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Impact of high density planting system demonstrations on cotton farmers in Bhuvanagiri and Jangaon districts of Telangana

¹B Raja MadhuShekar, ²B Anil Kumar, ³K Mamatha, ⁴G Narender, ⁵M Malla Reddy, ⁶M Venu, ⁷K Shankar Ganesh, ⁸R Roopa and ⁸B Vijaykanth

¹Scientist (TOT), Department of Agricultural Extension, District Agricultural Advisory & Transfer of Technology Centre, PJTAU, Bhuvanagiri, Telangana, India

²Principal Scientist & Coordinator, Department of Entomology, District Agricultural Advisory & Transfer of Technology Centre, PJTAU, Bhuvanagiri, Telangana, India

³Scientist (Crop Production), Department of Agronomy, District Agricultural Advisory & Transfer of Technology Centre, PJTAU, Bhuvanagiri, Telangana, India

⁴Scientist (Agronomy), Regional Sugarcane and Rice Research Station, Rudrur, PJTAU, Nizamabad, Telangana, India

⁵Director (Planning & Monitoring), PJTAU, Administrative Office, Rajendranagar, Hyderabad, Telangana, India

⁶Young Professional II, Department of Agronomy, District Agricultural Advisory & Transfer of Technology Centre, PJTAU, Bhuvanagiri, Telangana, India

⁷Senior Scientist, Department of Agricultural Entomology, Central Institute for Cotton Research, Regional Station, Coimbatore, Tamil Nadu, India

⁸Young Professional I, District Agricultural Advisory & Transfer of Technology Centre, PJTAU, Bhuvanagiri, Telangana, India

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Corresponding Author: B Raja MadhuShekar

Abstract

Cotton a major fibre and cash crop in the country providing livelihood to the farmers plays a vital role to sustain national economy. The yields in red soils where most of the cotton is cultivated in Telangana are low. To replace this anomaly DAATT Centre, Bhuvanagiri conducted demonstrations during Kharif from 2022-23 to 2024-25 in different villages of Bhuvanagiri and Jangaon districts. The main objective was to increase productivity and profitability in poor soils by High Density planting system in Cotton. This system is suitable for mechanical harvesting and other benefits being reduced labour costs, increased input use efficiency, timely harvesting, maintaining cotton quality, and offering the potential to increase productivity and profitability. 80 respondents were selected from the villages in the two districts. 63.75% of the selected respondent farmers were in middle age group. They adopted the recommended package of practices with slight modifications with a high adoption percentage (42.50%). The average yield recorded was 22.91 q ha⁻¹ in demonstration plot, a 33.50% increase over farmer's practice (17.16 q ha⁻¹). 45.00% of the farmers had high level of knowledge on HDPS technology. The demonstrated plots gave higher gross returns, net return with higher benefit cost ratio when compared to farmer's practice. The study also revealed that there was significant increase in knowledge level of the farmers due to the demonstrations. The results also revealed that the adoption of the high density planting system with full package of practices had significant impact on cotton yield and productivity.

Keywords: Adoption, cotton, HDPS, impact, gross returns, net returns

1. Introduction

Cotton (*Gossypium hirsutum* L.) is an important cash and fibre crop of global significance, which is cultivated in tropical and subtropical regions of more than seventy countries across the world. India is one among the important cotton growers on a global scale (Reddy *et al.*, 2020) [23]. It is a multipurpose crop grown under varied agro-climatic conditions, in most of the developed as well as developing countries (Venugopalan, 2019) [28]. The agricultural and industrial economy of world is significantly influenced by cotton crop (Pradeep *et al.*, 2017) [16]. It is popularly known

as "White Gold" and the "King of Fibres" for its role in the national economy in terms of foreign exchange earnings and employment generation (Ray *et al.*, 2019) [22]. It is commercially cultivated fibre crop of India after jute producing natural fibre, fuel and edible oil, playing an important role in Indian economy (Prasad *et al.*, 2018) [17] grown in India under diverse agro climatic conditions, varying from 8°–32° N latitude and 70°–80° E longitude (Ram prasad, 2022) [21].

India is the only country which grows all four species of cotton viz., *Gossypium arboreum* & *Gossypium herbaceum*

(Asian cotton), *Gossypium barbadense* (Egyptian cotton) and *Gossypium hirsutum* (American Upland cotton) in Gujarat, Maharashtra, Telangana, Andhra Pradesh, Punjab, Karnataka and Tamil Nadu (Sam *et al.*, 2023) ^[24]. It is cultivated in an area of 112.94 lakh ha (279.08 lakh acres) in India, with an output of 320.18 lakh bales (170 kg bale⁻¹) and productivity of 443kg ha⁻¹ (lint) against world average yield of 814kg ha⁻¹ (Anonymous, 2023-24) ^[2]. Telangana occupies 3rd position among cotton producing states in India with an area of 17.70 lakh ha (43.76 lakh acres), occupying 15.67 per cent of the total area under cotton cultivation in India followed by Maharashtra (36.18%) and Gujarat (20.95%) with a production of 65.87 lakh bales with the productivity of 546 kg ha⁻¹ (Anonymous, 2023-24) ^[2]. It plays a pivotal role in the livelihoods of millions of farmers, traders, millers, and the global textile industry (Wagh *et al.*, 2021) ^[29]. In India, area under cotton cultivation is more than the world, but productivity is low, there is a need to develop new technologies that can assist farmers in generating adequate income without suffering losses brought on by the ever changing climate, labor shortages, increased pest and disease incidence in cotton (Gunasekaran *et al.*, 2020) ^[6]. The high-density planting system (HDPS) aids farmers in overcoming these obstacles. Promoting plant density is particularly advantageous for increasing cotton yield in low fertility plots (Dong *et al.*, 2010; Sankaranarayanan *et al.*, 2018) ^[5, 25]. Cotton cultivation at high density is being examined as a possible technique for lowering production costs by shortening the growing season. Mostly High-density planting system is suited for early matured genotype. By using early matured genotype, the cotton growing period was reduced and provides yield in a smaller number of days (Leena *et al.*, 2018) ^[9]. The high density planting system (HDPS) is a method where planting is done very closely per unit area. It is one of the new systems of cultivation of cotton, popularly known as 'Ultra Narrow Row' cotton, developed in India by the Central Institute for Cotton Research, Nagpur in 2010 (Prasad *et al.*, 2023) ^[18]. The system is now being conceived as an alternate production system having a potential for improving productivity and profitability, increasing efficiency, reducing input costs and minimizing risks (Singh *et al.*, 2024) ^[27]. Given the growing global population and the increasing demand for food and clothing (Khan *et al.*, 2019) ^[7], the HDPS has emerged as an alternative strategy to conventional methods, proving to be a well-established agronomic technique for enhancing yield, profitability, input use efficiency (Nalayini *et al.*, 2018) ^[14]. In view of above facts, the present study was initiated to know the impact of High Density Planting System demonstrations on Cotton farmers in Bhuvanagiri and Jangaon districts of Telangana state

2. Materials and Methods

The study was conducted in Bhuvanagiri and Jangaon districts of Telangana state, India that lies between 17.5078°N latitude, 78.8802°E Longitude to 17.7227°N latitude, 79.1518°E Longitude from 2022-23 to 2024-25. Demonstrations conducted in various locations under real farming situations were selected from 2022-23 to 2024-25 during Kharif (June-Dec) in different villages located in different blocks under DAATT Centre in Bhuvanagiri and

Jangaon districts. Demos were conducted along with check plot and they were taken into consideration for the study to find out the impact of HDPS demonstrations among cotton farmers for enhancing productivity in the two districts. Each demonstration was conducted by the respondent farmers with improved recommended practices for HDPS in red soils or light soils such as 2kg seed rate per acre, HDPS spacing 90x15cm and closer spacing of 90x30cm, timely sowing (Sowing after receiving more than 60 mm rainfall), spraying of plant growth regulator Mepiquat chloride@ 45, 60 and 75 days after sowing based on plant height and growth. The neighbouring plot of demos acted as farmers practice.

3. Results and Discussion

3.1. Socio- economic characteristics of respondents

The results from the study conducted on the demonstrations carried out on High Density planting system in cotton are enumerated, the profile characteristics of the selected cotton farmers are given below

Table 1: Profile Characteristics of respondents (n=80)

S.no	Variables	Category	Frequency	Percentage
1	Age	Young (22-37)	18	22.50
		Middle (38-53)	51	63.75
		Old (54-69)	11	13.75
2	Education levels	Illiterate	08	10.00
		Upto 5 th class	15	18.75
		Upto High school	24	30.00
		Intermediate	22	27.50
		Upto Graduation and above	11	13.75
3	Farm Size (in acres)	Marginal (0-2.5)	21	26.25
		Small (2.5-5)	47	58.75
		Large (5 and above)	12	15.00
4	Area under HDPS cotton (in acres)	Low (< 2.5 acres)	41	51.25
		Medium (2.5 to 5 acres)	32	40.00
		High (> 5 acres)	07	8.75
5	Farming experience	< 5 years	19	23.75
		5-10 years	28	35.00
		>10 years	33	41.25
6	Information seeking behaviour	Low (13-17)	11	13.75
		Medium (18-22)	21	26.25
		High (23-27)	48	60.00
7	Social participation	No participation	17	21.25
		Membership in one organization	34	42.50
		Membership in more than one organization	25	31.25
		Membership with office bearer	04	5.00
8	Trainings received/ participated	No training	09	11.25
		One training	17	21.25
		Two trainings	47	58.75
		More than 3 trainings	07	8.75
9	Risk orientation	Low (9-12)	12	15.00
		Medium (13-15)	19	23.75
		High (16-18)	49	61.25
10	Extension contact	Low (< 27.13)	24	30.00
		Medium (27.14 - 43.13)	35	43.75
		High (> 43.13)	21	26.25

It can be inferred from Table 1 that nearly 63.75% of the respondents were in the middle aged group, an active and agile group for doing agricultural activities, quick in

decision making and willing to take risk for adoption of new technologies, 71.25% of the respondents had up to high school or above education levels thus helpful in creating awareness, with nearly three quarters of the respondents had 2.5 acres or above farm size (73.75%), and 91.25% of these farmers had 2.5 to 5 acres or less than that area under HDPS cotton cultivation shows reliability on the technology, 41.25% of the respondents had more than 10 years of experience in farming, 60.00% of these farmers had high information seeking behaviour, 42.50% of the respondents had membership in one organization, 58.75% of the farmers participated in more than one training conducted on Cotton by DAATTC and other extension agencies, 61.25% of the farmers had high risk orientation, 43.75% of the farmers had medium extension contact which shows that farmers are well connected with the agricultural agencies in the district. The results are in tune with the findings of Madhushekar *et al.*, 2022a^[10], Pallavi *et al.*, 2025^[15] who reported similar findings with regard to farming experience, extension contact, information seeking behaviour and risk orientation.

3.1.1 Recommended package of practices

The Gap between the Recommended practice and farmer's practice details were given in Table 2. It shows that most of the demo farmers fully adopted the recommended package of practices with slight modifications as per their situation where as non-demo farmers were unable to adopt the practices. Certain interventions like erection and increasing number of pheromone traps and shredding of cotton stalk with tractor mounted shredder after the crop is completed showed 100% gap, may be due to unavailability, limited supply of pheromone traps or implements, ignorance on part of the farmers on usage resulted in this gap. Manual planting by using marked rope, length sticks etc. to maintain plant to plant distance was not taken up by most of the farmers thus a gap of 90.00% was observed. Plant spacing between plant to plant in HDPS (90x15cm) or closer spacing (90x30cm) was not practised leading to a gap of 86.25%. Indiscriminate spraying of the insecticides was observed among non-demo farmers compared to demo farmers who monitored the pest and used prophylactic sprays with neem oil, hence a gap of 43.75%.

Table 2: Gap analysis between Recommended package of practices and farmer's practice on High Density planting system in Cotton

S. no	Technology Interventions	Recommended practice	Farmers practice	% Gap in the recommended practice
Selection of cultivars for HDPS				
1.	Cultivars with compact, short fruiting branches, early maturing, synchronous boll bursting with higher retention of first position bolls and big boll size (>4g) should be selected.	The hybrids or cultivators suggested for HDPS are sown by the farmers.	Cultivars available in market were selected	83.75%
Pre-sowing operations				
2.	Deep summer ploughings with mould board plough once in every three years	Summer ploughings are taken up during the last week of May	Partially practiced	30.00%
3.	Add well decomposed farm yard manure (FYM) @ 4 tonnes/acre at least 15 days before sowing	On availability FYM is spread and mixed evenly into the soil	Partially practiced	28.75%
4	2-3 harrowings after pre-monsoon showers	On receipt of rainfall field is cultivated to get good tilth	Partially practiced	63.75%
Sowing time operations				
5.	Manual sowing may be taken up after receipt of 60mm cumulative rainfall	Sowing on receipt of more than 60 mm rainfall	Partially practiced	82.50%
6.	Use of pneumatic planter for sowing facilitating precision placement of seed at the right depth (5-6 cm)	Sowing was done with pneumatic planter in few pockets	Manually sown by the farmers where planters were not available	63.75%
7.	Manual planting can be done by using marked rope, Gunter's chain, marked plastic pipes, length sticks etc. to maintain plant to plant distance (in case of non-availability of pneumatic planter)	Sowing is done with length sticks manually.	Partially practiced	90.00%
8.	Sowing to be carried out at spacing of 90x15cm (HDPS), 90x30cm (closer spacing) for optimum plant population.	Spacing is followed with length sticks when done manually	Partially practiced	86.25%
Weed management				
9.	HDPS ensures quick canopy closure and improves the competitiveness of cotton crop against weeds: Pre-emergence application of Pendimethalin 38.7% CS @ 700 ml/acre within 24-48 hours of sowing, post emergence application of Quizalofop ethyl 6% EC + Pyriproxyfen sodium 4% EC (combination product) @ 2.5 ml /lit	Weedicides were extensively used for control of both grassy and broad leaved weeds. Weeds between rows were controlled easily.	Weeding between plants within the row was difficult, hand hoeings were taken up as and when necessary.	83.75%
Nutrient Management				
10.	Recommended dose for HDPS and closer spacing is 48:24:24 kg /acre (N:P:K).	Higher dose than recommended are followed	Indiscriminate use of fertilizers	63.75%
11.	Basal or at time of sowing: 1/3rd N, full P and ½ dose of K; Squaring stage (40-45 days after sowing): 1/3rd N, ½ of K and 5 kg ZnSO ₄ ; Flowering and early boll formation stage (70-75 days after sowing): 1/3rd N + 2 kg Boron	Higher dose than recommended are followed	Indiscriminate use of fertilizers	66.25%
Canopy Management				

12.	To curtail excessive vegetative growth, plant growth regulator (PGR) like mepiquat chloride is used 2-3 times. 1 st Spray (40-45 day crop or Square initiation or crop is 40-45 cm tall)@1ml/lit; 2 nd Spray (15-20 days after 1st spray) or 55 to 65 days crop@1.2 ml/lit; 3 rd spray (need based in case of excessive growth due to rains) or 80 days crop@1.2ml/lit.	Sprayings based on soil type, amount of rainfall received, growth pattern of hybrid, plant height, availability of moisture were taken.	Partially practiced	75.00%
Plant protection				
13.	Install or erect pheromone traps at 45 days after crop sowing @ 4/acre for monitoring of pink boll worm.	Pheromone traps were freely supplied during trainings for erecting in cotton fields.	Not practiced	100.00%
14.	Increasing pheromone traps @8/acre for mass trapping and control of the pink boll worm	Trained to use Pheromone traps	Not practiced	100.00%
15.	Spray NSKE 5% or <i>Azadirachtin</i> (1500 ppm) @ 5 ml/l of water with surf or sandovit@ 1 ml/l of water as a prophylactic measure at 40–45 days of the crop.	Prophylactic spray with neem oil	Partially practiced	43.75%
Harvesting				
16.	Crop is ready for 1 st picking after 130-135 DAS and 2 nd picking by 150-160 DAS.	Picking is sometimes delayed	Partially practiced	80.00%
Cotton stalk shredding				
17.	Standing left over stalk of cotton to be shredded with tractor operated mobile cotton shredder	Availability of shredder is a problem	Not practiced	100.00%
18.	Terminate the crop between 150–160 days and go for second crop with green gram/ maize /sesamum /vegetables/melons etc	Crop duration is not prolonged	Partially practiced	73.75%

Plant protection, weed management and nutrient management aspects showed huge gaps as non-demo farmers didn't follow the recommended practices, even demo farmers also practiced interventions fully which were easy and feasible hence partial adoption was seen. Rajib *et al.*, 2022 ^[20] also observed similar differences in pest management. The above result of differences in recommended practices to farmers practice are in unity with the findings of Shekar *et al.*, 2021 ^[11] and Balai *et al.*, 2021 ^[3] who also reported similar findings in paddy and Mustard respectively.

3.2. Economic parameters

Economic indicators i.e. gross expenditure, gross returns,

net returns and BC ratio of demonstrations are presented in Table 3. The data clearly envisages that net returns from the demonstration plot were substantially higher than control plot during all the years of demonstration. Average net returns from demonstration plot was ₹65,794.17 ha⁻¹ compared to ₹28,586.25 ha⁻¹ in control. The average gross expenditure from the demonstration plot was recorded as ₹98,365.83 ha⁻¹ compared to ₹94,229.17 ha⁻¹ in control. The average gross returns from the demonstration plot was ₹1,64,160.00 ha⁻¹ compared to ₹1,22,815.42 ha⁻¹ in control plots. The results are in tune with the findings of Rajib *et al.*, 2022 ^[20], Singh *et al.*, 2018 ^[26] who observed higher B:C ratio in groundnut and mustard in demo plots than in farmer's practice.

Table 3: Cost economics of Demonstrations on High Density planting system in Cotton

Year	Yield ha ⁻¹ (kg ha ⁻¹)		Gross expenditure ha ⁻¹ (₹)		Gross returns ha ⁻¹ (₹)		Net Returns (₹)		B:C ratio	
	Demo	Check	Demo	Check	Demo	Check	Demo	Check	Demo	Check
2022-23	2225	1675	96282.5	92062.5	155305.00	116915.00	59022.50	24852.50	1.61	1.26
2023-24	2300	1725	98782.5	94687.5	164450.00	122906.25	65667.50	28218.75	1.67	1.29
2024-25	2350	1750	100032.5	95937.5	172725.00	128625.00	72692.50	32687.50	1.72	1.34
Average	2291.67	1716.67	98365.83	94229.17	164160.00	122815.42	65794.17	28586.25	1.67	1.30

Cotton price during 2022-23@6980/q; 2023-24@7150/q and 2024-25@7350/q

Economic analysis of the yield performance from Table 3 showed that benefit cost ratio of demonstration plots was observed to be significantly higher than farmer's practice. The benefit cost ratio of recommended and control plots were recorded as 1.61, 1.67 and 1.72 and 1.26, 1.29 and 1.34 during 2022-23, 2023-24 and 2024-25 respectively. The cumulative effect of technological interventions over three years, revealed an average benefit cost ratio of 1.67 in demonstration plots compared to 1.30 in control plots. High BC ratio during 2024-25 is due to high procurement price of cotton. The results are in conformity with the findings of Deka *et al.*, 2021 ^[4], Shekar *et al.*, 2021 ^[11] and Puniya *et al.*, 2021 ^[19] in Toria, Paddy and Mustard.

Table 4: Impact on Yield due to High Density Planting System in Cotton

Year	Yield (q ha ⁻¹)		Change in yield (q ha ⁻¹)	Impact (% change)
	Demonstration plot	Control plot		
2022-23	22.25	16.75	5.50	32.83
2023-24	23.00	17.25	5.75	33.34
2024-25	23.50	17.50	6.00	34.28
Average	22.91	17.16	5.75	33.50

It can be noted from Table 4 that yield change noticed due to High Density Planting System Demos in Cotton were 5.50, 5.75 and 6.00 q ha⁻¹ during 2022-23, 2023-24 and

2024-25 respectively, the average change in yield was 5.75 q ha⁻¹. The average percent change in yield observed was 33.50%. The results are in tune with the findings of Madhushekar *et al.*, 2022b^[12] in groundnut and Shekar *et*

al., 2025^[13] in cotton.

3.3. Knowledge levels of cotton farmers on package of practices on HDPS cotton

Table 5: Distribution of respondents according to their knowledge on HDPS cotton crop

S.no	Category	Range	Frequency	Percentage
1	Low level of Knowledge	18-26	21	26.25
2	Medium level of Knowledge	27-35	23	28.75
3	High level of Knowledge	36-44	36	45.00

It can be inferred from Table 5 that 45.00 percent of the farmers had high level of knowledge on HDPS cotton followed by 28.75 percent with medium knowledge levels and 26.25 percent of the farmers under low knowledge level category. The findings are similar to the findings of

Madhushaker *et al.*, 2022a, Kumar *et al.* 2022^[8], Anil *et al.*, 2025^[1] in Cotton.

3.4. Adoption of the recommended package of practices in cotton

Table 6: Distribution of respondents according to their extent of adoption in HDPS cotton crop

S.no	Category	Criteria & Score	Frequency	Percentage
1	Low level of adoption	$< \bar{x} - \frac{1}{2} SD$ (< 12.0)	21	26.25
2	Medium level of adoption	$< \bar{x} \pm \frac{1}{2} SD$ ($< 12.1-22.5$)	25	31.25
3	High level of adoption	$> \bar{x} + \frac{1}{2} SD$ (> 22.6)	34	42.50

The data was collected on the extent of adoption of High Density Planting System technology by the farmers. The results from Table 6 indicated that the percentage of the respondents according to their extent of adoption in cotton crop was 26.25% (Low), 31.25% (Medium) and 42.50% (High). The above results indicate ease of the technology for adoption by cotton farmers in red chalka soils. The findings are in line with the results of Anil *et al.*, 2025^[1].

4. Conclusion

High-density planting System (HDPS) has the potential to increase yield with reduced cost of cultivation in rainfed cotton. It is an upcoming technology with the potential to fortify India's cotton economy. Widely proven in various countries, this technology is known for boosting productivity and mitigating risks in cotton farming. HDPS, combined with appropriate agronomic techniques, plant protection management and improved genotypes, offers a promising approach to overcome stagnant yields in predominantly rainfed cotton-growing regions. This approach helps in attaining economic sustainability by reducing input costs and mitigating production risk. The yield potential of cotton can be increased to a great extent by this method. This will enhance the income as well as the livelihood of the farming community. There is need to adopt multi-pronged strategy that involves enhancing cotton production and productivity through improved technologies.

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