Study the growth attributes of cotton as influenced by various levels of nitrogen under rainfed condition

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 (N_1), FYM @ 5 t ha^{-1} (N_2), N_2 + 30 kg N ha^{-1} (N_3), N_2 + 60 kg N ha^{-1} (N_4), N_2 + 90 kg N ha^{-1} (N_5), N_2 +120 kg N ha^{-1} (N_6) and N_2 + 150 kg N ha^{-1} (N_7). Cotton crop was sawn 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 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.

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 [Zaman et al.2021; Zhao et al.2012; Qureshi et al. 2019].

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.

Materials and Method

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 (N_1), FYM @ 5 t ha^{-1} (N_2), N_2 + 30 kg N ha^{-1} (N_3), N_2 + 60 kg N ha^{-1} (N_4), N_2 + 90 kg N ha^{-1} (N_5), N_2 +120 kg N ha^{-1} (N_6) and N_2 + 150 kg N ha-1 (N_7). 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.

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 N_2+150 kg N ha^{-1} (N_7) recorded maximum improvement in plant height. However it was statistically at par with N_2+90 kg N ha^{-1} (N_5) and N_2+120 kg N ha^{-1} (N_6) (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.* (2000), Sharma *et al.* (2000), Nehra and Kumavat (2003), Ram and Giri (2012), Rananavare *et al.* (2006), Gadhiya *et al.* (2017) and Baraich *et al.* (2012).

From 60 DAS, the application of N_2 + 150 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 kg N ha^{-1} (N_5) and N_2 + 120 kg N ha^{-1} (N_6) (Table.2). This increased in number of sympodial branches with treatment N2 + 150 kg N ha-1 (N_7) was due to application of adequate doses of N and large quantity of nutrient supply. Brar *et al.* (2000), Kasap (2004), Kumbhar *et al.* (2008), Gadhiya *et al.* (2009) and Nadeem *et al.* (2010) reported similar result.

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 kg)	17.6	53.2	83.85	102.32	116.74	120.92	124.28
N_4 (N_2 +60 kg)	18.33	55.93	87.89	106.68	123.55	128.36	129.8
N_5 (N_2 +90 kg)	19.47	59.07	94.41	113.63	130.04	135.13	137.06
N_6 (N_2 +120 kg)	19.87	62.2	99.61	120.62	133.03	138.17	140.62
N_7 (N_2 +150 kg)	20.4	63.47	103.5	126.73	147.04	153.71	155.87
S.E. (m) ±	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 plan^{-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 kg)	6.7	10.9	13.3	16.5	18.5	18.5
N_4 (N_2 +60 kg)	9.5	14.4	16.9	19.7	20.5	20.5
N_5 (N_2 +90 kg)	10.7	16.1	18.6	21.3	22.3	22.3
N_6 (N_2 +120 kg)	12.0	17.3	19.9	22.9	23.8	23.8
N_7 (N_2 +150 kg)	13.1	18.7	21.6	24.7	25.9	25.9
S.E. (m) ±	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

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 kg N ha^{-1} (N_6) recorded maximum improvement in leaf area plant^{-1} which was at par with N_2+90 kg N ha^{-1} (N_5) and N_2+150 kg N ha^{-1} (N_7) (Table.3). The treatment of control (T_1) registered the lowest value of Leaf area plant^{-1}.

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

Treatments	Leaf area (dm2)						
	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

The dry matter accumulation plant^{-1} was found to be maximum improvement with application of N_2 + 120 kg N ha^{-1} (N_6) which was at par with N_2 + 90 kg N ha^{-1} (N_5) and N_2 + 150 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 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.* (2003), Ram and Giri (2006) and Sonawale *et.al*. (2006).

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

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} (N_7) which was at par with FYM @ 5 t ha^{-1} + 90 kg N ha^{-1} (N_5) and FYM @ 5 t ha^{-1} + 120 kg N ha^{-1} (N_6). However, leaf area and dry matter accumulation was maximum with treatment of FYM @ 5 t ha^{-1} + 120 kg N ha^{-1} (N_6) which was at par with FYM @ 5 t ha^{-1} + 90 kg N ha^{-1} (N_5) and FYM @ 5 t ha^{-1} + 150 kg N ha^{-1} (N_7).

References

Anonymous., (2018). ICAR-All India Coordinated Research Project on Cotton – Annual Report (2017-18). https://aiccip.cicr.org.in/3_A1_A17_PC_report.

Baraich A.A.K., A.H.K. Baraich, L.A. Jamali and A. U. Salarzi. 2012. Effet of nitrogen application rates on growth and yield of cotton varieties. *Pak. J. Agri., Agril. Engg., Vet. Sci*. 28 (2): 115-123.

Brar A.S., A. Singh, and T. Singh. 2000. Response of hybrid cotton (*Gossypium hirsutum*) to nitrogen and canopy modification practices. *Indian J. of Agron*. 45(2): 395-400.

Gadhiya S.S., B.B. Patel, N.J. Jadav, R.P. Pavaya, M.V. Patel and V.R. Patel. 2009. Effect of different levels of nitrogen, phosphorus and potassium on growth, yield and quality of Bt cotton. An *Asian Journal of Soil Science*. Vol. 4(1): 37-42.

Kasap, Y. and F. Killi. (2004). Effect of row space and nitrogen interaction on seed-cotton (*Gossypium hirsutum*) yield under irrigated conditions of Turkey. *Indian j. Agron,*49(1):64-67.

Kumbhar, A.M., U.A. Burio, F.C. Junejo, OAD and G.H. Jamro. (2008). Impact of different nitrogen levels on cotton (*Gossypium hirsutum* L.) growth, yield and N-uptake planted in legume rotation. *Pak. J.*, 40(2): 767-778.

Mahatale P.V., S.T. Wankhede, R.S. Shivankar, M.V. Mahatale and G.V. Thakare. 2003. Effect of different levels of plant density and nitrogen on growth and yield attributes

of *Gossypium arboreum* Hybrid (AKDH-7). *Annals of Plant Physiology* 17(1): 27-30.

Nadeem M.A., A. Ali, M. Tahir, M. Naeem, A.R. Chadhar and S. Ahmad. 2010. Effect of Nitrogen Levels and Plant Spacing on Growth and Yield of Cotton. *Pak. j. life soc. Sci*. 8(2): 121-124.

Nehra P.L. and P.D. Kumavat. 2003. Response of *hirsutum* cotton varieties to spacing and nitrogen levels. *J. Cotton Res. Dev.* 17(1): 41-42.

Ram and A.N. Giri. 2006. Response of newly release cotton (*Gossypium hirsutum* L.) varieties to plant densities and fertilizer levels. *J Cotton Res Dev*. 20(1): 85-86.

Rananavare P.K., S.M. Navlakhe, and P.S. Solunke. 2006. Influence of organics and inorganics on production of desi cotton (*Gossypium arboreum* L.). *Journal of Indian Society for Cotton Improvement.* pp: 31-35.

Sharma J. C., A.P. Sharma, A.D. Amarpal Taneja, J.S. Dhankhar. 2000. 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*. pp 33-36.

Sonawale A.B., V.S. Khawale,W.S. Pawar, P.C. Pagar and B.Y. Borkar. 2006. Studies on the effect of nitrogen levels and chlormequat on growth and yield of hybrid cotton. *Journal of Soils and Crops*. 16(1): 244-249.

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.