Research Article

Effect of Nitrogen Management on Nutrient Uptake in *Bt* (*Bacillus thuringiensis*) Cotton Hybrid

Priyanka Devi*, Karmal Singh, S.K. Thakral, Sonia Devi, Shweta and Meena Sewhag

CCS Haryana Agricultural University, Hisar-125004

Abstract

The present investigation was carried out at cotton research area of CCS Haryana Agricultural University, Hisar, during *kharif* season 2018 to study the effect of application method and scheduling of nitrogen on growth and quality of Bt cotton. There were seven treatments replicated thrice. The result revealed that significantly lower nitrogen and potash uptake were found in T_1 (control) as compared to other treatments whereas total phosphorus uptake was significantly higher in T_2 (100% of RDN band application in 2 splits at sowing and flowering) as compare to other treatments. Available nitrogen after harvesting of crop was found significantly higher in T_4 (75% of RDN + Placement; spot application in 2 splits at sowing and flowering) and T_7 (T_5+ raising of moong between rows incorporated before flowering (50-55 DAS)) treatment as compare to other treatments. Available phosphorus after harvest was statistically at par in all these treatments. Available potash after harvesting of crop was found higher in T_7 (T_5+ raising of moong between rows incorporated before flowering (50-55 DAS)) treatment which was statistically at par with T_1 (control), T_3 (75% of RDN; band application in 2 splits at sowing and flowering) treatment and significantly higher as compare to other treatments.

Keywords: nitrogen, management, uptake, cotton

***Correspondence**

Author: Priyanka Devi

Email: priyankabisla12@gmail.com

Introduction

Cotton (*Gossypium hirsutum* L.), also known as "White Gold" is one of the most important commercial cash crops of semi-arid regions. It has great economic importance in the agrarian and industrial activities of our country. India has been a traditional home of cottons and cotton textiles. The four cultivated species of cotton in India are; viz. *Gossypium arboreum, Gossypium herbaceum, Gossypium hirusutum, Gossypium barbadence* and their hybrids. All these cotton species are grown under diverse agro-climatic and farming conditions. The area, production and productivity of cotton in India is 12.23 m ha, 36.1 m bales, 501 kg/ha, respectively [1].

Cotton lint is woven into fabrics either alone or combined with other fibers. The seeds contain good percentage of edible oil and residual cake is rich in proteins and used as cattle feed. Cotton production, processing and trade provide livelihood and employment to millions of people. Export of raw cotton, yarn, textile garments, cotton seed cake, etc. earns valuable foreign exchange. Cotton fiber is preferred in apparel textiles and garments because of its hydrophilic properties and hence despite severe competition from synthetic fibers, cotton continues to enjoy a place of pride in the textile industry. The demand of cotton for technical textiles- medical (surgical/absorbent cotton) and geo textiles etc. has been increasing from last few years. Besides fiber, cotton is valued for its oil and cotton seed cake and several others by products.

Nitrogen is an important element for photosynthesis and canopy area development. Providing the right amount of N during the plant growth will provide healthy leaves with the photosynthetic capacity needed to support the development of the reproductive components. On other hand an inadequate supply of N will slow or stop leaf development. Surplus N application encourages excessive vegetative growth, resulting in poor boll set caused by vegetative shading and insect attractiveness, late maturity and difficulty in defoliation.

Split application is likely to be one of the best ways to enhance the nutrient use efficiency in cotton crop. As N requirement is more and losses of N are higher and cause of potential to environment pollutant. Nitrogen uptake efficiency was increased when were applied in splits [2].

Materials and Methods

The present investigation on "Effect of application method and N scheduling on nitrogen use efficiency of *Bt* (*Bacillus thuringiensis*) cotton" was carried out during *Kharif* season 2018. The details of materials used and the

experimental techniques adopted during the course of investigation are described below:

Experimental site and location

The study was conducted at Cotton Research Area of Choudhary Charan Singh Haryana Agricultural University, Hisar, during *kharif* season 2018. Hisar is situated in the sub-tropics at longitude 75º46'E, latitude 29º10'N and altitude of 215.2 m above mean sea level in Haryana state of India.

Weather and Climate

Hisar has semi-arid climate with very hot summers (temperature rises up to 45˚C or more) and extremely cool winter (temperature falls up to 1-2˚C or less than this). During summer season as well as winter season, the mean monthly temperature shows a wide range of fluctuation in minimum and maximum temperature. In December and January month, minimum temperature may fall up to 0˚C. Out of the total rainfall, around 80% is received in south-west monsoon during July to September and average annual rainfall is 450 mm.

The present study was conducted on *Bt* cotton hybrid (RCH 650) at cotton research area, CCS Haryana Agricultural University, Hisar. There were 7 treatments including the control. Sowing was done by dibbling method on well prepared bed with row to row spacing of 90 cm and plant to plant spacing of 45cm. thinning was done to keep the good crop stand. All the intercultural operations were followed as per the package of practices of raising cotton crop recommended by the CCS Haryana Agricultural University.

Treatments

T_1: Control
T_2: 100% of RDN* (band application in 2 splits at sowing and flowering)
T_3: 75% of RDN (band application in 2 splits at sowing and flowering)
T_4: 75% of RDN + Placement (spot application in 2 splits at sowing and flowering)
T_5: 75% of RDN + Placement (spot application in 4 splits at sowing, squaring, flowering, boll development)
T_6: T_5 + foliar application of 1% urea (3 times at squaring, flowering, boll development)
T_7: T_5 + raising of moong between rows incorporated before flowering (50-55 DAS)
*RDN = Recommended Dose of Nitrogen (175 kg/ha)
Observations were recorded as per standard procedures.

Plant Analysis

The oven dried samples taken at harvest were ground, and 0.2 g for straw and 0.1 g for seed of each ground sample was digested in di-acid mixture of H_2SO_4 and $HClO_4$ (9:1) for N, P and K estimation. After digestion, a known volume was made with distilled water and filtered through Whatman filter paper No. 42. All the estimation in aliquot was made according to following procedure.

Nitrogen content and uptake at harvest

Per cent nitrogen content was determined by Nessler's Reagent Method as described by Jackson (1973). The total nitrogen uptake at harvest was calculated as under:

$$\text{N uptake by seed (kg ha}^{-1}) = \frac{\text{N content (\%) in seed X seed yield (kg ha}^{-1})}{100}$$

$$\text{N uptake by straw (kg ha}^{-1}) = \frac{\text{N content (\%) in straw X straw yield (kg ha}^{-1})}{100}$$

Phosphorous content and uptake at harvest

Per cent phosphorous content was determined by Vanadomolybdo Phosphoric Acid Yellow Colour Method. The total P uptake at harvest was calculated as under:

$$\text{P uptake by seed (kg ha}^{-1}) = \frac{\text{P content (\%) in seed X seed yield (kg ha}^{-1})}{100}$$

$$\text{P uptake by straw (kg ha}^{-1}) = \frac{\text{P content (\%) in straw X straw yield (kg ha}^{-1})}{100}$$

Potassium content and uptake at harvest

Percent potassium content was determined by Flame Photometric Method. The total P uptake at harvest was calculated as under:

$$\text{K uptake by seed (kg ha}^{-1}) = \frac{\text{K content (\%) in seed X seed yield (kg ha}^{-1})}{100}$$

$$\text{K uptake by straw (kg ha}^{-1}) = \frac{\text{N content (\%) in straw X straw yield (kg ha}^{-1})}{100}$$

Soil analysis

The composite soil samples from 0 – 15 cm depth were analysed before sowing and after harvesting for determining the available nitrogen, phosphorus and potassium.

Available N in soil was determined according to alkaline permanganate method [3].

Available P in soil was determined by Olsen's method [4].

Available K in soil was extracted by neutral normal ammonium acetate and estimated by flame photometer [5].

Statistical analysis

The experiment was conducted in RBD design along with three replications. Data used in the study are the mean values of the replicated observations. For the statistical analysis of all the research field data, online computer programme was used.

Results and Discussion

The data pertaining to total nitrogen uptake (kg ha^{-1}) presented in **Table 1**. Total nitrogen uptake was found higher in T_6 (T_5+ foliar application of 1% urea 3 times at squaring, flowering, boll development) treatment and was statistically at par with T_2 (100% of RDN band application in 2 splits at sowing and flowering), T_4 (75% of RDN + Placement; spot application in 2 splits at sowing and flowering) and T_5 (75% of RDN + Placement spot application in 4 splits at sowing, squaring, flowering and boll development), significantly higher as compared to T_1 (control), T_3 (75% of RDN ; band application in 2 splits at sowing and flowering) and T_7 (T_5+ raising of moong between rows incorporated before flowering (50-55 DAS)) treatment. Less uptake might be due to lower yield of seed cotton and cotton stalk.

Table 1 Effect of various treatments on N, P and K uptake (kg ha^{-1}) by *Bt* cotton hybrid

Treatments	Total N uptake	Total P uptake	Total K uptake
T_1- Control	226	77	261
T_2- 100% of RDN (band application in 2 splits at sowing and flowering)	362	126	396
T_3- 75% of RDN (band application in 2 splits at sowing and flowering)	315	95	385
T_4-75% of RDN + Placement(spot application in 2 splits at sowing and flowering)	342	115	363
T_5-75% of RDN + Placement (spot application in 4 splits at sowing, squaring, flowering and boll development)	357	108	415
T_6- T_5+ foliar application of 1% urea (3 times at squaring, flowering and boll development)	363	111	389
T_7 –T_5+ raising of moong between rows incorporated before flowering (50-55 DAS)	329	73	320
SEm±	9.16	3.31	10.98
CD at 5 %	28.53	10.32	34.19

Total phosphorus uptake was significantly higher in T_2 (100% of RDN band application in 2 splits at sowing and flowering) as compared to other treatments might be because optimum application of nitrogen helps in higher uptake of phosphorus.

Total potash uptake was recorded highest in T_5 (75% of RDN + Placement spot application in 4 splits at sowing, squaring, flowering and boll development) treatment which was statistically at par with T_2 (100% of RDN band application in 2 splits at sowing and flowering), T_3 (75% of RDN band application in 2 splits at sowing and flowering) and T_6 (T5+ foliar application of 1% urea 3 times at squaring, flowering, boll development) treatment, significantly higher than rest of the treatment. This is in agreement with the findings of [6], [7] and [8].

Soil status

Available nitrogen after harvesting of crop was found significantly higher in T_4 (75% of RDN + Placement; spot application in 2 splits at sowing and flowering) and T_7 (T_5+ raising of moong between rows incorporated before flowering (50-55 DAS)) treatment as compare to other treatments. Available phosphorus after harvest was statistically at par in all the treatments. Available potash after harvesting of crop was found higher in T_7 (T_5+ raising of moong between rows incorporated before flowering (50-55 DAS)) treatment which was statistically at par with T_1 (control), T_3 (75% of RDN; band application in 2 splits at sowing and flowering) treatment and significantly higher as compare to other treatments. It might be due to split application of nitrogen, incorporation of moong and less losses due to leaching and volatilization. Similar results were observed by [9].

Table 2 Effect of various treatments on available N, P and K status in soil

Treatments	**After harvest**		
	N	**P**	**K**
T_1 - Control	119	10	265
T_2 - 100% of RDN (band application in 2 splits at sowing and flowering)	112	11	261
T_3 - 75% of RDN (band application in 2 splits at sowing and flowering)	105	9	265
T_4 - 75% of RDN + Placement(spot application in 2 splits at sowing and flowering)	126	12	261
T_5 -75% of RDN + Placement (spot application in 4 splits at sowing, squaring, flowering and boll development)	119	10	263
T_6 – T_5+ foliar application of 1% urea (3 times at squaring, flowering and boll development)	119	10	263
T_7 – T_5+ raising of moong between rows incorporated before flowering (50-55 DAS)	126	11	269
SEm±	0.56	0.6	1.35
CD at 5 %	1.75	NS	4.19
Initial soil status	126	12	270

Conclusion

Based on one year data it may be concluded that available Nitrogen and Potassium was highest in T_7 where we apply 75% of recommended dose of nitrogen with spot application in four splits i.e. sowing, squaring, flowering and boll development along with moong incorporation. Uptake of nitrogen, phosphorus and potassium by crop was found lowest in control.

References

[1] Anonymous, (2019) Accessed from agricoop.nic.in. Department of Agriculture Cooperation and Farmer Welfare.
[2] Bhati AS, Manpreet S. (2015). Effect of split application of nitrogen and potassium on yield, nutrient uptake and nutrient use efficiency in Bt cotton. Annals of Plant and Soil Research. 17(1):71-73.
[3] Subbaiah, B.V and Asija, G.L. (1956). A rapid procedure of estimation of available nitrogen in soils. Current Science. 65 (7): 477-480.
[4] Jackson, M.L. (1973). Soil chemical analysis. Prentice Hall India Pvt.Limited, New Delhi. p.498.
[5] Piper, C.S. (1966). Soil and plant analysis. Hons Publishers, Bombay.
[6] Mahendran, P. P.; Subramanian, S.; Balasubramaniam, P. and Pandian, S. P. (2005). Time course leaf N concentration and yield as influenced by split application of nitrogen in wet seeded rice. Oryza., 42 (3): 188-192.
[7] Nalyaini, P.; Sankarnarayanan, K. and Anandham, R. (2010). Bio inoculants for enhancing the productivity and

nutrient uptake of winter irrigated cotton (Gossypium hirsutum L.) under graded levels of nitrogen and phosphatic fertilizers. Indian Journal of Agronomy, 55 (1): 64-67.

[8] Srinivasan, G. (2003). Response of cotton (Gossypium hirsutum) to split application of major nutrients. Indian Journal of Agronomy, 48 (1): 59-61.

[9] Jat, R. D., Nanwal, R. K., Kumar, P. and Shivaran, A. C. (2014). Productivity and nutrient uptake of Bt cotton under different spacing and nutrient levels.Journal of Cotton Research and Development. 28 (2): 260-262.

Publication History

Received	13.11.2020
Revised	17.12.2020
Accepted	06.01.2021
Online	30.01.2021