



Study the Growth Attributes of Cotton as Influenced by Various Levels of Nitrogen under Rainfed Condition

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Authors' contributions

This work was carried out in collaboration among all authors. All authors read and approved the final manuscript.

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ABSTRACT

The field investigation was carried out at Department of Agronomy farm, Dr. Panjabrao Deshmukh Krishi Vidyapeeth, Akola during 2019-20. The experiment was laid out in randomized block design with three replications and seven different nitrogen levels treatment with an objective to study the growth and yield of cotton as influenced by various levels of nitrogen under rainfed condition. Treatments consisted of different nutrient management practices including FYM and nitrogen doses viz., Absolute Control (N₁), FYM @ 5 t ha⁻¹ (N₂), N₂ + 30 kg N ha⁻¹ (N₃), N₂ + 60 kg N ha⁻¹ (N₄), N₂ + 90 kg N ha⁻¹ (N₅), N₂ + 120 kg N ha⁻¹ (N₆) and N₂ + 150 kg N ha⁻¹ (N₇). Cotton crop was sown on 29th June 2019 while it was harvested in four pickings. The result revealed that a significant differences in plant height, leaf area, number of sympodial branches and dry matter accumulation

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and until harvest. Growth attributes viz., plant height and numbers of sympodial branches were maximum in treatment of FYM @ 5 t ha⁻¹+150 kg N ha⁻¹. However, leaf area and dry matter accumulation were maximum with treatment of FYM @ 5 t ha⁻¹+120 kg N ha⁻¹.

Keywords: Nitrogen levels; cotton; growth attributes; plant height; sympodial branches; dry matter accumulation.

1. INTRODUCTION

Cotton (*Gossypium hirsutum* L.) belongs to family Malvaceae, Tribe: Gossypieae, Genus: Gossypium. Cotton is the backbone of textile industry, which consumes 59% of the country's total fibre production. Cotton plant not only provides the fibre for making cloth to protect the human body but also edible oil for consumption & also excellent cattle, poultry and fish feed. India remains the leading country in terms of area under cotton cultivation and raw cotton production in the world. As per CAB estimate, cotton production in India during 2017-18 is expected to produce 377 lakh bales of 170 kg from 122 lakh hectares with a productivity of 524 kg lint/ha.

It is important to plan improved management practices that enhance cotton yield potential. Cotton is extremely susceptible to abiotic stresses. Cotton growth and development are significantly influenced by climatic adversaries and seasonal management practices such as variety selection, sowing date, sowing method, plant spacing, water requirement, seed treatment, and appropriate fertilizer application [1,2,3].

Cotton (*Gossypium hirsutum* L.) is one of the most important cash crops of Vidarbha but average yield per hectare is quite low. Among the nutritional factors, which are responsible for low yield of cotton, nitrogen stress is the important one. Nitrogen plays significant role in deciding the cotton yield since it markedly influences the growth and yield attributes. Nitrogen application often dramatically increases crop yields, but N needs vary spatially across fields and landscapes. With increased trend of intensive cultivation and introduction of high yielding varieties, the linear response of applied fertilizer are observed. Bt cotton is now released high yielding variety, which required high amount of fertilizer. So far there is paucity of information on the response of N application in Bt cotton crop, the present investigation was studied.

2. MATERIALS AND METHODS

The field experiment was carried out during *kharif* season of 2019-2020 at the Department of Agronomy Farm, Dr. Panjabrao Deshmukh Krishi Vidyapeeth, Akola (MS). The investigation was laid out in Randomized Block Design (RBD) with seven treatments replicated three times. The allotment of the treatments to various plots was done randomly. Treatments consisted of different nutrient management practices including FYM and nitrogen doses viz., Absolute Control (N₁), FYM @ 5 t ha⁻¹ (N₂), N₂ + 30 kg N ha⁻¹ (N₃), N₂ + 60 kg N ha⁻¹ (N₄), N₂ + 90 kg N ha⁻¹ (N₅), N₂ + 120 kg N ha⁻¹ (N₆) and N₂ + 150 kg N ha⁻¹ (N₇). The soil of experimental plot was clayey in texture with moderately alkaline in reaction (pH 8.12). The soil was low in available nitrogen (176 kg ha⁻¹), low in available phosphorus (15 kg ha⁻¹) and high in available potassium (360 kg ha⁻¹) while, low in organic carbon content (0.45%). The gross and net plot sizes was 10.8 m x 9.00 m and 9.00 m x 7.8 m, respectively. A cotton variety named PKV-Hy-2-BG-II recommended by Dr. Panjabrao Deshmukh Krishi Vidyapeeth, Akola was used in the present investigation. The seeds were procured from Mahabeej (M.S.). Cotton crop was sown in 29th June 2019 while it was harvested in four pickings. Normal cultural operations and plant protection measures were carried out as and when required.

3. RESULTS

The data from Table 1 shows that the plant height was significantly influenced due to application of nitrogen at all growth stages. From 30 DAS to at harvest, the application of N₂+150 kg N ha⁻¹ (N₇) recorded maximum improvement in plant height. However it was statistically at par with N₂+90 kg N ha⁻¹ (N₅) and N₂+120 kg N ha⁻¹ (N₆) (Table 1). Similar, observation of increased in plant height in cotton due to different dose of nitrogen by availability of optimum nitrogen for growth were reported by Brar et al. [4], Sharma et al. [5], Nehra and Kumavat [6], Ram and Giri [7], Ranavavare et al. [8], Gadhiya et al. [9] and Baraich et al. [10].

From 60 DAS, the application of $N_2 + 150 \text{ kg N ha}^{-1}$ (N_7) recorded maximum improvement in number of sympodial branches plant^{-1} which was statistically at par with $N_2 + 90 \text{ kg N ha}^{-1}$ (N_5) and $N_2 + 120 \text{ kg N ha}^{-1}$ (N_6) (Table 2). This increased in number of sympodial branches with treatment $N_2 + 150 \text{ kg N ha}^{-1}$ (N_7) was due to application of adequate doses of N and large quantity of nutrient supply. Brar et al. [4], Kasap [11], Kumbhar et al. [12], Gadhiya et al. [9] and Nadeem et al. [13] reported similar result.

In general, the leaf area plant^{-1} of cotton increased steadily with advance in the age of the crop from 30 DAS up to 150 DAS and then found declined towards harvest due to senescence of lower leaves. The Leaf area plant^{-1} differed significantly due to application of nitrogen at all growth stages. The application of $N_2 + 120 \text{ kg N ha}^{-1}$ (N_6) recorded maximum improvement in leaf area plant^{-1} which was at par with $N_2 + 90 \text{ kg N ha}^{-1}$ (N_5) and $N_2 + 150 \text{ kg N ha}^{-1}$ (N_7) (Table 3). The

treatment of control (T_1) registered the lowest value of Leaf area plant^{-1} .

The dry matter accumulation plant^{-1} was found to be maximum improvement with application of $N_2 + 120 \text{ kg N ha}^{-1}$ (N_6) which was at par with $N_2 + 90 \text{ kg N ha}^{-1}$ (N_5) and $N_2 + 150 \text{ kg N ha}^{-1}$ (N_7). However, the lowest value of dry matter accumulation plant^{-1} was recorded with control (N_1). Similar trend of observations were noted during further growth and reproductive phases of cotton i.e., from 30 DAS to harvest. However, the lowest value of dry accumulation plant^{-1} was observed in control (N_1). Total dry matter accumulation with treatment $N_2 + 120 \text{ kg N ha}^{-1}$ (N_6) was significantly influenced mainly due to greater availability of nutrients in soil, improved soil environment and higher root penetration leading to better absorption of moisture and nutrient which improved the photosynthesis and translocation assimilates. These results were supporting the findings Mahatale et al. [14], Ram and Giri [7] and Sonawale et al. [15,16].

Table 1. Plant height (cm) of cotton as influenced by various treatments

Treatments	Plant height (cm)						
	30 DAS	60 DAS	90 DAS	120 DAS	150 DAS	180 DAS	At harvest
N_1 (Absolute control)	17.33	38.52	61.27	84.63	91.48	97.32	102.13
N_2 (FYM @ 5.0 t ha^{-1})	17.53	50.13	77.85	95.45	110.57	114.45	116.86
N_3 ($N_2 + 30 \text{ kg}$)	17.6	53.2	83.85	102.32	116.74	120.92	124.28
N_4 ($N_2 + 60 \text{ kg}$)	18.33	55.93	87.89	106.68	123.55	128.36	129.8
N_5 ($N_2 + 90 \text{ kg}$)	19.47	59.07	94.41	113.63	130.04	135.13	137.06
N_6 ($N_2 + 120 \text{ kg}$)	19.87	62.2	99.61	120.62	133.03	138.17	140.62
N_7 ($N_2 + 150 \text{ kg}$)	20.4	63.47	103.5	126.73	147.04	153.71	155.87
S.E. (m) \pm	0.35	0.35	1.56	3.40	4.43	6.07	6.35
C.D. at 5%	1.05	1.05	4.68	10.21	13.29	18.22	19.05
G.M.	18.65	54.64	54.65	86.91	107.15	121.87	129.52

Table 2. Number of sympodial branches plant^{-1} of cotton as influenced by various treatments

Treatments	Number of sympodial branches plant^{-1}					
	60 DAS	90 DAS	120 DAS	150 DAS	180 DAS	At harvest
N_1 (Absolute control)	4.2	7.2	9.5	12.1	13.2	13.8
N_2 (FYM @ 5.0 t ha^{-1})	5.9	9.9	12.5	15.3	16.1	16.1
N_3 ($N_2 + 30 \text{ kg}$)	6.7	10.9	13.3	16.5	18.5	18.5
N_4 ($N_2 + 60 \text{ kg}$)	9.5	14.4	16.9	19.7	20.5	20.5
N_5 ($N_2 + 90 \text{ kg}$)	10.7	16.1	18.6	21.3	22.3	22.3
N_6 ($N_2 + 120 \text{ kg}$)	12.0	17.3	19.9	22.9	23.8	23.8
N_7 ($N_2 + 150 \text{ kg}$)	13.1	18.7	21.6	24.7	25.9	25.9
S.E. (m) \pm	0.84	0.95	1.03	1.19	1.32	1.25
C.D. at 5%	2.53	2.84	3.09	3.58	3.95	3.74
G.M.	8.9	13.5	16.0	18.9	20.0	20.1

Table 3. Leaf area (dm²) of cotton as influenced by various treatments

Treatments	Leaf area (dm ²)						
	30 DAS	60 DAS	90 DAS	120 DAS	150 DAS	180 DAS	At harvest
N ₁ (Absolute control)	3.00	9.93	35.12	84.35	126.15	107.90	91.69
N ₂ (FYM @ 5.0 t ha ⁻¹)	3.24	14.18	48.11	110.99	159.69	131.59	106.62
N ₃ (N ₂ + 30 kg)	3.45	15.73	56.00	138.09	184.69	154.38	124.19
N ₄ (N ₂ +60 kg)	3.69	16.97	61.01	152.35	224.97	184.22	148.47
N ₅ (N ₂ +90 kg)	3.82	17.74	64.63	164.70	230.31	191.41	154.21
N ₆ (N ₂ +120 kg)	4.04	20.23	81.19	236.99	370.21	317.10	253.15
N ₇ (N ₂ +150 kg)	3.97	19.65	77.65	221.69	331.09	273.53	219.04
S.E. (m) ±	0.11	0.95	6.48	27.21	46.75	43.12	33.80
C.D. at 5%	0.32	2.84	19.43	81.62	140.26	129.37	101.40
G.M.	3.60	16.35	60.53	158.45	232.44	194.30	156.77

Table 4. Total dry matter accumulation plant⁻¹ (g) of cotton as influenced by various treatments

Treatments	Total dry matter accumulation plant ⁻¹ (g)					
	60 DAS	90 DAS	120 DAS	150 DAS	180 DAS	At harvest
N ₁ (Absolute control)	9.2	27.5	63.7	89.6	188.6	208.5
N ₂ (FYM @ 5.0 t ha ⁻¹)	13.2	37.7	83.8	113.5	230.0	242.4
N ₃ (N ₂ + 30 kg)	14.0	40.1	89.0	169.1	311.4	276.3
N ₄ (N ₂ +60 kg)	23.3	66.6	148.0	233.5	365.0	294.4
N ₅ (N ₂ +90 kg)	31.7	90.5	201.0	256.3	386.3	318.9
N ₆ (N ₂ +120 kg)	38.4	109.7	243.7	302.3	431.6	323.8
N ₇ (N ₂ +150 kg)	32.7	93.3	207.3	278.5	418.7	321.4
S.E. (m) ±	2.31	6.92	14.54	15.76	15.61	1.76
C.D. at 5%	6.94	20.77	43.63	47.29	46.84	5.28
G.M.	23.2	66.5	148.1	206.1	333.1	283.7

4. CONCLUSION

From the present investigation it is concluded that the crop is in advanced age significant difference from 60 DAS were observed and continue to be significant till harvest in case of, number of sympodial branches and dry matter accumulation. Growth attributes viz., plant height and number of sympodial branches was maximum with treatment of FYM @ 5 t ha⁻¹ + 150 kg N ha⁻¹ (N₇) which was at par with FYM @ 5 t ha⁻¹ + 90 kg N ha⁻¹ (N₅) and FYM @ 5 t ha⁻¹ + 120 kg N ha⁻¹ (N₆). However, leaf area and dry matter accumulation was maximum with treatment of FYM @ 5 t ha⁻¹ + 120 kg N ha⁻¹ (N₆) which was at par with FYM @ 5 t ha⁻¹ + 90 kg N ha⁻¹ (N₅) and FYM @ 5 t ha⁻¹ + 150 kg N ha⁻¹ (N₇).

COMPETING INTERESTS

Authors have declared that no competing interests exist.

REFERENCES

- Zaman I, Ali M, Shahzad K, Tahir MS, Matloob A, Ahmad W, Alamri S, Khurshid MR, Qureshi MM, Wasaya A, Baig KS. Effect of plant spacings on growth, physiology, yield and fiber quality attributes of cotton genotypes under nitrogen fertilization. *Agronomy*. 2021 Dec 19; 11(12):2589.
- Zhao W, Wang Y, Zhou Z, Meng Y, Chen B, Oosterhuis D. Effect of nitrogen rates and flowering dates on fiber quality of cotton (*Gossypium hirsutum* L.). *American Journal of Experimental Agriculture*. 2012;2(2):133-59.
- Qureshi MA, Shahzad H, Saeed MS, Ullah S, Ali MA, Mujeeb F, Anjum MA. Relative potential of rhizobium species to enhance the growth and yield attributes of cotton (*Gossypium hirsutum* L.). *Eurasian Journal of Soil Science*. 2019;8(2):159-66.

4. Brar AS, Singh A, Singh T. Response of hybrid cotton (*Gossypium hirsutum*) to nitrogen and canopy modification practices. Indian J. of Agron. 2000;45(2): 395-400.
5. Sharma JC, Sharma AP, Amarpal Taneja AD, Dhankhar JS. Response of Sulphur and its sources, phosphorus and nitrogen on seed cotton yield and fiber quality in American cotton (*Gossypium hirsutum* L.). Journal of Indian Society for Cotton Improvement. 2000;33-36.
6. Nehra PL, Kumavat PD. Response of hirsutum cotton varieties to spacing and nitrogen levels. J. Cotton Res. Dev. 2003;17(1):41-42.
7. Ram AN, Giri. Response of newly release cotton (*Gossypium hirsutum* L.) varieties to plant densities and fertilizer levels. J Cotton Res Dev. 2006;20(1):85-86.
8. Rananavare PK, Navlakhe SM, Solunke PS. Influence of organics and inorganics on production of desi cotton (*Gossypium arboreum* L.). Journal of Indian Society for Cotton Improvement. 2006;31-35.
9. Gadhiya SS, Patel BB, Jadav NJ, Pavaya RP, Patel MV, Patel VR. Effect of different levels of nitrogen, phosphorus and potassium on growth, yield and quality of Bt cotton. An Asian Journal of Soil Science. 2009;4(1):37-42.
10. Baraich AAK, Baraich AHK, Jamali LA, Salarzi AU. Effect of nitrogen application rates on growth and yield of cotton varieties. Pak. J. Agri., Agril. Engg., Vet. Sci. 2012;28 (2):115-123.
11. Kasap Y, Killi F. Effect of row space and nitrogen interaction on seed-cotton (*Gossypium hirsutum*) yield under irrigated conditions of Turkey. Indian j. Agron. 2004;49(1):64-67.
12. Kumbhar AM, Burio UA, Junejo FC, OAD, Jamro GH. Impact of different nitrogen levels on cotton (*Gossypium hirsutum* L.) growth, yield and N-uptake planted in legume rotation. Pak. J. 2008;40(2):767-778.
13. Nadeem MA, Ali A, Tahir M, Naeem M, Chadhar AR, Ahmad S. Effect of Nitrogen Levels and Plant Spacing on Growth and Yield of Cotton. Pak. j. life soc. Sci. 2010;8(2):121-124.
14. Mahatale PV, Wankhede ST, Shivankar RS, Mahatale MV, Thakare GV. Effect of different levels of plant density and nitrogen on growth and yield attributes of *Gossypium arboreum* Hybrid (AKDH-7). Annals of Plant Physiology. 2003;17(1):27-30.
15. Sonawale AB, Khawale VS, Pawar WS, Pagar PC, Borkar BY. Studies on the effect of nitrogen levels and chlormequat on growth and yield of hybrid cotton. Journal of Soils and Crops. 2006;16(1):244-249.
16. Anonymous. ICAR-All India Coordinated Research Project on Cotton – Annual Report (2017-18); 2018. Available: https://aiccip.cicr.org.in/3_A1_A17_PC_report

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