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Research Paper

Yield and nutrient uptake of *Kharif* Bt cotton as influenced by conjoint use of FYM and chemical fertilizers

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ABSTRACT

The field experiment was conducted on vertisols at Rahuri to study the effect of conjoint use of FYM and chemical fertilizers on yield and nutrient uptake by *Kharif* Bt cotton (NCS-207, Mallica) during 2007-08 in fractional factorial randomized block design with 21 treatment including 3 control treatment replicated thrice. The result revealed that increasing trend in yield of Bt cotton with increase in FYM and similar trend was also observed with respect to N, P and K uptake by Bt cotton.

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Key words : Bt-cotton, Yield, Nutrient uptake, FYM, Chemical fertilizers

INTRODUCTION

Cotton is mainly a *Kharif* season crop. Bt cotton is one of the important commercial cash crops playing a key role in economic, political and social affairs of the world. Cotton is an important cash crop of Maharashtra in general and Marathwada in particular.

The fertilizer use in cotton has tremendously increased since 1960s in the country. Balanced fertilization *i.e.* appropriate quantity of nutrients in required proportions at right time, applied through right method. It is very essential to bring economy in the use of inorganic fertilizer by their judicious use in combination with organic manures for improving yield potential of the crop. It is also required to provide the crop with secondary and micronutrients in order to maintain high yield and nutrient uptake by Bt Cotton grown in vertisols.

It will be always better than the soil fertility and crop requirement should be based on fertilizing the crops.

MATERIALS AND METHODS

A field experiment based on inductive-methodology was conducted in vertisols of Rahuri during *Kharif* 2007-08 with Bt cotton (var. Mallica NCS-207). The soil of the experimental field was clayey in texture with pH 8.1 and EC 0.30 dSm^{-1}. The initial $KMnO_4$-N – Olsen – P and NH_4OAC – K status were 191.6, 17.69 and 449.8 kg ha^{-1}, respectively. Following the inductive methodology, three fertility gradients were created by dividing the experimental field into three equal strips which were fertilized with $N_0P_0K_0$, $N_1P_1K_1$ and $N_2P_2K_2$ levels. The recommended fertilizers ($N_1P_1K_1$) were 200, 150 and 150 kg ha^{-1} of N, P_2O_5 and K_2O, respectively. An exhaust crop of fodder maize was grown so that the fertilizers could undergo transformations in the soil with plant and microbial agencies.

By growing the exhaust crop, the operational range of soil fertility was created in the fertility strips which was evaluated in forms of variations in fodder yield uptake and soil test values. After the harvest of the exhaust crop, each fertility strip was divided into 24 plots, out of which there were 21 treatments with three levels of N (100, 200 and 300 kg ha^{-1}), three levels of P_2O_5 (75, 125 and 150 kg ha^{-1}), three levels of K_2O (100, 150 and 200 kg ha^{-1}) and

three levels of FYM (0, 10 and 20 t ha^{-1}) and 3 controls were superimposed to different plots in each strip in such a way that these occurred in three consecutive sub-blocks whether taken in north to south or east to west direction thus making a total of 72 plots over the three strips in both the directions. The fertilizer components *viz.,* NPK alone, NPK plus FYM were applied across each strip. Pre-sowing soil samples were collected from each plot before the superimposition of the treatments and were analysed for alkaline $KMnO_4$-N (Subbiah and Asija, 1956), Olsen-P (Olsen *et al.,* 1954) and neutral normal NH_4OAC-K (Hanway and Heidal, 1952). The test crop Bt cotton (var. Mallica, NCS-207) sowed during July, 2007 and grown to maturity and harvested during December 2007. The seed and stalk yields were recorded plot wise. The plant samples from each plot were analysed for total N, P and K content (Piper, 1966) and total uptake was computed using Bt cotton seed and stalk yield data.

RESULTS AND DISCUSSION

The results of the present investigation alongwith relevant discussion have been presented as under :

Crop yield:

The data pertaining Bt cotton of seed and stalk yield (Table 1) indicate an increasing trend in yield of Bt cotton with increase in FYM from o to 10 and 20 t/ha.

In F_1 and F_2 FYM blocks the same trend of increase in seed and stalk yield of treated and control plots were observed with increasing levels of NPK combinations. The average seed and stalk yield in treated plots was increased with increasing levels of FYM from F_0 to F_2. Average seed and stalk yield in treated plots were (12.99, 13.48,13.62 q ha^{-1}) and (49.97,53.55,59.20 q ha^{-1}) in F_0, F_1 and F_2 FYM levels, respectively. This shows the beneficial effect of FYM in increasing the yield.

This was clearly indicated that addition of FYM alone and in combination with NPK fertilizers helped in increasing seed and stalk yield of Bt cotton.

Uptake of nutrients:

The nitrogen, phosphorus and potassium uptake in seed and stalk increased with increasing fertilizer doses and with increase in FYM levels (Table 2). The uptake of nitrogen increased from 159.87 kg ha^{-1} in F_0 blocks to 173.83 kg ha^{-1} in F_1 and 192.37 kg ha^{-1} in F_2 blocks, which

Table 1: Seed and straw yield of *Kharif* Bt cotton (q ha^{-1}) as influenced by conjoint use of FYM and chemical fertilizers

Sr. No.	Treatments	F_0 block		F_1 block		F_2 block	
		Seed	Straw	Seed	Straw	Seed	Straw
1.	$N_{300}P_{150}K_{200}$	19.71	67.89	12.42	69.64	16.27	75.47
2.	$N_{300}P_{150}K_{150}$	11.87	67.72	16.14	67.79	17.50	71.63
3.	$N_{300}P_{150}K_{100}$	11.76	60.32	16.02	67.27	17.42	67.79
4.	$N_{300}P_{125}K_{200}$	15.45	71.20	11.64	55.46	15.23	71.31
5.	$N_{300}P_{125}K_{150}$	14.88	56.44	17.30	84.25	11.47	63.42
6.	$N_{300}P_{125}K_{100}$	17.27	76.61	11.27	53.24	14.87	55.36
7.	$N_{300}P_{75}K_{100}$	14.66	52.45	16.86	76.48	10.96	56.84
8.	$N_{200}P_{150}K_{200}$	10.73	48.86	14.54	49.04	15.93	75.21
9.	$N_{200}P_{150}K_{150}$	14.47	46.61	15.83	72.09	10.45	56.60
10.	$N_{200}P_{125}K_{200}$	14.77	46.61	9.77	46.45	14.17	55.67
11.	$N_{200}P_{125}K_{150}$	14.04	39.30	15.45	71.10	9.59	55.23
12.	$N_{200}P_{125}K1_{00}$	8.92	44.35	14.98	39.07	15.42	70.75
13.	$N_{200}P_{125}K_0$	13.77	3.95	16.41	54.18	8.56	54.26
14.	$N_{200}P_{75}K_{150}$	88.22	40.87	12.58	41.62	15.21	65.68
15.	$N_{200}P_{75}K_{100}$	15.01	60.93	10.48	40.20	13.30	48.18
16.	$N_{200}P_0K_{150}$	14.77	60.34	9.00	39.88	12.84	46.84
17.	$N_{100}P_{125}K_{150}$	13.77	39.09	8.89	36.26	12.77	45.91
18.	$N_{100}P_{125}K_{100}$	8.04	39.34	12.44	34.20	14.37	57.66
19.	$N_{100}P_{75}K_{150}$	12.36	34.18	14.37	43.38	13.88	49.11
20.	$N_{100}P_{75}K_{100}$	12.29	33.06	14.36	49.91	13.16	50.80
21.	$N_0P_{125}K_{150}$	6.21	24.25	11.59	33.00	12.69	49.29
	Average of treated plots	12.99	49.97	13.48	53.55	13.62	59.20
	Average of control plots	8.03	27.51	10.11	32.15	11.23	34.67

Table 2: Nitrogen uptake by Bt cotton (kg ha^{-1}) as influenced by conjoint use of FYM and chemical fertilizers

Sr. No.	Treatments	FYM blocks									Average (kg ha^{-1})		
		F_0			F_1			F_2					
		Seed	Straw	Total	Seed	Straw	Total	Seed	Straw	Total	Seed	Straw	Total
1.	N_{300}-P_{150}-K_{200}	78.05	170.41	248.46	39.00	186.64	225.63	57.76	166.80	224.56	58.27	174.62	232.88
2.	N_{300}-P_{150}-K_{150}	37.27	168.62	205.89	57.30	171.51	228.81	69.30	161.92	231.22	54.62	167.35	221.97
3.	N_{300}-P_{150}-K_{100}	36.96	147.78	184.71	56.87	168.18	225.05	68.98	160.25	229.23	54.27	158.74	213.00
4.	N_{300}-P_{125}-K_{200}	61.18	160.91	222.18	36.55	134.77	171.32	54.07	164.38	218.45	50.60	153.35	203.98
5.	N_{300}-P_{125}-K_{150}	52.82	131.51	184.33	68.51	197.15	265.65	45.42	165.80	211.22	55.58	164.82	220.40
6.	N_{300}-P_{125}-K_{100}	68.39	177.74	246.12	35.39	122.98	158.37	52.79	155.53	208.32	52.19	152.08	204.27
7.	N_{300}-P_{75}-K_{100}	52.84	128.50	180.55	66.77	175.14	241.90	43.40	167.95	211.35	54.34	157.20	211.27
8.	N_{200}-P_{150}-K_{200}	33.69	112.93	146.62	51.62	116.72	168.33	56.55	174.25	230.80	47.29	134.63	181.92
9.	N_{200}-P_{150}-K_{150}	51.37	112.80	164.16	62.69	167.25	229.94	41.38	167.84	209.22	51.81	149.30	201.11
10.	N_{200}-P_{125}-K_{200}	52.43	112.79	165.22	30.68	105.91	136.58	56.11	176.21	232.32	46.41	131.64	178.04
11.	N_{200}-P_{125}-K_{150}	49.84	91.96	141.80	61.18	159.26	220.45	37.98	163.34	201.32	49.67	138.19	187.86
12.	N_{200}-P_{125}-K_{100}	28.01	102.89	130.90	59.32	92.99	152.32	48.42	176.78	225.20	45.25	124.22	169.47
13.	N_{200}-P_{125}-K_0	48.88	86.47	135.35	51.53	113.78	165.22	33.89	125.75	159.64	44.77	108.67	153.40
14.	N_{200}-P_{75}-K_{150}	25.81	90.32	116.13	44.66	91.56	136.22	47.75	170.11	217.86	39.41	117.33	156.74
15.	N_{200}-P_{75}-K_{100}	59.44	133.44	192.88	41.50	90.05	131.55	47.21	112.09	159.30	49.38	111.86	161.24
16.	N_{200}-P_0-K_{150}	58.49	132.14	190.63	38.80	99.70	138.56	45.58	119.97	165.55	47.62	117.27	164.91
17.	N_{100}-P_{125}-K_{150}	48.88	86.78	135.66	35.20	87.02	122.22	45.33	99.89	145.22	43.14	91.23	134.37
18.	N_{100}-P_{125}-K_{100}	25.25	84.97	110.22	44.16	74.90	119.06	56.91	128.58	185.49	42.11	96.15	138.26
19.	N_{100}-P_{75}-K_{150}	43.88	72.46	116.34	45.12	91.10	136.22	43.58	72.04	115.62	44.19	78.53	122.73
20.	N_{100}-P_{75}-K_{100}	43.63	70.09	113.72	45.09	117.78	162.87	41.32	80.00	121.32	43.35	89.29	132.64
21.	N_0-P_{125}-K_{150}	19.50	50.93	70.42	41.14	72.93	114.07	39.84	94.82	134.66	33.49	72.89	106.38
	Average of treated plots	46.47	113.40	159.87	48.24	125.59	173.83	49.31	143.06	192.37	48.01	127.35	175.36
	Control average	26.26	54.52	80.78	38.52	61.78	100.30	36.62	73.85	110.47	33.80	63.38	97.18

Table 3: Phosphorus uptake by Bt cotton (kg ha^{-1}) as influenced by conjoint use of FYM and chemical fertilizers

Sr. No.	Treatments	FYM blocks									Average (kg ha^{-1})		
		F_0			F_1			F_2					
		Seed	Straw	Total	Seed	Straw	Total	Seed	Straw	Total	Seed	Straw	Total
1.	$N_{300}P_{150}K_{200}$	13.99	52.95	66.88	10.06	66.08	76.14	14.48	77.77	92.25	12.84	65.60	78.42
2.	$N_{300}P_{150}K_{150}$	8.42	46.32	54.74	12.75	59.65	82.40	14.17	81.01	95.18	11.78	62.33	77.44
3.	$N_{300}P_{150}K_{100}$	8.11	44.76	52.87	12.50	70.78	83.28	14.11	96.01	110.12	11.57	70.52	82.09
4.	$N_{300}P_{125}K_{200}$	11.43	52.78	64.21	8.85	67.37	76.22	12.34	73.12	85.46	10.87	64.42	75.30
5.	$N_{300}P_{125}K_{150}$	11.30	51.14	62.44	13.67	60.58	74.25	11.69	78.53	90.22	12.22	63.42	75.64
6.	$N_{300}P_{125}K_{100}$	12.43	50.22	62.65	8.57	55.68	64.25	13.23	66.99	80.22	11.41	57.63	69.04
7.	$N_{300}P_{75}K_{100}$	9.53	28.29	37.82	12.14	33.48	45.62	8.88	37.91	46.79	10.18	33.23	43.41
8.	$N_{200}P_{150}K_{200}$	7.72	63.49	71.21	11.05	80.17	91.22	14.34	83.10	97.44	11.04	75.59	86.62
9.	$N_{200}P_{150}K_{150}$	9.69	60.53	70.22	12.34	77.87	90.21	8.46	80.20	88.66	10.16	72.87	83.03
10.	$N_{200}P_{125}K_{200}$	10.63	48.59	59.22	7.03	58.22	65.25	12.89	58.33	71.22	10.18	55.05	65.23
11.	$N_{200}P_{125}K_{150}$	9.13	30.77	59.25	12.05	51.20	63.25	8.63	80.29	88.92	9.94	54.09	70.47
12.	$N_{200}P_{125}K_{100}$	5.79	44.99	50.78	11.38	59.84	71.22	13.72	66.53	80.25	10.30	57.12	67.42
13.	$N_{200}P_{125}K_0$	9.50	38.94	48.44	12.14	60.31	72.45	7.79	69.93	77.72	9.81	56.39	66.20
14.	$N_{200}P_{75}K_{150}$	4.77	31.78	36.55	9.05	32.17	41.22	12.32	38.55	50.87	8.71	34.17	42.88
15.	$N_{200}P_{75}K_{100}$	10.81	37.57	48.38	7.54	32.99	40.53	10.91	44.99	55.90	9.75	38.52	48.27
16.	$N_{200}P_0K_{150}$	10.63	33.62	44.25	6.95	26.43	33.38	10.40	24.47	34.87	9.33	28.17	37.50
17.	$N_{100}P_{125}K_{150}$	10.18	51.44	61.62	6.13	59.75	65.88	10.47	74.53	85.00	8.93	61.91	70.83
18.	$N_{100}P_{125}K_{100}$	5.78	51.51	57.29	9.45	40.89	50.34	12.78	73.34	86.12	9.34	55.25	64.58
19.	$N_{100}P_{75}K_{150}$	8.90	32.32	41.22	10.92	31.32	42.24	12.35	32.99	45.34	10.72	32.21	42.93
20.	$N_{100}P_{75}K_{100}$	8.48	34.68	43.16	10.63	30.59	41.22	11.71	34.81	46.52	10.27	33.36	43.63
21.	$N_0P_{125}K_{150}$	3.60	15.04	18.64	7.53	21.45	28.98	10.27	40.12	50.39	7.13	25.54	32.67
	Average of treated plots	9.09	42.91	52.00	10.13	50.32	60.45	11.85	62.54	74.39	10.36	51.92	62.28
	Control average	5.30	10.41	15.71	7.08	16.86	23.94	27.42	45.89	73.31	13.27	24.39	37.65

Table 4 : Potassium uptake by Bt cotton (kg ha^{-1}) as influenced by conjoint use of FYM and chemical fertilizers

Sr. No.	Treatments	FYM blocks									Average (kg ha^{-1})		
		F_0			F_1			F_2					
		Seed	Straw	Total	Seed	Straw	Total	Seed	Straw	Total	Seed	Straw	Total
1.	N_{300}-P_{150}-K_{200}	32.92	109.08	142.00	20.74	121.48	142.22	27.50	114.05	141.55	27.05	114.87	141.92
2.	N_{300}-P_{150}-K_{150}	19.11	99.44	118.55	21.30	100.95	122.25	28.18	101.75	129.93	22.86	100.71	123.58
3.	N_{300}-P_{150}-K_{100}	18.46	91.76	110.22	21.15	111.07	132.22	28.04	90.70	118.74	22.55	97.84	120.39
4.	N_{300}-P_{125}-K_{200}	26.42	116.58	143.00	20.25	125.53	145.78	23.91	114.64	138.55	23.53	118.92	142.44
5.	N_{300}-P_{125}-K_{150}	23.36	98.86	122.22	25.43	106.79	132.22	19.15	101.07	120.22	22.65	102.24	124.89
6.	N_{300}-P_{125}-K_{100}	26.25	82.97	109.22	19.38	92.84	112.22	23.94	98.28	122.22	23.19	91.36	114.55
7.	N_{300}-P_{75}-K_{100}	23.01	78.54	101.55	24.78	84.88	109.66	18.74	116.48	135.22	22.18	93.30	115.48
8.	N_{200}-P_{150}-K_{200}	19.09	119.46	138.55	21.37	133.85	155.22	26.92	114.70	141.62	22.46	122.67	145.13
9.	N_{200}-P_{150}-K_{150}	22.14	90.41	112.55	23.27	106.29	129.56	17.45	113.77	131.22	20.95	103.49	124.44
10.	N_{200}-P_{125}-K_{200}	23.18	103.27	126.45	15.73	129.89	145.62	22.81	128.42	151.23	20.57	120.53	141.10
11.	N_{200}-P_{125}-K_{150}	22.04	99.19	121.23	22.71	89.51	112.22	16.01	125.25	141.26	20.25	104.65	124.90
12.	N_{200}-P_{125}-K_{100}	14.36	84.28	98.64	19.77	88.75	108.52	24.83	94.80	119.63	19.65	89.28	108.93
13.	N_{200}-P_{125}-K_0	21.61	55.01	76.61	21.66	92.56	114.22	13.78	35.18	48.96	19.02	60.92	79.93
14.	N_{200}-P_{75}-K_{150}	13.73	96.39	110.12	20.25	102.00	122.25	24.89	123.33	148.22	19.62	107.24	126.86
15.	N_{200}-P_{75}-K_{100}	25.06	70.27	95.33	15.41	94.81	110.22	22.21	99.31	121.52	20.89	88.13	109.02
16.	N_{200}-P_0-K_{150}	24.96	93.56	118.52	14.40	105.16	119.56	21.44	110.88	132.32	20.27	103.20	123.47
17.	N_{100}-P_{125}-K_{150}	22.16	87.07	109.23	11.73	105.83	117.56	21.32	120.90	142.22	18.40	104.60	123.00
18.	N_{100}-P_{125}-K_{100}	13.82	84.40	98.22	16.42	88.80	105.22	24.00	98.25	122.25	18.08	90.48	108.56
19.	N_{100}-P_{75}-K_{150}	19.90	92.35	112.25	21.12	105.33	126.45	23.46	117.76	141.22	21.49	105.15	126.64
20.	N_{100}-P_{75}-K_{100}	19.79	80.43	100.22	21.10	94.12	115.22	21.97	100.31	122.22	20.95	91.62	112.55
21.	N_0-P_{125}-K_{150}	10.49	42.78	53.27	15.30	85.92	101.22	21.45	110.07	131.52	15.75	79.59	95.34
	Average of treated plots	21.04	89.34	110.38	19.68	93.92	113.60	22.48	106.18	128.66	21.07	96.48	117.55
	Control average	12.70	74.18	86.88	14.67	81.82	96.49	18.83	93.73	112.56	15.40	83.24	98.64

was increased by 6.68 and 18.68 per cent over two F_0 blocks. The same trend of increase in uptake was observed in control plot.

The phosphorus uptake of Bt cotton was increased as like the N uptake (Table 3). The P uptake increased with increase in the levels of P fertilizer doses and N and K within the FYM blocks and increased with increasing levels of FYM application. The total P upake in F_0 blocks was 52.00 kg ha^{-1} which was increased to 60.45 kg ha^{-1} in F_1 and 74.39 kg ha^{-1} in F_2 block. This indicated the effect of added P and complementary effect of FYM which two together helped in increasing the uptake of P with increasing FYM application.

The same trend was observed in respect to uptake of K as in N and P by Bt cotton (Table 4). The lowest uptake was observed in the control plots and treatment with no K application. The mean total uptake of K in treated plots of two F_0 blocks was 110.38 kg ha^{-1} which was increased to 122.84 kg ha^{-1} in F_1 and 128.66 kg ha^{-1} in F_2 blocks.These results indicated an increase in uptake of K with increase in levels of K fertilizers and FYM application.

Due to increased dose of FYM which help in efficient use of applied NPK fertilizers there by increasing uptake of nutrients and improvement in soil physical condition.

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