The Pharma Innovation Journal 2024; 13(6): 100-105

www.ThePharmaJournal.com

The Pharma Innovation

ISSN (E): 2277-7695
ISSN (P): 2349-8242
TPI 2024; 13(6): 100-105

www.thepharmajournal.com
Received: 02-04-2024
Accepted: 10-05-2024

Deepak Kochar
Department of Soil Science, CCS Haryana Agricultural University, Hisar, Haryana, India

Dr. Devender Singh Jakhar
Department of Soil Science, CCS Haryana Agricultural University, Hisar, Haryana, India

Dr. Dev Raj
Department of Soil Science, CCS Haryana Agricultural University, Hisar, Haryana, India

Corresponding Author:
Deepak Kochar
Department of Soil Science, CCS Haryana Agricultural University, Hisar, Haryana, India

Effect of different nutrient management practices on yield, yield attributes nutrients content and economics in Bt. Cotton

Deepak Kochar, Dr. Devender Singh Jakhar and Dr. Dev Raj

Abstract

A field experiment was conducted to study effect of different nutrient management practices on yield, yield attributed, nutrient content and economics in Bt. cotton. The experiment was laid out in a randomized block design (RBD) with following treatments i.e. T_1-Control, T_2-RDF on soil test basis (N in three split doses at basal, 45 and 75 DAS), T_3-RDN + *Azotobacter*, T_4-75%RDN + *Azotobacter*, T_5-75%RDN + *Azotobacter* + 3 foliar spray of 2.5% Urea, T_6-75% RDN + 3 foliar spray of 2.5% Urea, T_7-100% RDN in four split doses @sowing, 45, 75, 100 DAS and T_8-75% RDN in four split doses @ sowing, 45, 75, 100 DAS + 3 foliar spray of 2.5% Urea. The treatment were replicated thrice in a net plot area of 6 m x 5 m. The result revealed that the plant population was not significantly affected with different nutrient management treatments. Application of 75% RDN + 3 foliar spray of 2.5% urea (T_6) recorded highest seed cotton yield (2948.89 kg ha-1), boll weight (4.06 g), seed cotton yield per plant (200.33 g) and number of bolls per plant (49.67). Also, the highest (1.43, 0.17 and 1.96%) nutrient content in the plant was recorded in T_6 and the lowest was in control. Also, the mean value of nutrient content were observed highest at square formation stage (2.97, 0.23 and 2.83%) and lowest at harvesting except potassium. Similarly, the highest net income of (Rs.68,214/ ha) and B: C (1.84) was obtained in T_6 while it was lowest in control.

Keywords: Nutrient management, economics, yield attributes, seed cotton, nutrient content etc

Introduction

Cotton is the most important cash crop in India which has a major share in the raw material for the textile industries. Thus cotton plays a dominant role in the industrial and agricultural economy of the country. Introduction of transgenic cotton in Indian agriculture has resulted in an immense increase in seed cotton yield. This economically viable technology (Mehta *et al.*, 2009) [17] of Bt. cotton has helped significantly in increasing the net income of farmers. Accounting for 11.91 per cent production and 6.77 per cent of hectare, Haryana is the fifth largest producer of cotton in India. In the year 2002-03, Haryana produced 11.38 lack bales. The state has the second highest yield of 3.4 quintals/hectare in the country next only to that of the neighboring Punjab. About 80 per cent of the production comes from Hisar, Sirsa and Fatehabad districts. Bhiwani, Jind and Rohtak and Ambala are other cotton producing districts. Cotton plant being a heavy feeder, needs proper supply of plant nutrients for its successive cultivation (Tayade and Dhoble, 2010) [25]. The rates of nutrient uptake increase at flowering through fruiting, and then slow as the bolls mature (Mullins and Burmester, 2010) [18]. The maximum yield potential of Bt. cotton hybrid can only be achieved with suitable agronomic practices like plant geometry and optimum fertilization over the years. Cotton is a heavy feeder and removes a large quantity of nutrients from the soil thus crop nutrition forms a crucial components of cotton production (Kaur *et al.*, 2007) [12]. To cater the uptake needs of these crops, soil reserves alone are not sufficient, hence needs to supply them through chemical fertilizers. Among plant nutrients, N plays key role in crop productivity and it is regarded as growth and yield determinant in irrigated cotton (Ahmad *et al.* 2000) [1]. Low efficiency of nitrogen applied to soil is a major problem to farmers. Nitrogen was subject to leaching, denitrification and volatilization losses, which made it unavailable to crop. Therefore, it is essential to introduce such fertilizer practices as would ensure maximum efficiency of applied nitrogen and these relate to placement, split application, appropriate rates and use of nitrification inhibitor for Bt-cotton (Hallikeri *et al.*, 2010) [9]. Foliar application of nutrients is highly beneficial, as crop benefits are achieved when the roots are unable to meet the nutrient requirement of the crop at a critical stage.

Foliar applications of urea, especially late in the season when soil application may not be feasible or effective, correct the deficiency quickly and efficiently. Augmentation of nutrient supply through foliar application at the critical stage increases yield. Luo *et al*., (2015) [15] observed that the foliar application of N alone increased the total uptake of N, balanced N concentrations in different tissues through enhanced uptake and accumulation in both leaves and roots, and higher ratio of K+/Na+. Foliar fertilization does not totally replace soil-applied fertilizer but it increases the uptake and the efficiency of the nutrients applied to the soil. The foliar fertilization reduces the need for soil-applied fertilizer, reduces leaching and run-off of nutrients, reducing the impact on the environment of fertilizer salts (Bhuyan *et al.*, 2012) [2]. The foliar fertilizers provide relief and help to gain recovery from different biotic and abiotic stress and avoid root uptake problems. Biofertilizers play a very significant role in improving soil fertility by fixing atmospheric nitrogen by plant roots. These solubilise insoluble soil phosphates to soluble and produces plant growth substances in the soil. Azatobacter belongs to family Azotobacteriaceae being Chemoheterotropic in nature and is a free living, non-symbiotic in nature and fixes nearly 20 to 40 kg nitrogen ha^{-1}, produces growth promoting substances like vitamins of B group, Indole acetic acid (IAA) and Gibberellic acid (GA Application of these Biofertilizers results in increased mineral and water uptake, root development, vegetative growth and finally resulting 15 to 30 per cent increase in crop yield. The yield of Bt. cotton has been considerably improved by nutrient management practices such as nutrient levels (Ponmurugan and Gopi, 2006) [19].

To achieve the target to increase income of the farmers, the economical analysis of the produce is very essential. It is a topic of great interest how much amount is being spent for achieving a particular yield of a crop. The difference between the amount spent and yield achieved is the earning from a particular piece of land. The role of foliar application of fertilizer nutrients and application of biofertilisers in combinations with other mineral nutrients has been a subject of great concern towards increasing the yield of cotton.

Therefore, keeping the above facts in view. A field experiment entitled "Effect of different nutrient management practices on yield, yield attributes nutrients content and economics in Bt. Cotton" was designed and conducted on experimental Farm of Krishi Vigyan Kendra, Sirsa.

Materials and Methods

Experiment site characteristics

The field experiment was conducted at research farm of Krishi Vigyan Kendra (KVK), Sirsa. Sirsa is a city in the westernmost region of the Indian state of Haryana on 29.53°N latitude and longitude of 75.02°E with an altitude of 205 meter above the mean sea level. This region comes under semi-arid with an average annual rainfall of 335 mm. About 72 percent of the annual normal rainfall in the district is received during the short south east monsoon period, July to September, July and August being the rainiest months. On an average there are 20 rainy days (i.e. days with rainfall of 2.5 mm or more) in a year in the district. The maximum temperature ranges between 41.5°C to 49°C and the minimum temperature between 5.1°C to 21.5°C. January is the coldest month, whereas the temperature attains the peak towards the end of the May.

Experiment soil characteristics

The initial soil samples were collected prior to the layout of the experiment from 0-15 cm depth and analyzed for texture, physical and chemical properties following standard analytical methods. The soil was sandy loam in texture, alkaline in reaction (8.24) with electrical conductivity (0.57 dSm^{-1}), medium in organic carbon content (0.57%), low in available N (156.8 kg ha^{-1}), medium in available P (16.2 kg ha^{-1}) and medium in available K (277.5 kg ha^{-1}).

Treatments and experiment design

The different treatment used in the experiment were Control (T_1), RDF on soil test basis (N in three split doses at basal, 45 and 75 DAS) (T_2), RDN + Azotobector (T_3), 75% RDN + Azotobector (T_4), 75% RDN + Azotobector + 3 foliar spray of 2.5% Urea (T5), 75%RDN + 3 foliar spray of 2.5% Urea (T_6), 100% RDN in four split doses @sowing, 45, 75, 100 DAS (T_7), 75% RDN in four split doses @sowing, 45, 75, 100 DAS + 3 foliar spray of 2.5% Urea (T_8). The experiment was layout in randomize block design and the size of the plot is 5m x 6m. Replications were three of each of the treatment. The experimental field was ploughed twice with the tractor drawn plough followed by harrowing and cultivator. Planking was done to level the field. All the treatments were imposed using straight fertilizers Viz., Urea, Single Super Phosphate and Muriate of Potash to supply NPK. Entire phosphorus and potash was applied at the time of sowing as basal dose while nitrogen was applied in four splits at 0, 45, 75 and 100 days after sowing as recommended by CCSHAU. Three foliar sprays of Urea were applied at flowering to peak boll formation at 10 days interval.

Sampling and measurements

The data of the seed cotton yield and the yield attributing characters were recorded. The plant samples were collected at square formation, at flowering, at 50% flower opening and at harvest stage of crop from each plot. Samples were dried, ground by mechanical grinder and digested in di-acid mixture of H_2SO_4 and $HClO_4$ in a ratio of 9:1. The digested samples were analyzed in Department of Soil Science, CCS Haryana Agricultural University, Hisar using standard procedure. The nitrogen content in the dry sample were analyzed by Colorimetric method (Linder, 1944) [14], phosphorus content by Vandomolydophosphoric yellow colour method (Koening and Johnson, 1942) [3] and the potassium content by Flame photometer (Black, 1965) [3].

Statistical Analysis

The data generated in both laboratory and field experiments were statistical analysed as per the design of experiment. Treatment effects were compared with CD (0.05). Statistical analysis was done in consultation with Department of Mathematics and Statistics, CCS Haryana Agricultural University, Hisar.

Results and Discussion

Yield attributing characters

The data on effect of different nutrient management practices on yield and yield attributing characters of cotton crop have been presented in Table 1. The plant population differed due to different nutrient management practices. However, difference between plant populations due to different nutrient management practices was statistically not of significance.

The difference in plant population in different plots did not follow any definite trend. The minimum population of cotton plant was observed 14,222 in treatment T_8 whereas the maximum population of cotton plant was observed in T_7 i.e. 14,778. Boll weight is one of important character of cotton which directly affects the yield of the crop. It was revealed that the data of boll weight vary significantly and the maximum value was observed in T_6 treatment whereas the minimum was in control. Highest boll weight in treatment T_6 may be because of foliar application of urea at the time of boll development which had enhanced the N translocation to the seed, which in turn improved the seed weight. These results are in line with those of Hallikeri *et al.* (2010) [9] who reported that split application of different N levels significantly increased boll weight in cotton. Sattar *et al.* (2017) [21] also reported the similar result with split application of N with irrigation water in an experiment. The data showed a significant increase in number of bolls/ plant with application of treatments. The minimum number of bolls / plant (i.e.30.50) was observed in control plot. The maximum number of bolls/ plant (i.e. 49.67) was observed in T_6 treatment in which 75% RDN and 3 foliar spray of 2.5% Urea was applied followed by T_7 (i.e. 48.17). The data revealed that among the treatments T_6 (75% RDN + 3 foliar spray of 2.5% Urea) had significantly higher number of bolls than other treatments but it was at par with the T_7 and T_8. This might be due to higher availability of N by foliar application of urea from flowering to peak boll formation stages, which may reduce the shedding of fruiting bodies. The beneficial effects of foliar application of urea on later stage were also noted by Malode *et al.* (2014) [16]. The height of the plant was observed and revealed that it vary significantly. The minimum height of plant was observed 110.77 cm in control plot. The maximum height of plant was observed in T_7 i.e. 122.00 cm which was closely followed by T_5 i.e. 121.50 cm. The data revealed that among the treatments T_7 (100% RDN in four split doses) had significantly maximum height than other treatments but it was at par with the T_5 and T_2. This might be due to favourable effect of NPK application on growth and yield attributing characters. The variation in the plant height is probably due to difference in the dose and time of nitrogen application. Shivamurthy and Biradar (2014) [23] observed similar results on plant height with the application of recommended dose of fertilizer with FYM.

Seed cotton yield

Seed cotton yield per plant was also affected significantly with different treatments. The maximum seed cotton yield per plant was observed with (T_6)75% RDN + 3 foliar spray of 2.5% Urea (200.33 g), which was found at par with (T_8) 75% RDN in four split doses @sowing, 45, 75, 100 DAS + 3 foliar spray of 2.5% Urea (197.33 g). The minimum seed cotton yield per plot was obtained with control (Table 1). Also, the seed cotton yield was significantly affected with application of treatments. The maximum seed cotton yield was observed with (T_6)75%RDN + 3 foliar spray of 2.5% Urea (2948.89 kg ha^{-1}) which was closely followed by the seed cotton yield observed under the treatments (T_8)75% RDN in four split doses @sowing, 45, 75, 100 DAS + 3 foliar spray of 2.5% Urea (2808.89kg ha^{-1}). It may be due to impact of nitrogen application on early and vigorous vegetative growth of the crop. The increase in yield may be attributed to favourable effect of nitrogen application on yield attributing characters such as boll weight, no. of boll/ plant and plant height (Table 1). Tomar and Julka (1997) [26], Shashri *et al.* (2001) [22], Sarkar and Majumdar (2002) [20], Blaise *et al.* (2004) [4] and Devraj *et al.* (2012) [7] also reported highest biomass and yield when N was applied in split doses. The minimum seed cotton yield was observed with control (no application of fertilizers) (1878.89 kg ha^{-1}).

Table 1: Effect of nutrient management practices on ancillary characters of cotton

Treatment	Detail of treatment	Plant Population (ha)	Plant Height (cm)	No. of bolls/plant	Boll weight (g)	Yield / plant (g)	Total yield (kg ha^{-1})
T_1	Control	14,333.33	110.6	30.5	3.10	130.67	1,878.89
T_2	RDF on soil test basis (N in three split doses at basal, 45 and 75 DAS)	14,666.67	119.33	45.7	3.65	168.00	2,470.00
T_3	RDN + Azotobector	14,777.67	118.73	45.6	3.52	162.00	2,402.22
T_4	75% RDN + Azotobector	14,555.67	114.87	46.1	3.72	174.00	2,533.33
T_5	75% RDN + Azotobector + 3 foliar spray of 2.5% Urea	14,666.67	121.50	46.33	3.81	177.33	2,608.89
T_6	75% RDN + 3 foliar spray of 2.5% Urea	14,666.67	116.63	49.67	4.06	200.33	2,948.89
T_7	100% RDN in four split doses @sowing, 45, 75, 100 DAS	14,778.00	122.00	48.17	3.83	183.33	2,714.44
T_8	75% RDN in four split doses @sowing, 45, 75, 100 DAS + 3 foliar spray of 2.5% Urea	14,222.00	115.43	49.00	3.99	197.33	2,808.89
SEM+		223.712	0.993	0.882	0.013	1.315	14.752
CD at 5%		NS	3.04	2.701	0.04	4.026	45.178

Nutrient content in plant

Nitrogen content

The nitrogen content of the plant at different stages was significantly affected by the treatments (Table 2). The maximum mean value of nitrogen (1.43%) was observed in T_6 (75% RDN + 3 foliar spray of 2.5% urea) whereas the minimum mean value (1.10%) was under T_1 (control). The mean value of nitrogen content in T_6 was statistically at par with T_3, T_7 and T_8 but significantly higher than the rest of the treatment. Also, the mean value nitrogen content in the plant was highest at square formation stage (2.97%) which was significantly higher than the other stages whereas the lowest nitrogen content was it harvesting stage (0.54%). The highest value of nitrogen content in cotton plant was 3.17% at square formation stage under T_6 which was significantly higher than the rest of the treatment whereas the lowest value was 0.45% at harvesting stage under control. Higher value of nitrogen content under T_6 was might be due to foliar spray of urea which easily taken up by plant without any loss and increase the nitrogen content. The increase in N content with the foliar application of urea increased the nitrogen content which was also reported by Malode *et al.*, (2014) [16] and Devraj *et al.*, (2012) [7]. The N content was higher at square formation stage because of availability of fertilizer nitrogen to crop which was applied as basal dose during sowing of crop. The nitrogen content showed a decreasing trend as the plant became mature. It might be due to an inverse relationship between the N use efficiency and the level of N applied. Janaki *et al.*, (2004) [11] also observed the similar inverse relationship between the N use efficiency and the level of N applied.

Table 2: Effect of different nutrient management practices on the nitrogen content (%) in plant at various growth stages of cotton crop

Treatment	Detail of treatment	Square formation	Flowering	50% boll opening	Harvesting	Mean
T_1	Control	2.10	1.10	0.72	0.45	1.10
T_2	RDF on soil test basis (N in three split doses at sowing, 45 and 75 DAS)	3.07	1.16	0.85	0.55	1.41
T_3	RDN + *Azotobacter*	3.11	1.15	0.88	0.54	1.42
T_4	75% RDN + *Azotobacter*	3.05	1.18	0.83	0.56	1.41
T_5	75% RDN + *Azotobacter* + 3 foliar spray of 2.5% urea	3.01	1.17	0.84	0.57	1.40
T_6	75% RDN + 3 foliar spray of 2.5% urea	3.17	1.13	0.87	0.55	1.43
T_7	100% RDN in four split doses @sowing, 45, 75, 100 DAS	3.13	1.14	0.84	0.56	1.42
T_8	75% RDN in four split doses @sowing, 45, 75, 100 DAS + 3 foliar spray of 2.5% urea	3.13	1.12	0.85	0.56	1.42
Mean		2.97	1.14	0.84	0.54	

CD at 5%, Treatment=0.01, Stages=0.02, Treatment x Stages = 0.12

Phosphorus content

The phosphorus concentration in the plant was also significantly affected by the treatment as well as different stages of cotton crop (Table 3). The highest mean value (0.17%) of phosphorus content in the plant was reported in T_6 (75% RDN + 3 foliar spray of 2.5% urea) whereas the lowest mean value (0.12%) was in T_1 where no fertilizer was applied. The mean value of phosphorus content in T_6 was statistically at par with T_3 and T_5 but significantly higher than the rest of the treatment. However among the growth stages, the highest mean value of phosphorus content was observed at square formation stage (0.23%) which was significantly higher than the phosphorus content at rest of stages. The lowest mean value was at harvesting stage (0.07%) of the crop. The highest value of phosphorus content was 0.25% at square formation stage under T_6 which was statistically at par with the phosphorus content with all the treatment at square formation stage except control and significantly higher than rest of the treatment. Also, the lowest value of phosphorus content in plant was 0.06% at harvesting stage in T_1 which was statistically at par with all the treatments at harvesting stage except T_6 and significantly lower than the rest of the treatments. The phosphorus content of the crop decreases as the crop became mature. The decrease in the phosphorus content in plant might be due to fixation with time in soil or dilution effect which reduces the uptake. Also, phosphotic fertilizer applied at the size of sowing of crop solubalize and become available to crop at square formation stage results in higher P content at square formation stage. The results obtained are in conformity with the experimental findings of Wanjari *et al.*, (1997) [27]. Malode *et al.*, (2014) [16] also observed that the nutrient spray might have improved the photosynthesis activity and influence the P content of plant.

Table 3: Effect of different nutrient management practices on the phosphorus content in plant at various growth stages of cotton crop

Treatment	Detail of treatment	Square formation	Flowering	50% boll opening	Harvesting	Mean
T_1	Control	0.19	0.12	0.11	0.06	0.12
T_2	RDF on soil test basis (N in three split doses at sowing, 45 and 75 DAS)	0.23	0.17	0.12	0.08	0.15
T_3	RDN + *Azotobacter*	0.24	0.18	0.13	0.07	0.16
T_4	75% RDN + *Azotobacter*	0.24	0.16	0.13	0.08	0.15
T_5	75% RDN + *Azotobacter* + 3 foliar spray of 2.5% urea	0.23	0.16	0.15	0.08	0.16
T_6	75% RDN + 3 foliar spray of 2.5% urea	0.25	0.19	0.15	0.09	0.17
T_7	100% RDN in four split doses @sowing, 45, 75, 100 DAS	0.23	0.15	0.12	0.07	0.14
T_8	75% RDN in four split doses @sowing, 45, 75, 100 DAS + 3 foliar spray of 2.5% urea	0.24	0.17	0.13	0.08	0.15
Mean		0.23	0.16	0.13	0.07	

CD at 5%, Treatment=0.01, Stages=0.01, Treatment x Stages = 0.02

Potassium content

The potassium concentration in the plant was also significantly affected by the treatment as well as different stages of cotton crop (Table 4). The highest mean value (1.96%) of potassium content in the plant was reported in T_6 (75% RDN + 3 foliar spray of 2.5% urea) whereas the lowest mean value (1.81%) was in control. The mean value of potassium content in T_6 was statistically at par with T_3, T_4, T_5, T_7 and T_8 but significantly higher than the rest of the treatment. However among the growth stages, the highest mean value of potassium content was observed at square formation stage (2.83%) which was significantly higher than the mean phosphorus content at rest of stages. The lowest mean value was at 50% boll opening stage (1.44%) of the crop. The highest value of potassium content was 2.91% at square formation stage under T_6 which was statistically at par with T_3, T_4, T_5, T_7 and T_8 at square formation stage and significantly higher than rest of the treatment. Also, the lowest value of potassium content in plant was 1.37% at 50% ball opening stage in control (T_1) which was statistically at par with T_2 at 50% boll opening stage and significantly lower than the rest of the treatments. The K content increased significantly with application fertilizers in treatments over control at all four stages of growth. Hosamani *et al.,* (2013) [10] and Dastur and Ahad (1941) [5] observed that the potash content of the root, stem and leaf decreased with per unit dry matter as the plant grew indicating an increase in the dry weight of each plant in proportion to the uptake of potash from soil. The maximum K content was observed at initial stage of growth. The similar findings were observed by Dastur (1962) [6] and Wanjari *et al.,* (1997) [27].

Table 4: Effect of different nutrient management practices on the potassium content in plant at various growth stages of cotton crop

Treatment	Detail of treatment	Square formation	Flowering	50% boll opening	Harvesting	Mean
T_1	Control	2.57	1.74	1.37	1.54	1.81
T_2	RDF on soil test basis (N in three split doses at sowing, 45 and 75 DAS)	2.79	1.83	1.43	1.60	1.91
T_3	RDN + *Azotobacter*	2.86	1.84	1.45	1.59	1.94
T_4	75% RDN + *Azotobacter*	2.87	1.85	1.46	1.60	1.95
T_5	75% RDN + *Azotobacter* + 3 foliar spray of 2.5% urea	2.88	1.84	1.44	1.59	1.94
T_6	75% RDN + 3 foliar spray of 2.5% urea	2.91	1.86	1.45	1.61	1.96
T_7	100% RDN in four split doses @sowing, 45, 75, 100 DAS	2.89	1.82	1.47	1.58	1.94
T_8	75% RDN in four split doses @sowing, 45, 75, 100 DAS + 3 foliar spray of 2.5% urea	2.90	1.84	1.45	1.59	1.95
Mean		2.83	1.82	1.44	1.59	

CD at 5%, Treatment=0.03, Stages=0.03, Treatment x Stages = 0.06

Economics of cotton cultivation

The data on monetary return are presented in Table 5. The maximum gross return was obtained with T_6 (75%RDN + 3 foliar spray of 2.5% urea) of Rs.1,51,868/ha, while the minimum gross return was obtained with control (no application of fertilizer) Rs.96,763 /ha. The maximum cost of cultivation was noted with T_8 (75% RDN in four split doses @sowing, 45, 75, 100 DAS + 3 foliar spray of 2.5% urea) Rs.86,749/ha and the minimum cost of cultivation was noted with control (no application of fertilizer) Rs.65,479/ha. The maximum net monetary return was obtained with T_6 (75% RDN + 3 foliar spray of 2.5% urea) Rs.68,214/ha and the minimum net monetary return was obtained with control (no application of fertilizers) Rs.31,284/ha. The maximum benefit cost (B: C) ratio was obtained with T_6 (75% RDN + 3 foliar spray of 2.5% urea) 1.84 and minimum was in control 1.48. Shivamurthy and Biradar (2014) [23], also report similar kind of results in their research.

Table 5. Effect of different nutrient management practices on economics of cotton cultivation

Treatment	Detail of treatment	Seed cotton yield (q/ha)	Gross return (Rs/ha)	Cost of cultivation (Rs/ha)	Net return (Rs/ha)	B:C
T_1	Control	18.79	96763	65479	31284	1.48
T_2	RDF on soil test basis (N in three split doses at basal, 45 and 75 DAS)	24.70	127205	74699	52506	1.70
T_3	RDN + Azotobacter	24.02	123714	72549	51166	1.71
T_4	75% RDN + Azotobacter	25.33	130467	78696	51771	1.66
T_5	75% RDN + Azotobacter + 3 foliar spray of 2.5% urea	26.09	134358	85979	48379	1.56
T_6	75% RDN + 3 foliar spray of 2.5% urea	29.49	151868	83654	68214	1.84
T_7	100% RDN in four split doses @sowing, 45, 75, 100 DAS	27.14	139794	79547	60245	1.76
T_8	75% RDN in four split doses @sowing, 45, 75, 100 DAS + 3 foliar spray of 2.5% urea	28.12	144829	86749	58080	1.67

Conclusion

It was concluded from the study that T_6 (75% RDN + 3 foliar spray of 2.5% urea) gave highest seed cotton yield and yield attributing characters. It was significantly higher than T_2 (RDF on soil test basis (N in three split doses at basal, 45 and 75 DAS)). The nitrogen, phosphorus and potassium content in the plant was also highest under T_6 whereas the lowest content was in T_1. The benefit cost ratio of the cotton cultivation was also highest under T_6 while lowest under control.

References

1. Ahmad N. Fertilizer scenario in Pakistan policies and development. In: Proceedings of Conference Agricultural and Fertilizer Use. 2010 NFDC, P and D Division, Government of Pakistan; c1999.
2. Bhuyan MHM, Ferdousi MR, Iqbal MT. Foliar spray of nitrogen fertilizer on raised bed increases yield of transplanted aman rice over conventional method. ISRN Agronomy; c2012.
3. Black CA. Methods of Soil Analysis (Part 2). Madison, WI: American Soc. of Agron. Inc. Publ.; c1965.
4. Blaise D, Singh JV, Bonde AN, Rao MRK, Singh P. Nutrient management for sustainable cotton production on rainfed vertisol. In: International Symposium on Strategies for Sustainable Cotton Production-A Global Vision; 2004 Nov 23-25; Dharwad, Karnataka (India): University of Agricultural Sciences; c2004. p. 171.
5. Dastur TH, Ahad A. The uptake and the distribution of minerals in the cotton plants. Indian J Agric Sci. 1941;11:279-281.
6. Dastur RH. The interrelationship between the uptake of nitrogen, phosphorus and potash from the soil by cotton crop. Indian J Agric Sci. 1962;32(1):119-128.
7. Devraj, Promila K, Bhardwaj KK, Pervender S, Antil RS, Duhan BS, Gurnam S. Direct and residual effect of

integrated nutrient management on productivity and fertility status of cotton wheat cropping system. Journal of Cotton Research and Development. 2012;26(2):176-180.
8. Devraj, Sharma AP, Promila K, Duhan BS. Effect of balanced fertilization on seed cotton yield and nutrient uptake by cotton (*Gossypium hirsutum* L.) under irrigated condition. Journal of Cotton Research and Development. 2007;21(1):72-74.
9. Hallikeri SS, Halemani HL, Patil VC, Palled YB, Patil BC, Katageri IS. Effect of nitrogen levels, split application of nitrogen and detopping on seed cotton yield and fibre quality in Bt-cotton. Karnataka J Agric Sci. 2010;23(3):418-422.
10. Hosamani V, Halepyati AS, Santhosh UN, Nataraja M, Manu TG. Effect of foliar application of potassium and growth and nutrient uptake. Global Journal of Biology Agriculture and Health Sciences. 2013;21(1):29-32.
11. Janaki P, Rajarajan A, Vadivel A, Sabrinathan R. Effect of different levels of nitrogen and phosphorous on nitrogen use efficiency in hybrid cotton. In: National Symposium on Changing World Order-Cotton Research Development and Policy in Context; 2004 Aug 10-12; Hyderabad, India: AN GRAU; c2004. p. 47.
12. Kaur M, Kaur M, Brar AS. Effect of nutrients applied through organic and inorganic sources on the growth and yield of American cotton (*Gossypium hirsutum* L.). Journal of Cotton Research and Development. 2007;21(2):194-196.
13. Koeing RF, Johnson CR. Colorimetric determination of phosphorous in biological materials. Indian Engg Chem Anal Ed. 1942;14:155-156.
14. Linder RC. Rapid analytical methods for some of the more common inorganic constituents of plant tissue. Plant Physiol. 1944;19:76-89.
15. Luo Z, Kong X, Dai J, Dong H. Soil plus foliar nitrogen application increases cotton growth and salinity tolerance. Journal of Plant Nutrition. 2015;38(3):443-455.
16. Malode KR, Tamgadge DB, Rathod ND, Ghube ND. Yield and yield attributes of cotton to foliar application of nutrients under rainfed condition. Asian Journal of Soil Science. 2014;9(2):261-264.
17. Mehta AK, Thakral SK, Saharan HS. Effect of organic and inorganic sources of nutrition on yield and fibre quality of cotton (*Gossypium hirsutum*). Journal of Cotton Research and Development. 2009;23(2):255-257.
18. Mullins GL, Burmester CH. Relation of growth and development to mineral nutrition. In: *Physiology of Cotton*. Dordrecht: Springer; c2010. p. 97-105.
19. Ponmurugan P, Gopi C. *In vitro* production of growth regulators and phosphatase activity by phosphate solubilizing bacteria. African Journal of Biotechnology. 2006;5(4):348-350.
20. Sarkar RK, Majumdar RC. Effect of farmyard manure, nitrogen and phosphorus on yield and fibre quality of upland cotton (*Gossypium hirsutum*) in rice fallow land. Indian Journal of Agricultural Science. 2002;72(10):607-610.
21. Sattar M, Safdar ME, Iqbal N, Hussain S, Waqar M, Ali MA, Ali A, Javed MA. Timing of nitrogen fertilizer application influences on seed cotton yield. International Journal of Advanced Science and Research. 2017;2(1):6-9.
22. Shashri G, Thyagarajan CP, Shrimathi P, Malaskodi K, Venkateshalam EP. Influence of higher levels of NPK on seed cotton yield, and seed quality characters of cotton cv. MCU-5 and hybrid TCHB-213. Madras Agricultural Journal. 2001;88(1-3):60-63.
23. Shivamurthy D, Biradar DP. Effect of foliar nutrition on growth, yield attributes and seed cotton yield of Bt cotton. Karnataka Journal of Agricultural Sciences, 2014, 27(1).
24. Singh K, Rathore P, Gumber RK. Effects of foliar application of nutrients on growth and yield of Bt cotton (*Gossypium hirsutum* L.). Bangladesh Journal of Botany. 2015;44(1):9-14.
25. Tayade AS, Dhoble MV. Effect of transgenic Bt cotton hybrid, nutrient and pest management on seed cotton yield, nutrient uptake and status of available nutrient in soil. Indian Journal of Fertilizers. 2010;6(8):34-40.
26. Tomar RSS, Julka R. Effect of fertility levels and spacing on growth and yield of *hirsutum* cotton genotypes under rainfed conditions. Crop Research-Hisar. 1997;14:421-426.
27. Wanjari SS, Wankhede SG, Potidhukhe NR, Patil DR, Ingle RW. Nutrient uptake behaviour of field crops. Indian J Agric Sci. 1997;31:127-132.