

Samrat Bt: Empowering Rainfed Cotton Farmers of South India with Higher Yields and Lower Costs

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ABSTRACT

Cotton is one of India's most important commercial crops and plays a major role in supporting the textile industry and rural livelihoods. Although Bt cotton hybrids occupy more than 90% of the cotton-growing area, productivity under rainfed conditions remains relatively low because of moisture stress, pest pressure, and high cultivation costs. Samrat Bt (CICR-H Bt Cotton 63), developed by ICAR-Central Institute for Cotton Research (ICAR-CICR), Nagpur, is a newly released Bt cotton variety specifically designed for rainfed cotton-growing regions of South India. The variety combines early maturity, compact plant architecture, bollworm resistance, tolerance to jassids, suitability for High Density Planting System (HDPS), and good fibre quality. Samrat Bt provides stable yield performance under rainfed conditions while reducing dependence on insecticides and costly inputs. Its early maturity enables the crop to escape pink bollworm damage and terminal drought stress. The variety recorded superior yield and desirable fibre characteristics in multi-location trials across Karnataka,

Telangana, Andhra Pradesh, and Tamil Nadu. Samrat Bt represents an important advancement toward climate-resilient, sustainable, and farmer-friendly cotton cultivation in South India.

INTRODUCTION

Cotton, often referred to as "white gold," is one of the most important commercial crops cultivated in India. The crop contributes significantly to the national economy through textile production, export earnings, employment generation, and livelihood support for millions of farming families. India is currently the world's largest producer of cotton and one of the leading exporters of cotton fibre (ICAC, 2025). The introduction of Bt cotton technology revolutionized cotton cultivation by providing effective protection against bollworms. Today, over 90% of India's cotton area is cultivated with Bt cotton hybrids (Kranthi and Stone, 2020). However, despite widespread adoption, national productivity has remained below the global average, particularly under rainfed conditions where more than 60% of cotton cultivation depends on rainfall (Chakraborty *et al.* 2022). Most commercially cultivated Bt hybrids are long-duration crops requiring higher inputs and prolonged moisture availability. Under rainfed situations, these hybrids frequently suffer moisture stress during boll development, leading to reduced productivity (Rajput *et al.* 2023). Therefore, there has been a growing need for compact, early-maturing Bt cotton varieties that are better adapted to rainfed production systems (Times of India, 2017). To address this challenge, researchers at ICAR-Central Institute for Cotton Research (ICAR-CICR), Nagpur developed Samrat Bt (CICR-H Bt Cotton 63), a climate-resilient Bt cotton variety suitable for South Indian rainfed conditions.

Need for Bt Cotton Varieties in India Bt cotton hybrids have played a major role in

managing bollworms in India, but they face several limitations under rainfed and low-input farming systems. Farmers must purchase fresh seed every year, while hybrids generally require higher fertilizer and irrigation inputs. Their longer crop duration increases exposure to drought stress, pest damage, and pink bollworm infestation, often resulting in unstable performance under rainfed conditions. In contrast, Bt cotton varieties offer several advantages, including stable inheritance of the Bt gene, lower seed costs, reduced input requirements, and the option for farmers to save seed for future cultivation. Their better adaptation to stress conditions, suitability for High Density Planting System (HDPS), and greater climate resilience make them a sustainable and cost-effective alternative for improving cotton productivity in rainfed regions of India.

Development of Samrat Bt

Samrat Bt (CICR-H Bt Cotton 63) was developed at ICAR-Central Institute for Cotton Research (ICAR-CICR), Nagpur (Santosh *et al.* 2024) through pedigree breeding. The variety originated from a four-way cross (Bikaneri Narma Bt × RCRSC7) × (RCRSC2 × RCRSC12). The presence of the Bt gene was monitored across generations using Cry1Ac-ELISA, while homozygosity of the cry1Ac gene was confirmed through zygosity PCR analysis. Selection was carried out for several desirable traits including early maturity, compact plant architecture, bollworm resistance, jassid tolerance, fibre quality, yield performance and HDPS suitability. Based on its outstanding performance in All India Coordinated Research Project (AICRP) on

Cotton trials during 2019–2022, Samrat Bt was identified and approved for commercial cultivation. The variety was officially released in 2022 for rainfed conditions of the South Zone comprising Karnataka, Telangana, Andhra Pradesh, and Tamil Nadu (Government of India, 2022).

Field view of Samrat Bt



Field View



Plant View



Flower



Green Boll



Open Boll

Important Features of Samrat Bt

1. Early Maturity

One of the most important characteristics of Samrat Bt is its early maturity, with the crop completing its life cycle within 140–150 days. Early maturity provides several advantages under rainfed conditions, where soil moisture often becomes limiting during the later stages of crop growth. By maturing earlier, the variety can escape terminal drought stress and reduce exposure to late-season pink bollworm infestation. It also enables more efficient utilization of available soil moisture, facilitates timely harvesting, and creates an opportunity for farmers to cultivate a succeeding crop.

These attributes make Samrat Bt particularly suitable for improving the stability and profitability of cotton production in moisture-stressed environments.

2. Compact Plant Architecture

Samrat Bt possesses a compact growth habit characterized by less than one monopodial branch per plant on average. This compact architecture promotes better utilization of sunlight and allows a higher plant population under High Density Planting Systems (HDPS). The variety produces approximately 70 bolls per square metre, reflecting its high boll-bearing capacity and suitability for intensive cultivation. Its uniform growth habit simplifies crop management and enhances productivity per unit area. Furthermore, the compact plant type is well suited for mechanized harvesting, making Samrat Bt compatible with modern cotton production practices aimed at improving efficiency and reducing labour requirements.

3. Superior Yield Performance

Samrat Bt has demonstrated excellent yield performance across the cotton-growing regions of South India. In multi-location trials, the variety recorded an average seed cotton yield of 13.73 q/ha and achieved a maximum yield of 24.14 q/ha at Mudhole. It exhibited a remarkable yield superiority of 80.56% over the Bt zonal check and 3.94% over the non-Bt local check, highlighting its strong adaptability and productivity under diverse rainfed environments. These consistent yield advantages, coupled with its early maturity and pest tolerance, indicate that Samrat Bt has significant potential to enhance cotton productivity and profitability for farmers in the South Zone.

4. Bollworm Resistance

Samrat Bt contains the cry1Ac Bt gene, which provides effective protection against

bollworms, particularly the American bollworm (*Helicoverpa armigera*). The bollworm resistance present in Samrat Bt helps reduce the need for insecticide applications, thereby lowering production costs and minimizing environmental pollution. It provides effective protection against bollworm damage, resulting in improved crop health, reduced yield losses, and greater yield stability under field conditions. Reduced dependence on insecticides also improves farmer safety and environmental sustainability.

5. Tolerance to Jassids

Samrat Bt exhibits tolerance to jassids, one of the most important sucking pests of cotton. Jassids damage leaves by sucking plant sap, reducing photosynthesis and weakening plant growth. Tolerance to jassids contributes to improved crop performance and yield stability under field conditions.

6. Fibre Quality

Good fibre quality is essential for the textile industry. Samrat Bt possesses desirable medium-staple fibre quality suitable for textile manufacturing. The variety has an average fibre length of 25.17 mm and a fibre strength of 25.1 g/tex, indicating good spinning quality and durability. It produces bolls with an average weight of 3.7 g, with a potential boll weight of up to 4.7 g under favourable conditions. The variety also records a mean seed index of 9.07 g. In addition, Samrat Bt exhibits a good ginning outturn (GOT) of 36.77%, with a maximum recorded GOT of 42.0%, reflecting its ability to provide higher lint recovery and better economic returns to farmers.

Importance of Samrat Bt for Rainfed Agriculture

Rainfed agriculture forms the backbone of cotton cultivation in South India. However, farmers often face challenges such as erratic

rainfall, drought stress, pest incidence, and low productivity. Samrat Bt offers several advantages to farmers under rainfed conditions. Its bollworm resistance and the ability to save seed can reduce cultivation costs by lowering expenditure on insecticides and seed purchases. The variety exhibits greater climate resilience due to its early maturity and compact plant architecture, which help it adapt better to moisture-stressed environments. Its suitability for High Density Planting System (HDPS) and higher boll density contribute to improved productivity and yield potential. Resistance to bollworms coupled with tolerance to jassids helps minimize pest-related crop losses, while its early maturity enables timely harvesting and provides an opportunity for sowing a succeeding crop, thereby supporting multiple cropping systems.

High Density Planting System (HDPS) and Samrat Bt

High Density Planting System (HDPS) is an emerging cotton production strategy that involves growing a higher number of plants per unit area using compact and early maturing varieties. Samrat Bt is particularly well suited for HDPS due to its compact plant architecture, fewer monopodial branches, higher boll density, uniform growth habit, and suitability for mechanized harvesting. These characteristics allow efficient utilization of available space and resources while maintaining good crop performance. Adoption of HDPS with Samrat Bt can result in higher productivity per hectare through better utilization of sunlight, water, and nutrients. Additionally, the system helps suppress weed growth through quicker canopy coverage, facilitates mechanized operations, and improves overall resource-use efficiency, making cotton cultivation more productive and sustainable under rainfed conditions.

CONCLUSION

Samrat Bt (CICR-H Bt Cotton 63) is a climate-resilient Bt cotton variety developed specifically for rainfed farming conditions of South India. The variety combines early maturity, bollworm resistance, tolerance to jassids, compact plant architecture, HDPS suitability, mechanization friendliness, and good fibre quality. Its ability to escape terminal drought stress and pink bollworm damage makes it particularly suitable for rainfed production systems. By reducing pesticide use, lowering cultivation costs, and providing stable yields, Samrat Bt offers an important pathway toward sustainable, profitable, and climate-smart cotton farming in South India.

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