

Effect of Balanced Fertilization on Yield, Nutrient Content and Uptake in the Bt. Cotton (*Gossypium hirsutum* L.) of South Saurashtra Region

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ABSTRACT

A field experiment was conducted on medium black calcareous soil during 2009 and 2010 at Junagadh (Gujarat) to evaluate the balance fertilization in the Bt. cotton crop in terms of productivity, profitability and soil health. Treatments comprised FYM, Nitrogen, Phosphorus levels and RDF. Results revealed that application of FYM@10t/ha recorded significantly higher grain yield (2497 Kg/ha) and stalk yield (3540 Kg/ha), while application of Nitrogen @ 240 Kg/ha were recorded significantly higher seed cotton yield of 2429, 2525, 2477 Kg/ha and stalk yield of 3585, 3568, 3576 Kg/ha in individual years as well as in pooled and application of phosphorus @ 50 Kg/ha were recorded significantly higher seed cotton yield (2461 Kg/ha) and stalk yield (3614 Kg/ha) of Bt. cotton as compared to RDF. Maximum net return and B:C ratio was obtained with application of FYM, Nitrogen and Phosphorus significantly increase the content and uptake as respective elements. The effect of FYM, N and P₂O₅ gave the maximum yield, net return and B:C ratio as FYM improved post harvest bulk density, organic carbon and availability of N, P, K and S in soil.

Keywords: *Bt.cotton, Gossypium hirsutum L., Fertilizer, FYM, Yield.*

1. INTRODUCTION

Cotton (*Gossypium hirsutum* L.) is known as the white gold and one of the most important commercial crops and plays a key role in economic and cultural factors of the India, Gujarat is one of the leading Bt.cotton producer state in India. Cotton is very important crop in the economy of the farmers of Saurashtra region of Gujarat.

The hybrid Bt. Cotton cover the growing areas of 93.15 lakhs hectare in India and 29.95 lakhs hectare in Gujarat during 2005-06 (DOA 2005). The balance supply of nutrients (N, P & K) is important for the yield and quality of cotton. Gadhiya, *et. al.*, (2006) reported that the application of N (240 Kg/ha), P₂O₅ (25 Kg/ha) and K₂O (80 Kg/ha) increased seed cotton yields and yields attributes of Bt. Cotton. The varying levels of N, P and K on yield, quality and nutrients uptake by Bt.cotton were studied and in some pockets of Saurashtra region symptoms of Zn deficiency is observed during the research.

2. MATERIALS AND METHODS

A field experiment was conducted at Research Farm, College of Agriculture, Cotton Research Station, J.A.U, Junagadh (Gujarat) under South Saurashtra Agroclimatic Zone during *kharif* 2009 and 2010. The soil of the experimental plot was medium black calcareous and slightly acidic in reaction (pH 7.9) as well as low in available nitrogen (215 kg/ha.), high in available phosphorus (60 kg/ha.) and high in available potash (673.4 kg/ha.). The experiment comprising of twelve treatment combinations consisting two levels of fertility (160 and 240 kg N and P₂O₅/ha), two levels of FYM (0 and 10 t FYM /ha) and three phosphorous levels (0, 50, and 50 Kg), were laid out in factorial randomized complete block design with four replications. The crop was sown on *kharif* season in 2009 of 6, June and 2010 of 11, June and harvested in 5, April and 26, March all two years. The dose of N was applied as 4 split at sowing and remaining three at 30, 60 and 90 days after sowing of crop. Phosphorus will be applied as basal at the time of sowing and split that is 50% at sowing and remaining 50% at the time of earthing up.

3. RESULTS AND DISCUSSION

Effect of different treatments on yield

The yield parameters, *viz.*, seed and stalk yield of cotton were significantly influenced by fertility levels. Significantly application of FYM in individual year as well as in pooled results except stalk yield (2009) influenced the highest seed cotton yield of 2476, 2518 and 2497 Kg/ha and stalk yield of 3589 and 3565 Kg/ha were recorded with application of FYM @ 10 t/ha during year 2009, 2010 and in pooled respectively. While in case of stalk yield during 2009, it was found highest (3540 Kg/ha) with FYM application 10 t/ha. The highest seed cotton yield of 2429, 2525 and 2477 Kg/ha and stalk yield of 3585, 3568 and 3576 Kg/ha were recorded with application of nitrogen @ 240 Kg/ha. The seed cotton and stalk yield of cotton were significantly influenced by phosphorus level in individual year as well as in pooled result except seed cotton and stalk yield during 2009 and 2010, respectively. Significantly the highest seed cotton yield 2461 Kg/ha and stalk yield 3614 Kg/ha were recorded with application of phosphorus @ 50 Kg/ha respectively in pooled.

Effect of different treatments on yield attributes.

The oil content of cotton was significantly influenced by FYM application while Ginning (%), plant height, sympodial branches and maturity ratio of cotton were remain unaffected with application of FYM, nitrogen levels and phosphorous levels respectively. The highest oil content (19.01%) was found with FYM application @ 10 t/ha over control.

Effect of different treatment on soil available nutrients

The experiment pooled results revealed that the soil available nutrients were affected due to FYM levels, nitrogen levels and phosphorus levels. Significantly the highest available of N (258 Kg/ha),

P_2O_5 (80.98 Kg/ha) and K_2O (642 Kg/ha) were recorded with F_2 (FYM 10 t/ha) level. Significantly the highest available N (258 Kg/ha), P_2O_5 (79.33 Kg/ha) were obtained with N_2 (240 Kg/ha) level. Significantly the higher soil available N (255 Kg/ha), P_2O_5 (73.03 Kg/ha) were obtained with P_3 (50 Kg/ha) level. The soil available K_2O was not affected significantly by N and P levels. The soil available N was at par with P_2 level (50 Kg/ha basal).

Effect of different treatments on nutrient content

The experiment pooled results revealed that the nutrient content was affected due to FYM, N and P respectively. Application of FYM, N and P in seed cotton and stalk of cotton crop except N and P content in seed and N, P and S content in stalk. Significantly the higher content of K (0.81%) and S (0.31%) in seed cotton and K (0.61%) in stalk were found with FYM application @ 10 t/ha over control. Significantly the higher N (3.72%), P(0.41%), K (0.80%) and S (0.13%) content in seed cotton were observed with N_2 level (240 Kg/ha) while in cotton stalk nutrient content were not affected significantly due to different nitrogen level. Significantly the higher P (0.41%), K (0.80%) and S (0.134%) content in seed cotton and P (0.123%) and S (0.16%) content in stalk were observed with P_3 level (P-50% as basal and 50% at the time of earthing up).

Effect of different treatments on nutrient uptake

The experiment pooled result revealed that different nutrient uptake by seed cotton and stalk yield were significantly affected by FYM, N and P application except S uptake by seed cotton and N uptake by stalk. Significantly higher N (91.55 and 40.32 Kg/ha), P (10.22 and 4.20 Kg/ha), K (20.12 and 21.77 Kg/ha) and S (3.28 and 5.58 Kg/ha) uptake by seed and stalk were observed with F_2 (FYM @10 t/ha) respectively. Significantly the higher N (93.35 Kg/ha) P (10.16 Kg/ha) and K (19.88 Kg/ha) uptake by seed cotton and P (4.24 Kg/ha), K (21.70 Kg/ha) and S (5.50 Kg/ha) uptake by stalk were observed with N_2 (240 Kg/ha) level respectively. Except N uptake by cotton stalk significantly the higher N (89.36 Kg/ha), P (10.18 and 4.44 Kg/ha), K (19.82 and 21.93 Kg/ha) and S (3.30 and 5.62 Kg/ha) uptake by seed cotton and stalk were observed with phosphorus application @ 50 Kg/ha (2 split, 50% as basal and 50% at the time of earthing up) level respectively.

Table 1.1: Effect of different treatments on yield of cotton crop

Treatments	Seed cotton yield (kg/ha)			Cotton stalk yield (kg/ha)		
	2009	2010	Pooled	2009	2010	Pooled
Level of FYM						
F_0 -10 t/ha	2235	2317	2276	3442	3359	3401
F_1 -10 t/ha	2476	2518	2497	3540	3589	3565
S.E. (m) \pm	43.92	27.10	25.81	50.02	51.75	35.99

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C.D.(at 5%)	126.47	78.04	72.92	NS	149.0	101.7
Level of N						
N ₁ -160 Kg/ha	2281	2310	2296	3397	3380	3389
N ₂ -240 Kg/ha	2429	2525	2477	3585	3568	3576
S.E. (m) ±	43.92	27.10	25.81	50.02	51.76	35.99
C.D. (at 5%)	126.47	78.04	72.92	144.0	149.0	101.7
Level of P						
P ₁ -0 Kg/ha	2296	2316	2306	3287	3381	3334
P ₂ -50 Kg./ha (basal)	2363	2421	2392	3531	3469	3500
P ₃ -50 Kg/ha(2 split)	2406	2515	2461	3655	3572	3614
S.E. (m) ±	53.8	33.19	31.61	61.27	63.39	44.08
C.D. (at 5%)	NS	95.58	89.31	176.4	NS	124.5
C.V %	9.14	6.49	7.50	7.02	7.30	7.16

Table 1.2: Effect of different treatments on yield attributes of cotton crop

Treatments	Oil content (%)	Ginning %	Plant height (cm)	Sympodial branches	Maturity Ratio
Level of FYM					
F₀-10 t/ha	2235	2317	2276	3442	3359
F₁-10 t/ha	2476	2518	2497	3540	3589
S.E. (m) ±	43.92	27.10	25.81	50.02	51.75
C.D. (at 5%)	126.47	78.04	72.92	NS	149.0
Level of N					
N ₁ -160 Kg/ha	18.98	34.53	128.4	35.27	0.83
N ₂ -240 Kg/ha	18.99	33.64	129.7	35.60	0.83
S.E. (m) ±	0.017	0.46	1.10	0.71	0.002
C.D. (at 5%)	NS	NS	NS	NS	NS
Level of P					
P ₁ -0 Kg/ha	18.99	33.43	127.6	35.88	0.83
P₂-50 Kg./ha (basal)	18.94	34.40	129.8	35.31	0.83
P ₃ -50 Kg/ha(2split)	19.01	34.41	129.6	35.13	0.83
S.E. (m) ±	0.021	0.57	1.35	0.87	0.002
C.D. (at 5%)	NS	NS	NS	NS	NS
C.V.%	0.63	9.4	5.93	13.85	1.66

Table 1.3: Effect of different treatments on soil available nutrients

Treatments	Soil available nutrient (kg/ha)		
	N	P ₂ O ₅	K ₂ O
Level of FYM			
F ₀ -0 t/ha	241	74.26	611
F ₁ -10 t/ha	258	80.98	642
S.E. (m) ±	1.98	0.629	6.75
C.D. (at 5%)	5.58	1.777	19.09
Level of N			
N ₁ -160 Kg/ha	240	75.91	628
N ₂ -240 Kg/ha	258	79.33	625
S.E. (m) ±	1.98	0.629	6.75
C.D. (at 5%)	5.58	1.777	NS
Level of P			
P ₁ -0 Kg/ha	242	70.69	631
P ₂ -50 Kg/ha(basal)	251	79.15	630
P ₃ -50 Kg/ha(split)	255	83.03	620
S.E. (m) ±	2.42	0.77	8.27
C.D. (at 5%)	6.84	2.18	NS
C.V.%	5.49	5.61	7.47

Table 1.4: Effect of different treatments on nutrient content (%) in cotton crop

Treatments	Nutrient content (%)							
	Seed cotton				Cotton stalk			
	N	P	K	S	N	P	K	S
Level of FYM								
F ₀ -0 t/ha 3.60	3.60	0.39	0.78	0.127	1.11	0.12	0.60	0.15
F ₁ -10 t/ha 3.66	3.66	0.41	0.81	0.131	0.15	0.12	0.61	0.16
S.E. (m) ±	0.042	0.0058	0.0029	0.001	0.020	0.0012	0.003	0.0066
C.D. (at 5%)	NS	NS	0.0082	0.0039	NS	NS	0.010	NS
Level of N								
N ₁ -160 Kg/ha 3.54	3.54	0.39	0.78	0.13	1.14	0.12	0.60	0.15
N ₂ -240 Kg/ha	3.72	0.41	0.80	0.13	0.12	0.12	0.61	0.15
S.E. (m) ±	0.042	0.002	0.002	0.001	0.0012	0.020	0.003	0.001
C.D. (at 5%)	0.119	0.005	0.0082	0.0039	NS	NS	NS	NS
Level of P								
P ₁ -0 Kg/ha 3.59	3.59	0.39	0.78	0.124	1.15	0.113	0.60	0.15

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P ₂ -50 Kg/ha (Basal)	3.68	0.40	0.79	0.130	1.14	0.117	0.60	0.15
P ₃ -50 Kg/ha (2 split)	3.63	0.41	0.80	0.134	1.11	0.123	0.61	0.16
S.E. (m) ±	0.051	0.002	0.0035	0.002	0.025	0.0015	0.004	0.002
C.D. (at 5%)	NS	0.006	0.010	0.004	NS	0.004	NS	0.006
C.V. %	8.02	3.06	2.53	7.47	12.54	7.06	3.91	7.46

Table-1.5: Effect of different treatments on nutrient uptake (Kg/ha) by cotton crop

Treatments	Nutrient uptake (kg/ha)							
	Seed cotton				Cotton stalk			
	N	P	K	S	N	P	K	S
Level of FYM								
F ₀ -0 t/ha	82.21	8.96	17.70	2.90	38.42	4.00	20.23	5.00
F ₁ -10 t/ha	91.55	10.22	20.12	3.28	40.32	4.20	21.770	5.58
S.E. (m) ±	1.42	0.140	0.222	0.051	0.868	0.053	0.486	0.151
C.D. (at5%)	4.010	0.295	0.628	0.143	2.455	0.150	1.46	2.72
Level of N								
N ₁ -160 Kg/ha	81.41	9.02	17.94	3.02	38.65	3.96	20.30	5.07
N ₂ -240 Kg/ha	92.35	10.16	19.88	3.16	40.11	4.24	21.70	5.50
S.E. (m) ±	1.42	0.104	0.222	0.103	0.868	0.053	0.242	0.071
C.D. (at5%)	4.010	0.295	0.628	NS	NS	0.150	0.684	0.200
Level of P								
P ₁ -0Kg/ha	83.14	8.93	17.94	2.86	153.7	3.75	20.08	4.92
P ₂ 50kg/ha (basal)	88.15	9.66	18.98	3.11	152.0	4.10	20.99	5.32
P ₃ -50kg/ha (2split)	89.36	10.18	19.82	3.30	140.6	4.44	21.93	5.62
S.E. (m) ±	1.74	0.128	0.272	0.062	1.064	0.065	0.297	0.087
C.D. (at5%)	4.91	0.362	0.769	0.175	NS	0.183	0.838	0.245
C.V. %	11.32	7.55	8.14	11.34	15.29	8.98	7.99	9.27

Table 1.6: Economic of different balance fertilization on cotton yield

Treatments	Additional seed cotton yield over control (kg/ha)	Net return (Rs/ha)	Net ICBR
F ₀ -0 t/ha	--	--	--
F ₁ -10 t/ha	221	7445	1:2.98
N ₁ -160 Kg/ha	--	--	--
N ₂ -240 Kg/ha	181	7132	1:7.04
P ₁ -0 Kg/ha	--	--	--
P ₂ - 50 Kg/ha (basal)	86	1880	1:0.94
P ₃ -50 Kg/ha (2 split)	155	4985	1:2.51

4. CONCLUSION

On the basis of two years field experimentation, it seems quite logical to conclude that maximum yield and net return from Bt. cotton can be secured by application of FYM @ 10 t/ha, nitrogen @ 240 kg/ha (four split, 25 % of sowing and remaining three equal dose at 30, 60 and 90 DAS) and P₂O₅ @ 50 kg/ha (two split 50% at basal and 50% at 60 DAS) per hectare to cotton crop at South Saurashtra Agro Climatic Zone in medium black calcareous soil of Gujarat.

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