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EFFECT OF SPLIT APPLICATION OF NITROGEN AND POTASSIUM ON YIELD, NUTRIENT UPTAKE AND NUTRIENT USE EFFICIENCY IN BT COTTON

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ABSTRACT

A field experiment was conducted to assess N and NK split application to synchronize nutrient application with crop demand. Nine timings of application and different dose of N and NK both were taken as different treatments. Timings were planned to supply the fertilizer at different crop growth stages i e., as basal at 30, 45, 60 and 75 DAS. Split application of N and NK did not have any significant effect on seed cotton yield, yield per plant, bolls per plant, boll weight, seed index, lint yield and G.O.T. (Ginning Percentage).Bolls per plant was affected significantly with interaction between the fertilizer and its timing of application. Similarly, split application of N at basal, 30 and 60 DAS (50-25-25), timing of fertilizer application resulted in significant difference for N,P and K uptake. Nitrogen uptake was highest, when the fertilizer was applied in four equal doses at sowing time, 30, 45 and 75 DAS (553 kgha^{-1}). Potassium use efficiency was found to be significantly higher in N split application as compared to NK split application treatment (5.43 KUE).Oil content was found to be significantly higher in NK split application over only N split application. Timing of fertilizer application did not influence the oil content in seeds.

Key words: Bt cotton, nitrogen, potassium, split application, nutrient use efficiency

INTRODUCTION

Cotton is an important commercial crop in India because it plays vital role in Indian economy. Bt cotton has been developed by transferring crystal protein gene (Cry1AC) from a soil bacterium *Bacillus thurigiensis* var. Kurstaki in to cotton. Research on Bt cotton in India is monitored and resulted by the department of Biotechnology, Government of India. Mahyco in collaboration with Monsanto Company of USA started efforts to commercialize Bt cotton in India. In northern cotton growing states, Viz. Punjab, Haryana and Rajasthan six Bt cotton hybrids were approved for commercial cultivation for the first time during 2005. Out of these six Bt cotton hybrids, two each have been developed by Mahyco (MRC 6301 Bt and MRC 6304 Bt), Rasi seeds (RCH 134 Bt and RCH 317 Bt) and Ankur seeds (Ankur 651 Bt and Ankur 2534 Bt) (Singh and Kaushik, 2007).Nitrogen is most essential nutrient for plant growth needs to be supplied in proper time and quantities. A positive correlation between vegetative growth and the number of fruiting points produced by cotton is well known. N supplement therefore by split application becomes important as it is supplied ideally in a time when crop critically requires. Bt cotton differs in its requirement either by total of it in the different stages of crop. Split applications of nitrogen fertilizer can play an important role in a nutrient management strategy that is productive, profitable and environmentally responsible. Application of nitrogen in two or more than two splits doses can help growers enhance nutrient efficiency, promote optimum yield and mitigate the loss of nutrient. Potassium (K) is the third major essential plant nutrient along with N and P. Potassium plays a specific role in most plant species in opening and closing of stomata which cannot be done by other cation (Saxena, 1985).It increases root growth and improves drought resistance, activates many enzymes systems, reduce water loss and willing, prevent energy losses and aids in photosynthesis, respiration and food formation (Tiwari, 2001). As the requirement of plants to potassium differ from stage to stage (Brady, 1996) and there might be better response of plants to potassium, if potassium is applied in splits at different stages. Therefore the present study was initiated using Bt cotton as test crop.

MATERIALS AND METHODS

A field experiment was conducted at PAU, Regional Station, Abohar (Punjab) during kharif season 2008. The soil was sandy loam in texture having organic carbon 4.9 g kg^{-1} available P_2O_5 30 kg ha^{-1} and available k_20 560 kg ha^{-1}. There were 18 treatment combinations comprising N and NK split application Viz. T_1, 2 splits (50-50) at sowing and 45 DAS,T_2, 3 split (50-25-50) at sowing, 45 and 75 DAS,T_3, 3 splits (30-40-30) at sowing, 45 and 75 DAS,T_4, 3 splits (50-25-25) at sowing, 30 and 45 DAS,T_5, 3 splits (50-25-25) at sowing, 30 and 60 DAS,T_6, 3 splits (50-25-25) at sowing, 45 and 60 DAS,T_7, 3 splits (50-25-25) at sowing , 30 and 75 DAS,T_8, 4 splits (25-25-25-25) at sowing, 30, 45 and 60 DAS.T_9, (25-25-25-25) at sowing, 30, 45and 75 DAS. These were evaluated in factorial randomized block design with three replications in 8 rows × 9 m plots. Bt cotton Hybrid RCH-134 was sown

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on 18.05.2008. In N split dose plots, whole of P and K was applied at the time of sowing as basal dose in the form of DAP and MOP @ 67.5 kg ha^{-1} and 50 kg ha^{-1}, respectively. The nitrogen was applied in the form of urea @ 325 kg ha^{-1}in the split dose as per treatments. In NK split dose plots, only P was applied as recommended dose, while N and K was applied at the same rates in splits as per treatments. Number of boll per plant, boll weight, yield per plant and seed cotton yield were recorded. The uptakes of N, P and K at harvest by plant were computed by multiplying content value with yield data. Samples were analyzed for N by colorimetric method (Snell and Snell, 1939), P content was determined by vanadomolybdo phosphoric acid yellow method (Jackson, 1973) and K by flame photometer.in di acid digests. Oil content in seed was determined by solvent extraction method. The nutrient use efficiency was worked out by Crasswell and Godwin (1984) and expressed in kg seed cotton kg^{-1} nutrient.

RESULTS AND DISCUSSION

Split application of N and NK did not have any significant effect on seed cotton yield, yield per plant, bolls/plant, boll weight, seed index, lint yield and G.O.T. (Ginning Percentage). Similarly, a non-significant effect due to split application of N was recorded by Solaiappan and Sheriff (1994) and Hallikeri *et al*. (2010). Oil content was significantly higher in NK split application (22.76 %) as compared to N split application. Timing of fertilizer application did not show any significant effect on oil content but higher (22.77%) amount was noted when the fertilizer was applied in three splits (50-50-25) at sowing, 30 and 60 DAS (Table1). Timing of fertilizer application at different stages of crop growth did not show any significant effect on any of these parameters. Bolls/ plant showed significant interaction between the fertilizer and its timing of application (Table.1). Split application of both N and K at basal and 45 DAS (T_1) and basal, 45 and 75 DAS (50-25-25) i.e. T_2: gave higher bolls per plant than other combinations. This might be due to continued availability of nitrogen and potassium to the crop all through its growth period. This is in agreement with the findings of Mondal *et al. (*1982). Similarly, split application of N at basal, 30 and 60 DAS (50-25-25) i.e., T_5 gave higher bolls per plant as compared to NK split application at same timings. Supplementation of N at these stages may be ideal to meet the requirement even for Bt- cotton (Srinivasan 2003). At any other timing, split application of N and NK both exhibit non-significant differences.

Table 1: Interaction effect of split application of N and K fertilizer with timing of fertilizer application

Treatments	Bolls per plant	
	N	NK
T_1. 50-50 (0 and 45 DAS)	30.9	44.6
T_2. 50-25-25 (0 45 and 75 DAS)	33.7	50.5
T_3. 30-40-30(0 45 and 75 DAS)	37.9	43.5
T_4. 50-25-25(0 30 and 45 DAS)	35.3	29.3
T_5. 50-25-25(0 30 and 60 DAS)	44.9	30.7
T_6. 50-25-25(0 45 and 60 DAS)	35.1	41.8
T_7. 50-25-25(0 30 and 75 DAS)	35.7	41.7
T_8.25-25-25-25(0 30, 45 and 60 DAS)	44.5	37.6
T_9. 25-25-25-25(0 30, 45 and 75 DAS)	41.7	42.6
CD (P=0.05)	10.4	

The P uptake was significantly higher in N split application as compared to both NK split application, whereas K uptake showed the reverse trend with significantly higher value in NK split application over N application alone. Nitrogen and K in splits might have supplied adequate quantity of nutrients to coincide with peak demand for nutrients to cotton. Besides, the external application of K might

Table 2: Yield and quality parameters of RCH 134 Bt as influenced by split application of N and K fertilizer

Treatments	Seed Cotton Yield (Kg/ha)	Yield per Plant (g)	Bolls per plant	Boll weight (g)	Seed Index (g)	Oil content (%)	Lint yield (Kg ha^{-1})	G.O.T (%)
Fertilizer with split doses								
N	2281	173.3	40.2	4.47	9.64	22.28	790	34.67
NK	2183	165.6	37.8	4.35	9.87	22.76	757	34.64
CD (P=0.05)	NS	NS	NS	NS	NS	0.33	NS	NS
Timing of application								
T_1	2141	166.7	37.8	4.50	9.39	22.64	743	34.74
T_2	2307	180.0	42.1	4.31	9.70	22.74	788	34.16
T_3	2264	170.0	40.7	4.16	9.80	22.29	782	34.66
T_4	2068	138.3	32.3	4.04	9.87	22.30	716	34.60
T_5	2197	168.3	37.8	4.48	9.60	22.77	743	33.76
T_6	2237	171.7	38.4	4.70	9.79	22.56	768	34.16
T_7	2253	171.7	38.7	4.48	9.78	22.35	809	35.94
T_8	2292	176.7	41.1	4.56	9.91	22.39	801	35.07
T_9	2327	181.7	42.2	4.48	9.97	22.64	815	34.84
CD (P=0.05)	NS	NS	NS	NS	NS	NS	NS	NS

have increased the quantity of readily available K to cotton thus resulting in higher K uptake (Srinivasan, 2003). Nitrogen uptake did not show any significant difference while comparing N and NK split application (Table 2). Timing of fertilizer application resulted in significant differences for N. P and K uptake. Nitrogen uptake was highest when the fertilizer was applied in 4 equal doses at sowing, 30, 45 and 75 DAS (T_9) and was at par with 4 equal doses at sowing, 30, 45 and 60 DAS (T_8). Phosphorus and K uptake was highest when the fertilizer was applied in 4 equal doses at sowing, 30, 45 and 60 DAS (T_8).This might be due to attributed to improved utilization of N in the presence of K. Similar positive effect of potassium application on N uptake was reported by Senthivel and Paloniappan (1985). Superiority of split application of N and NK might be attributed to availability of nutrients at growth stage when cotton crop starts growing faster. This may be due to prevention of loss through leaching.

Table 3: Nutrient uptake inRCH 134 Bt as influenced by split application of N and K fertilizer

Treatments	N (kg ha^{-1})	P (kg ha^{-1})	K (kg ha^{-1})	Nutrient Use Efficiency(kg seed cotton kg^{-1} NPK applied)		
				Nitrogen	Phosphorus	Potassium
Fertilizer with split doses						
N	426	163	436	5.56	14.44	5.43
NK	446	148	481	5.34	15.49	4.76
CD (P=0.05)	NS	15	41	NS	NS	0.58
Timing of application						
T_1	489	162	531	4.50	13.63	4.16
T_2	503	155	484	4.79	15.65	4.99
T_3	440	147	392	5.35	15.94	5.86
T_4	303	128	407	6.97	16.53	5.22
T_5	378	153	454	6.00	14.94	5.10
T_6	378	144	410	6.19	15.91	5.71
T_7	343	152	416	6.66	15.18	5.59
T_8	537	182	553	4.34	13.26	4.31
T_9	553	175	480	4.26	13.65	4.90
CD (P=0.05)	84	31	87	1.29	NS	NS

Nutrient use efficiency of nitrogen and phosphorus was not affected significantly by N and NK split application, but K use efficiency was found to be significantly higher in N split application (5.43 kg ha^{-1}) as compared to NK split application treatment. Nutrient use efficiency of P and K was not influence by timing of fertilizer application, whereas N use efficiency was significantly higher (6.97 kg ha^{-1}) when the fertilizer was applied at sowing, 30 and 45 DAS (T_4).

REFERENCES

Brady, N. C. (1996) The Nature and properties of soils.Prentice hall of India Pvt. Ltd., New Delhi. P: 369

Crasswell, E. T. and Godwin, D. C. (1984) The efficiency of nitrogen fertilizers applied to cereals in different climates. Advance in Plant Nutrition.Vol.I, Praegor Scientific, NewYork. pp 1-55

Hallikeri,S. S., Halemani, H. L., Patil, V. C. Palled, Y. B., Patil, B. C. and Katageri, I.S. (2010) Effect of nitrogen levels, split application of nitrogen and detopping on seed cotton yield and fibre quality in Btcotton. *Karnataka Journal of Agricultural Sci*ences, 23(3):418-422

Jakson, M. L. (1973) Soil Chemical Analysis Prentice Hall of India Private Limited,New Delhi.

Mondal, S.S.; Dasmahapatra, A.N. and Chatterjee, B.N, (1982) Potassium nutrition at high level of N fertilization on rice. *Potash Review* 52, 1-7.

Saxena, N. P. (1985) The role of potassium in drought tolerance. Based on paper published in *Potash Review*, subject 16, site 102 (1985) ICRISAT, Patancheru, Andhra Pradesh. P: 37-38

Senthivel, T. and Palaniappan, S. P. (1985) Effect of Potash top dressing through NK granules on yield and nutrient uptake of rice under low rand conditions. *Journal of potassium Research* 1:166-173.

Singh, Jagmail and Kaushik, S. K. (2007) Bt cotton in India, *India farming*. P: 25-28.

Snell, F.D. and Snell, C.T. (1939) Colorimetric Methods of Analysis, 3rd Edn.VanNostrand Co. Inc., New York.

Solaiappan, U. and Sherif Mohammed, N. (1994) Effect of tillage practices and nitrogen application in cotton (*Gossypium spp.*) grown after rice. *Indian Journal of Agronomy*, 39(2):302-304

Srinivasan, G. (2003) Response of cotton (*Gossypium hirsutum*) to split applicaton of major nutrients.Indian J. Agronomy, 48:59-61

Tiwari, K. N. (2001) Potassium needs of Indian soils and crops. *Fertilizer Marketing News*. 32(10):1-7.