Evaluating the Performance of High Density Planting System of Cotton in alfisols of Vikarabad district in Telangana

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Abstract:

A comparative study was conducted during the *Kharif* seasons of 2023 and 2024 in the Vikarabad district of Telangana to evaluate the performance of High-Density Planting System (HDPS) against traditional farmer's practices in cotton cultivation under ICAR-CICR special project on cotton. The primary objective was to assess plant growth, yield parameters, and economic returns under both methods. The results indicated that the HDPS treatment (T1) recorded a lower average plant height (101.35 cm) and a reduced average number of bolls per plant (23.5) when compared to the farmer's practice, which achieved an average plant height of 126.3 cm and an average of 36.5 bolls per plant. Despite of this, the HDPS system significantly outperformed the farmer's practice in terms of average seed cotton yield, achieving 24.51 q/ha, which is 36% higher than the yield under the farmer's practice (18.025 q/ha). Economic analysis revealed that the HDPS system generated substantially higher net profits of ₹77,999 with a benefit-cost (B:C) ratio of 1.79, compared to ₹43,489.50 and a B:C ratio of 1.49 under the farmer's practice. These findings highlight that while HDPS resulted in shorter plants with fewer bolls, the system of higher plant density and efficient resource utilization contributed to superior overall yields and economic returns. This system of HDPS cotton ensures a viable and profitable alternative to traditional cotton farming practices, offering a pathway to enhanced productivity and sustainability for cotton growers in the region.

Keywords: High density planting system (HDPS), cottonyield, plant geometry

Introduction:

Cotton is a globally significant commercial commodity and a cornerstone of India's agro-industrial economy. Revered as "The King of Fibers" or "White Gold," cotton remains the primary raw material for the highest-quality textiles. It is cultivated in over 100 countries across diverse agroclimatic conditions (Anon, 2012). In India, cotton directly supports the livelihoods of approximately 60 million people through agriculture, processing, and the textile industry, contributing 29% to the nation's GDP. Globally, in 2021–22, cotton was grown on 32.94 million hectares, producing 120.2 million bales with a productivity of 778 kg per hectare. In India, cotton production during the same period reached 362.18 lakh bales from an area of

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120.69 lakh hectares, with an average yield of 510 kg per hectare (Cotton Corporation of India, 2022).

Within India, Maharashtra leads in cotton acreage (42.86 lakh hectares), while Gujarat is the top producer (90 lakh bales). Telangana ranks as the third-largest cotton producer and second in acreage, with an estimated production of 51 lakh bales from 24.72 lakh hectares during 2020–21 (Telangana Agriculture Department, 2022). Among Telangana's districts, Nalgonda had the largest area under cotton cultivation (5,66,929 acres), followed by Adilabad, Sangareddy, Asifabad, and Vikarabad, which accounted for 2,61,966 acres.

The adoption of a high-density planting system (HDPS) offers a transformative approach to enhancing cotton productivity, especially in challenging soil types like alfisols. HDPS involves planting early-maturing, semi-compact cotton varieties at closer spacing to maximize the number of bolls per unit area, even as the number of bolls per plant is limited (Khan et al., 2019). By replacing traditional cultivation methods, HDPS ensures efficient resource utilization and higher yields. For instance, cotton is sown before July 10 during the kharif season with a spacing of 90 × 15 cm, accommodating 29,629 plants per acre.

This study aimed to evaluate the impact of HDPS on cotton productivity in the Vikarabad district of Telangana, which is characterized by alfisols, a soil type known for its low fertility and water-holding capacity. By focusing on improved cultivation practices, this research seeks to highlight the potential of HDPS as a sustainable solution to enhance cotton yields and support farmers in the region.

Material and methods:

This study under taken in the vikarabad district of Telangana state during kharif 2023 and 2024 on enhanced cultivation techniques using a high density planting system of cotton by implementation of ICAR-CICR's special project on cotton entitled "Targeting technologies to agro-ecological zones – large scale demonstrations of best practices to enhance the cotton productivity " under NFSM. Large scale demonstrations were done in the farmer fields in the different location of the vikarabad district.

Idea of high density planting method in cotton is a brand new technique for growing cotton. Instated of using regular farmers practice, this method involves sowing of cotton with spacing of 90 X 15 cm with 29,629 plants per acre and 4938 plants per acre in farmer practice with spacing of 90 X 60 cm. Seed rate of 2.5 kgs per acre is used in high density planting system 1 kg per acre of seed is used in farmers practice. Cultivation package of practices are common in the both the systems with recommended dose of fertilizers 120 kg nitrogen (N), 60

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kg phosphorus (P), and 60 kg potassium (K) per hectare. Mepiquat chloride, a growth regulator, was applied twice during the crop cycle: first during the flowering stage (45 days after sowing) at a dosage of 1.2 ml per liter of water, and then during the boll formation stage (60 days after sowing) at a dosage of 1.5 ml per liter of water. This application regulated plant growth and size, promoting uniform boll bursting and simplifying the cotton-picking process. The effectiveness of pink bollworm control and peasant surveillance also diminished in subsequent *kharif* crops. Harvesting cotton before the last week of November allows for alternate rabi crop cultivation, such as sesamum and groundnut (Prasad et al., 2023). The actual plant height, number of bolls per plant, yield per hectare was recorded, and the cost of cultivation, gross returns, and net returns were calculated based on prevailing market rates. The benefit-cost ratio (B:C) was determined by dividing the average gross return by the average gross cost.

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RESULTS AND DISCUSSIONS:

The experimental trial conducted during the Kharif seasons of 2023 and 2024 provided a detailed comparative analysis of the High-Density Planting System (HDPS) and traditional farmer practices for cotton cultivation. The findings revealed significant differences in plant growth, yield, and economic performance between the two systems.

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Yield and Agronomic Performance

The study results revealed that the average plant height 101.35 cm and number of bolls per plant 23.5 were lower under HDPS cotton when compared plant height 126.3 cm and 36.5 bolls per plant under farmers practice. The higher seed cotton yield of 24.51 q/ha was in HDPS cotton when compared to traditional farmer practice, which achieved 18.025 q/ha. This 36% increase in yield under HDPS is attributable to the optimized plant population density, which enhances resource use efficiency, particularly for sunlight, nutrients, and water. This indicates that while individual plants in HDPS produced fewer bolls, the higher plant density effectively compensated for this reduction, resulting in significantly higher total productivity per hectare. These above are in accordance with those obtained by Giri and Gore (2006); Buttar and Singh (2007); Narayana and Aparna (2011)

Economic Analysis

The average cost of cultivation was higher for HDPS at ₹101,875 per hectare compared to ₹89,895.5 per hectare for the farmer practice. Despite the increased costs, HDPS demonstrated superior economic performance with gross returns of ₹181,374 per hectare compared to

₹133,385 per hectare under the farmer practice. The net returns under HDPS were markedly higher at ₹77,999 per hectare, compared to ₹43,489.5 per hectare for the farmer practice. The benefit-cost ratio further underscored the economic advantage of HDPS, standing at 1.77 compared to 1.49 for the farmer practice. This indicates that for every rupee invested, HDPS delivered 77% higher returns, making it a more profitable and efficient system.

Table.1 performance of cotton under high density planting system over farmer practice during *Kharif*: 2023 and 2024

Sl. No.	Yield parameters	2023		2024		Pooled Mean	
		T1	T2	T1	T2	T1	T2
1	**Plant Height (cm)**	94	125	108.7	127.6	101.35	126.3
2	**No of bolls/plant**	23	38	24	35	23.5	36.5
3	**Yield (Qtl/ha)**	25.27	18.25	23.75	17.80	24.51	18.025
7	**Cost of cultivation (in rupees)**	99,250	86,875	1,04,500	92,916	101875	89895.5
8	**Gross returns**	1,86,998	1,35,050	1,75,750	1,31,720	181374	133385
9	**Net returns**	84748	48,175	71,250	38,804	77999	43489.5
10	**B:C Ratio**	**1.85**	**1.55**	**1.69**	**1.42**	**1.77**	**1.49**

Conclusion:

From the above study farmers' perspective, the High-Density Planting System (HDPS) has proven to be a transformative approach in cotton cultivation, particularly in alfisols conditions. The system demonstrated clear advantages over traditional practices, with significantly higher yields, net profits of ₹77,999 per hectare, and a superior benefit-cost ratio of 1.77, compared to ₹43,489.5 and 1.49, respectively, under the farmers' practice. The increased profitability is attributed to the higher plant population and greater number of bolls per unit area, which outweigh the relatively higher costs of cultivation. Harvesting cotton before the last week of November allows for alternate rabi crop cultivation with double remunerative to the farmers.

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