pink bollworm, whitefly, cotton leaf curl virus and boll rot) in irrigated tracts (33% area). New initiatives, strategies and innovative technologies are needed for a vibrant cotton supply and value chain in the country.

Need For New Initiatives and Partnerships

Public-private partnerships (PPP) in the areas of (1) collaborative research to generate new seed technologies, scaling-up tailored agronomy and ushering contamination-free quality cotton through modernised processing is the need of the hour. Launch of a cotton technology mission in PPP mode is warranted. Globally there is no released GM product that is still effective against pink bollworm. Collaborative research for development of novel transgenic technology effective against pink bollworm with a proven history of biosafety is contemplated. Also, in the near future, genome editing approach to develop 'gene drive' technology for male sterility has the potential to reduce resistant pink bollworm populations substantially and prevent loss in yield and fibre quality.

Developing Varieties with Higher Ginning Percentage (GP)

Indian cotton is characterised by low ginning % (per cent of fibre weight in seed-cotton) which is currently about 33%. compared to varieties in other cotton growing countries that have higher productivity due to higher GP (38 to 44%). For example, processing of 1000-kg seed-cotton yields 330 kg fibre compared to ~380 to 440 kg fibre in other countries. Thus, the fibre yield is low. Development and popularisation of cultivars with high GP will boost cotton productivity in India and pave way for lint-based markets benefiting farmers. Every 3% increase in GP will boost seed cotton yield by 9%. Every 1% increase in GP will boost lint yield by 25 kg/ha.

Tapping the Potential of Artificial Intelligence

AI is fast emerging as a disruptive technology. ICAR-CICR tapped the potential of AI by developing and deploying a solution for monitoring of pink bollworm moth arrivals into cotton fields. The AI pheromone

trap is useful for real time monitoring of pink bollworm. This technology was field deployed for the first-time in Punjab at 18 locations in 3 districts in the ongoing season. The solar powered AI trap takes the image of the adult moths attracted to the sex pheromone lure and get trapped on the sticky liner of the trap. The image is transmitted at set intervals to a cloud server where a machine learning (ML) algorithm identifies and counts the trapped adult moths. Farmers, extension workers and advisors can access and visualize the real time data on their mobile. Pest alert and advisory is issued by various modes whenever trap catches cross the economic threshold level (ETL). The technology is scalable and useful for monitoring the dreaded pink bollworm by deploying AI pheromone traps in a grid pattern in all cotton growing areas. Access to monitoring data will enable informed spray decisions by farmers for timely management, reduce pesticide use and costs, increase yield and profitability.

Novel Attractants for Monitoring and Trapping Insect Pests

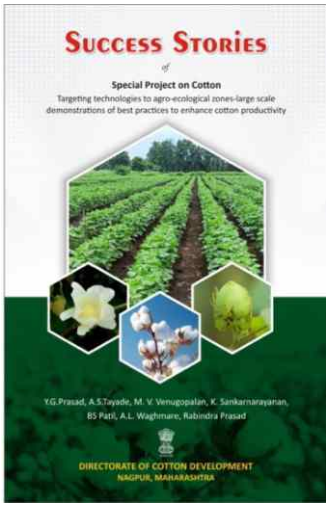
Microbial volatile organic compound formulations have been developed as insect attractants and patented by ICAR-CICR. These attractant formulations are to be used in combination with yellow sticky traps for monitoring and mass trapping of a variety of sucking insect pests of cotton such as whitefly, jassids, thrips and aphids. Molecules have been identified for attracting beneficial insects into cotton fields to bring down harmful insect populations in an eco-friendly manner.

Remote Sensing Applications in Cotton Farming

Remote sensing can provide accurate and reliable information to guide crop health management in many crops including cotton. The main applications of remote sensing include crop area estimation, crop growth monitoring and yield estimation, monitoring soil, moisture and nutrient status, precision nutrient and weed management using variable rate technology, crop damage/disaster monitoring, etc. Use of satellite imagery to detect weeds using custom algorithms has been demonstrated to be cost effective, reduce herbicide use by 70-80% and GHG emissions by 60 kg CO_2e/ha in large farm holdings in Australia.

Promote 5 'G' Concept in Cotton Production

It is estimated that adoption of new agronomy in nearly 4 million ha (~25% area) can boost average cotton productivity in rainfed areas. The approach is targeting technologies to agro-ecology. Match Genotypes (short duration, compact and sucking pest tolerant) to Geography (soil type of farms and water availability) with suitable Geometry (row to row and plant to plant spacing as per soil type), use Growth regulators to boost harvest index (retain more bolls by regulating vegetative growth) for significant Gain in yield/ha and net returns on investment. Several compact hybrids with market preferred traits for yield and fibre have been identified based on suitability for high density planting system (HDPS). Large scale demonstrations under the special project on cotton on HDPS in light soils and closer planting in medium soils in 8 states significant yield gain during 2023-24 season. Analysis indicated yield increase above 20% in 72% of farmers' fields in Akola district, while the yield range shifted to a higher level of more than 9 q seed cotton/ha in 78% farmers' fields under HDPS compared to only 8% by farmers adopting conventional practice.



Switch From Pilots to Saturation Mode

Scale-up high density planting system (HDPS) and closer spacing (CS) technologies in saturation mode at district level for visible impact. The technology is to be expanded to cover the potential area in identified districts which is suitable for HDPS or CS technology. Partnerships among stakeholders can make this a reality. This will eventually pave way for mechanical harvesting of cotton in view of increasing labour cost for picking and also resolve contamination issue. However, introduction of effective chemical defoliants will make it possible to reduce trash content in seed cotton and in lint by equipping ginneries with pre- and post-cleaners.

Way Forward

As area under cotton is giving way to other competing crops in several states and competition from manmade fibre is on the rise, increasing cotton productivity is the top priority for meeting the domestic demand and export opportunities. While novel seed technologies can reduce losses due to pests and disease outbreaks, adoption of climate resilient technologies can ensure stability in production. Scaling up of HDPS promoting the '5G concept' will certainly boost productivity in the short run and eventually pave way for mechanization of cotton production and harvesting in the medium term. In this context, partnership among stakeholders is even more critical in addressing the mounting challenges faced by the cotton sector.