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M Nikhith Balaji
PG. Research Scholar, Department
of Agronomy, Agricultural College,
Mahanandi, Andhra Pradesh, India

K Ashok Kumar
Principal Scientist (Agronomy),
AICRP on Cotton, RARS,
Nandyal, Andhra Pradesh, India

A Malliswara Reddy
Senior Scientist (Agronomy),
AINP on Tobacco, RARS,
Nandyal, Andhra Pradesh, India

Y Siva Jyothi
Assistant Professor, Department of
Soil Science, Agricultural College,
Mahanandi, Andhra Pradesh, India

Planting densities and canopy management practices effect on cotton crop under rainfed

M Nikhith Balaji, K Ashok Kumar, A Malliswara Reddy and Y Siva Jyothi

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Abstract

A field experiment as carried out at College Farm, Agricultural College, Mahanandi to understand the impact of different planting densities and canopy management practices on crop growth and yield of Bt cotton hybrid during *kharif* 2025 season under rainfed. The experiment was carried out in split plot design containing twelve treatmental combinations in three replications. Three planting densities *i.e.*, M₁: 75 cm x 20 cm (66,666 plants ha⁻¹), M₂: 90 cm x 15 cm (74,074 plants ha⁻¹) and M₃: 90 cm x 30 cm (37,037 plants ha⁻¹) and four canopy management practices *i.e.*, S₁: Control, S₂: Single spray of mepiquat chloride @ 1.5 ml L⁻¹ of water at 45-50 DAS, S₃: Two sprays of mepiquat chloride @ 2.0 ml L⁻¹ of water at 45-50 DAS and 15 days after first spray and S₄: De-topping at 100 cm height.

The results revealed that increase in planting density recorded maximum plant height, monopodial plant⁻¹. Plant spacing of 90 cm x 15 cm with plant density 74,074 plants ha⁻¹ registered higher seed cotton yield (1641 kg ha⁻¹) and lower in 90 cm x 30 cm spacing (1288 kg ha⁻¹) with plant density (37,037 plants ha⁻¹).

Application of growth regulators and other canopy management practice reduced plant height, monopodia plant⁻¹ but increased seed cotton yield. Single spray of mepiquat chloride @ 1.5 ml L⁻¹ of water at 45-50 DAS has recorded maximum seed cotton yield compared to other treatmental practice.

Keywords: High density planting, Canopy management practice, mepiquat chloride, detopping

Introduction

Cotton (*Gossypium sp.*) often referred as “King of Fibres” is one of the oldest cultivated fibre crops and an important commercial crop in the world. It is the principal natural fibre in textile industry and contributes majorly in development of agricultural and industrial sector worldwide. The crop significantly plays a major contribution for economic growth, employment generation and for providing rural livelihood mainly in developing countries. In India, a significant population percentage is aligned with cotton allied industries like ginning, spinning, processing and textile manufacturing thus contributing more than 75 percent of the raw material needed for textile industry.

Among the cotton producing nations highest production was seen in Russia, United States of America, China, India, Brazil, Pakistan, Turkey, Egypt, Mexico and Sudan, contributing nearly 85 percent of global cotton production. As per global statistical data (2024-25), total area of cultivation was about 31.3 million hectares, with production approximately 117.40 million bales (1 bale = 217.72 kg) (Agricultural Market Intelligence Centre, PJTSAU, 2024-25).

Among cotton growing countries, China recorded the highest production of about 31.75 million bales from 2.90 million hectares, whereas India ranked second with about 25 million bales, but with the largest cultivated area of around 11.8 million hectares. Despite having the largest area under cotton cultivation, productivity in India remains relatively lower compared to several other cotton producing countries. Globally, the highest productivity has been reported in China (2384 kg ha⁻¹) followed by Australia (1960 kg ha⁻¹), Brazil (1879 kg ha⁻¹) and Turkey (1873 kg ha⁻¹). The world average productivity is around 845 kg ha⁻¹ (ICAR – AICRP on Cotton, Annual Report 2024-25), while productivity levels in India are comparatively lower. State wise, Maharashtra ranks first in area under cultivation, followed by Gujarat and higher productivity was recorded in Gujarat (597 kg ha⁻¹) followed by Odisha (544 kg ha⁻¹), Rajasthan (524 kg ha⁻¹), Karnataka (473 kg ha⁻¹), Madhya Pradesh (469 kg ha⁻¹), Telangana (467 kg ha⁻¹) and Punjab

Corresponding Author:

M Nikhith Balaji
PG. Research Scholar, Department
of Agronomy, Agricultural College,
Mahanandi, Andhra Pradesh, India

(409 kg ha⁻¹).

India's seed cotton yield per unit area is very low compared and is far below than many other cotton growing countries across the world. Among the various factors responsible, low yields are impacted due to low plant populations and yield characteristics of the crop. Adjusting planting density and canopy can have major impact of the seed cotton yield. Maintaining right population and canopy practice will significantly impact the yield by influencing abiotic and physiological factors like light interception, soil moisture uptake, air flow, better usage of nutrients etc., Managing these factors will inturn influence crop yield by influencing canopy architecture, sympodial branches, boll formation, crop maturity and ultimately yield.

Methodology

A field experiment was conducted in *alfisols* at College farm, Agricultural college, Mahanandi during *kharif* 2025-26. The soil was sandy loam with pH of 7.7 accordingly. FYM application was carried out before sowing. The experiment was carried out in three replications, with each replication containing twelve treatmental combinations, with intra-plot spacing of 0.5 m and 1 m between replication. Aadhya hybrid (NCS-1134) was chosen for carrying out the research experiment and was sown at August 24 in 2025. Three planting densities viz., 75 cm x 20 cm (66,666 plants ha⁻¹), 90 cm x 15 cm (74,074 plants ha⁻¹) and 90 cm x 30 cm (37,037 plants ha⁻¹) and four canopy management practices viz., control, single spray of mepiquat chloride @ 1.5 ml L⁻¹ of water at 45- 50 DAS, Two sprays of mepiquat chloride @ 2.0 ml L⁻¹ of water at 45-50 DAS and 15 days after first spray and detopping at 100 cm plant height. These treatments were laid out in split plot design with a gross plot of 5.4 m x 5.4 m and nutrient application was carried as per recommendation. Data on plant height, number of monopodia plant⁻¹ were recorded at periodic intervals and seed cotton yield (kg ha⁻¹) were collected and statistically analyzed.

Results and Discussion

Planting densities

Plant height increased progressively during the crop growth period with maximum plant height of 115.7 cm at harvest in 90 cm x 15 cm (M₂) Similar observations were noted by Kavya *et al.* (2022) [1] and Parihar *et al.* (2018) [6]. Increase in the plant height might be due to increased competition among the plants for interception of light, thereby increasing vertical growth.

Among the different planting densities evaluated, significantly higher number of monopodia per plant was recorded with 90 cm x 30 cm (M₃) compared to 75 cm x 20 cm (M₁) and 90 cm x 15 cm (M₂). However, the number of monopodia per plant recorded under M₁ and M₂ did not differ significantly and were statistically on par with each other.

High density planting of 90 cm x 15 cm, recorded higher seed cotton yield compared to 90 cm x 30 cm, but was on par with 75 cm x 20 cm. The higher seed cotton yield under closer spacing is attributed to higher plant population per unit area compared to wider spacing. Though the seed cotton yield plant⁻¹ was higher under wider spacing, due to more number of bolls plant⁻¹ and

higher boll weight, the presence of more plants per unit area under closer spacing compensated the overall yield though the per plant yield was lower. Similar results were observed by Kavya and Kumari (2025) [5], Gohil *et al.* (2023) [3].

Canopy management practices

During the crop growth stage *i.e.*, harvest, control (S₁) registered maximum plant height and lowest in two sprays of mepiquat chloride @ 2.0 ml L⁻¹ of water at 45-50 DAS and 15 days after first spray (S₃) followed by single spray of mepiquat chloride @ 2.0 ml L⁻¹ of water at 45-50 DAS (S₂). The lower plant height might be due to inhibitory action of mepiquat chloride by interfering with the biosynthetic pathway of gibberellic acid, thus reducing the plant height. Gohil *et al.* (2023) [3], Gouthami *et al.* (2023) [4] also revealed similar observations.

Among the canopy management practices, the control (S₁) produced a significantly higher number of monopodia per plant than detopping at 100 cm plant height (S₄). In turn, S₄ recorded significantly higher monopodia per plant than a single spray of mepiquat chloride @ 1.5 ml L⁻¹ of water applied at 45-50 DAS (S₂) and two sprays of mepiquat chloride @ 2.0 ml L⁻¹ of water applied at 45-50 DAS and again 15 days after the first spray (S₃), with S₃ recording the lowest number of monopodia per plant.

Higher seed cotton yield was registered with single spray of mepiquat chloride @ 1.5 ml L⁻¹ of water at 45-50 DAS (S₂) compared to control (S₁) and with two sprays of mepiquat chloride @ 2.0 ml L⁻¹ of water at 45-50 DAS and 15 days after first spray (S₃), but was at par with detopping at 100 cm plant height (S₄). This might be due the effect of growth regulator on plant canopy making it compact, thus improving light penetration, increasing photosynthetic rate and diverting the photosynthates towards bolls increasing boll weight and reducing boll shedding. Gobi and Vaiyapuri (2013) [2] claimed similar results.

Interaction effects

The interaction effect between planting densities and canopy management practices on plant height at harvest was found to be significant. Among the treatment combinations, 90 cm x 30 cm in combination with two sprays of mepiquat chloride @ 2.0 ml L⁻¹ of water applied at 45-50 DAS and 15 days after the first spray (M₃S₃) recorded the significantly lowest plant height compared to all other treatment combinations. However, it was statistically on par with 90 cm x 30 cm in combination with a single spray of mepiquat chloride @ 1.5 ml L⁻¹ of water applied at 45-50 DAS (M₃S₂), which recorded a plant height.

Similarly, the interaction between planting densities and canopy management practices was found to be significant for seed cotton yield. Significantly higher seed cotton yield was recorded under 90 cm x 15 cm in combination with a single spray of mepiquat chloride @ 1.5 ml L⁻¹ of water applied at 45-50 DAS (M₂S₂) compared to all other treatment combinations. However, it was statistically at par with 75 cm x 20 cm in combination with a single spray of mepiquat chloride @ 1.5 ml L⁻¹ of water applied at 45-50 DAS (M₁S₂).

Table 1: Mean attributes of plant as influenced by planting densities and canopy management practices

Treatments	Plant height (cm)	No. of monopodia plant ⁻¹	Seed Cotton yield (kg ha ⁻¹)
Planting densities: 3			
M ₁ : 75 cm x 20 cm	111.4	0.55	1472
M ₂ : 90 cm x 15 cm	115.7	0.59	1641
M ₃ : 90 cm x 30 cm	89.3	0.88	1288
SEm ±	3.2	0.03	40
CD (P=0.05)	12.9	0.05	161
Canopy management practices: 4			
S ₁ : Control	122.9	1.39	1347
S ₂ : Single spray of mepiquat chloride @ 1.5 ml L ⁻¹ of water at 45-50 DAS	104.8	0.28	1642
S ₃ : Two sprays of mepiquat chloride @ 2.0 ml L ⁻¹ of water at 45-50 DAS and 15 days after first spray	94.2	0.15	1326
S ₄ : Detopping at 100 cm plant height	100.0	0.88	1553
SEm ±	3.4	0.03	44
CD (P=0.05)	10.1	0.06	132
Interaction (M x S)			
S at M			
SEm ±	6.4	0.05	80
CD (P=0.05)	19.3	NS	249
M at S			
SEm ±	6.0	0.06	77
CD (P=0.05)	19.7	NS	253
M x S			
SEm ±	5.4	-	83
CD (P=0.05)	S	-	S

Conclusion

Based on the field investigation, it can be concluded that, planting density of 90 cm x 15 cm was best suited for obtaining higher seed cotton yield. Similarly, canopy management practice, single spray of mepiquat chloride @ 1.5 ml L⁻¹ of water at 45-50 DAS has increased seed cotton yield.

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