

Effect of Fertility Levels and Green Manuring on Bt Cotton

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ABSTRACT: A field investigation entitled 'Effect of fertility levels and green manuring on Bt cotton' was planned on clayey soil at VNMKV, Parbhani (Maharashtra) during kharif season 2008-2009 to study the effect of different sources of green manuring on growth and yield of Bt cotton, to evaluate the fertilizer of Bt cotton. The experiment was laid out in a split plot design with three replications. Main plot treatments comprised of three fertilizer level i.e. F₁ (NPK @ 80:40:40 kg/ha), F₂ (NPK @ 100:50:50 kg/ha) and F₃ (120:60:60 kg/ha) and subplot treatments consisted of four green manuring and one organic manure i.e. FYM application.

Key words: Bt-cotton, green manuring, fertility

INTRODUCTION

Cotton (*Gossypium* spp.) is an important fibre crop of global significance, which is, cultivated in tropical and sub-tropical regions of more than seventy countries the world over. Cotton is the major cash crop of India and accounts for 65% of the fibre used in the textile industry which has 1063 spinning mills. Cotton plays a key role in the national economy in terms of both employment generation and foreign exchange earnings. Cotton impacts the lives of an estimated 60 million people in India. By way of exports, foreign exchange earnings of cotton amounts to about 10 billion dollar which is one-third of the total foreign exchange earnings of the country. India has the largest acreage (9.13 million ha) under cotton at global level and has the productivity of 520 kg lint/ha and ranks second in production (4.76 million tones) after China during 2006-07. The total availability of cotton in country was 5.64 million tonnes in 2006-07 as compared to 4.63 million tonnes in 2004-05 while the demand has increased from 3.47 million tonnes in 2004-05 to 4.90 million tonnes in 2006-07. Cotton is an important cash crop of Maharashtra State and grown on an area of 2.00 million hectares with the production of 0.88 million tonnes (2006-07). The development of Bt cotton in India from the transgenic

cotton of Monsanto, USA, underwent a stringent regulatory process before it finally reached farmer fields. Mahyco had obtained Coker 312 Bt (Cry 1Ac) cotton seed from Monsanto USA, in 1996. Bt cotton, which confers resistance of Lepidopteron pests of cotton, was first adopted in India as hybrid in 2002 after stringent assessment for bio-safety and profitability. In the first year of its (Bt cotton hybrid) release, it occupied 38,038 ha in 2002-03. The area under Bt cotton hybrids has gradually increased from 38,038 ha in 2002-03 to 0.56 million ha by 2004-05 and showed a steep increase to 1.3 million ha in 2005-06, an increase of 160% over 2004 followed by a phenomenal enhancement to 3.72 million ha in 2006-07. Thus within a span of five years nearly 41% of the cotton area in India came under Bt hybrid umbrella. The nutrient supply is the second most important limiting factor in cotton production only after water. Nutrient management in cotton is complex phenomenon due to simultaneous production of vegetative and reproductive structures during the active growth phase. Cotton plant being heavy feeder needs proper manuring for its successful cultivation and showed better response to N and P while K in deficient soil. However, the information on nutrient management of cotton is scarce, particularly for new

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Bt cotton hybrid under agroclimatic region of Marathwada. In the face of a continuing energy crisis, increasing fertilizer prices and growing concern for environmental quality, there has been, in recent years, a tremendous renewal of interest, on the part of both researchers and farmers, in the old practice of green manuring. In addition to supplying, N green manure can increase the availability of P, K and S in soils. The solubility of P in soils is markedly increased through the incorporation of green manures, particularly in flooded soils. Continuous application of inorganic fertilizers alone caused deterioration of soil, pollution of environment and once again stagnation of crop production. To improve the soil fertility status, pollution free environment and to stabilize the crop production by using organics in combination with inorganics in the possible way. The information on nutritional requirement and green manuring of Bt cotton in Maharashtra state is not available. This became a main constraint for rapid coverage of Bt cotton and also for increasing cotton production. With this preamble, the present investigation to study "Effect of different fertility levels and green manuring on Bt cotton".

OBJECTIVES

1. To study the effect of different sources of green manuring on growth and yield of Bt cotton.
2. To evaluate the fertilizer requirement of Bt cotton.

MATERIAL AND METHODS

A field experiment was conducted during kharif season of 2008-2009 at the experimental farm (Block A), Department of Agronomy, Vasantrao Naik Marathwada Krishi Vidyapeeth, Parbhani. The field was fairly uniform, leveled and had a good drainage. The soil samples from 0-30 cm soil strata were taken at random all over the experimental area after layout but before the application of fertilizers. The experimental plot was clayey in texture, slightly alkalinity (7.95 pH) in reaction, medium in organic carbon, low in available nitrogen, medium in available phosphorus and rich in available potash. The electrical conductivity was medium. The rainfall received during the *kharif* 2007 in the total life period of the cotton crop was 700.1 mm and the rainy days were 36. In general, maximum temperature fluctuated during the total life period of crop were 30.5°C to 34.2 °C and minimum temperature fluctuated from 10.4 °C to 21.9°C. The mean relative humidity was in between 75% to 94% during the life period of crop. The weekly mean evaporation varied from 2.9 mm/

day to 5.8 mm/day. The bright sunshine hours were fluctuated from 2.8 hrs/day to 10.4 hrs/day. Wind velocity was varied from 2.6 km/hr to 9.3 km/hr. The experiment was laid out in a split plot design with three replications. There were 8 treatment combinations. The combination of three fertility levels included in the main plot and four green manuring and one organic manure i.e. FYM in sub plots. The gross plot size was 7.2 m x 5.4 m, whereas, net plot size was 4.5 m x 3.6 m. The fertilizers were applied as per treatments. Half dose of nitrogen and complete dose of P₂O₅ and K₂O was applied through 18:18:10 and as basal application by ring method. Top dressing of remaining half dose of nitrogen was given after 40 days after sowing through Urea by ring method. Popular Bt. cotton hybrid viz. MRC 6301 was selected for experimental purpose. The crop was sown on 27th June, 2008 (26th meteorological week) by dibbling cotton seeds per hill as per the treatment at 150 cm x 30 cm. The emergence started on 1st July, 2008 and completed by 4th July, 2008. Gap filling was done on 7th July, 2008. Plant stand was maintained after gap filling. Sprayed 0.02 % Monocrotophos for control of sucking pest. Second spraying of fungicide (Copper oxichloride) @ 20 g/10 litre carried out to protect the crop from disease like blackarm, anthracnose etc. Five plants were selected from each net plot randomly using Tippet's random table and those selected plants were numbered for recording biometrics observations at various stages of crop growth. The data recorded on various variables were statistically analysed by using technique of analysis of variance and significance was determined as given by Panse and Sukhatme (1967).

RESULT AND DISCUSSION

Response to fertilizer levels

Every higher level of NPK @ 80:40:40, 100:50:50 and 120:60:60 kg/ha increased the growth characters substantially *viz.*, number of functional leaves, leaf area, number of sympodial branches and dry matter per plant over its slower level.

Application of higher level of NPK i.e. 120:60:60 kg/ha had significant effect on yield attributes. The number of picked bolls, boll weight and seed cotton yield per plant was increased with increase in the fertilizer level.

Seed cotton yield was highest at higher level of NPK i.e. 120:60:60 which was significantly more than both the lower levels of NPK i.e. 100:50:50 and 80:40:40 kg/ha.

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Table 1
Mean height (cm) of cotton as influenced by various treatments at different growth stages

Treatment	Days after sowing				
	30	60	90	120	150
Fertility level (kg/ha)					
F ₁ (80:40:40)	14.19	48.97	130.82	153.58	156.22
F ₂ (100:50:50)	14.51	52.32	134.06	157.09	159.39
F ₃ (120:60:60)	14.90	52.69	135.11	158.32	160.22
SE ±	0.26	0.26	0.40	0.50	0.65
CD at 5%	NS	0.76	1.18	1.47	1.89
Green Manuring					
T ₁ (Sannhemp green manuring at 45 days after sowing)	14.55	53.11	135.64	158.67	163.07
T ₂ (Dhaincha green manuring at 45 days after sowing)	14.00	51.55	133.44	156.45	155.57
T ₃ (Cowpea green manuring at 45 days after sowing)	14.97	52.08	135.37	158.48	160.04
T ₄ (Glyricidia application @ 3 t/ha at 30 days after sowing)	13.87	51.17	131.18	154.02	154.83
T ₅ (Cotton + FYM @ 10 t/ha at sowing)	15.27	48.72	131.02	154.03	159.54
SE ±	0.41	0.46	0.41	0.42	0.67
CD at 5%	NS	1.35	1.19	1.22	1.96

Table 2
Mean number of functional Leaves per plant as influenced by different treatments at various growth stages.

Treatment	Days after sowing				
	30	60	90	120	150
Fertility level (kg/ha)					
F ₁ (80:40:40)	14.50	42.27	199.33	270.16	75.38
F ₂ (100:50:50)	15.10	44.35	201.44	275.00	80.20
F ₃ (120:60:60)	15.23	46.24	203.68	275.43	80.56
SE ±	0.29	0.01	0.10	1.06	1.09
CD at 5%	NS	0.04	0.30	3.10	3.18
Green Manuring					
T ₁ (Sannhemp green manuring at 45 days after sowing)	14.80	46.60	204.73	278.36	83.37
T ₂ (Dhaincha green manuring at 45 days after sowing)	14.66	44.66	202.37	274.46	79.42
T ₃ (Cowpea green manuring at 45 days after sowing)	14.29	45.70	203.49	276.76	80.67
T ₄ (Glyricidia application @ 3 t/ha at 30 days after sowing)	14.79	43.78	200.84	271.39	77.42
T ₅ (Cotton + FYM @ 10 t/ha at sowing)	15.18	40.69	195.96	266.68	72.68
SE ±	0.45	0.033	0.10	0.57	0.57
CD at 5%	NS	NS	NS	NS	NS

Table 3
Mean leaf area (dm²) per plant in different treatments at various growth stages

Treatment	Days after sowing				
	30	60	90	120	150
Fertility level (kg/ha)					
F ₁ (80:40:40)	5.12	23.34	75.67	117.97	79.97
F ₂ (100:50:50)	5.36	26.06	78.59	122.03	86.58
F ₃ (120:60:60)	5.48	26.69	79.04	123.09	86.90
SE ±	0.17	0.53	0.68	0.59	1.15
CD at 5%	NS	1.54	1.99	1.74	3.37
Green Manuring					
T ₁ (Sannhemp green manuring at 45 days after sowing)	5.20	27.32	80.18	124.041	87.36
T ₂ (Dhaincha green manuring at 45 days after sowing)	5.20	26.04	77.85	121.04	84.37
T ₃ (Cowpea green manuring at 45 days after sowing)	5.21	27.30	79.40	121.78	85.91
T ₄ (Glyricidia application @ 3 t/ha at 30 days after sowing)	5.33	23.65	76.00	119.37	82.94
T ₅ (Cotton + FYM @ 10 t/ha at sowing)	5.67	22.50	75.41	118.94	81.84
SE ±	0.22	0.99	1.36	0.72	0.83
CD at 5%	NS	2.89	NS	2.11	2.43

Table 4
Mean number of sympodial branches per plant as influenced by different treatments at various growth stages

Treatments	Days after sowing			
	60	90	120	150
Fertility level (kg/ha)				
F ₁ (80:40:40)	12.39	20.93	25.36	27.42
F ₂ (100:50:50)	12.96	23.23	28.83	30.45
F ₃ (120:60:60)	13.19	24.02	29.41	30.49
SE ±	0.09	0.40	0.43	0.54
CD at 5%	0.26	1.16	1.27	1.58
Green Manuring				
T ₁ (Sannhemp green manuring at 45 days after sowing)	13.39	25.94	29.99	30.44
T ₂ (Dhaincha green manuring at 45 days after sowing)	12.55	21.50	28.01	30.24
T ₃ (Cowpea green manuring at 45 days after sowing)	13.23	23.35	29.03	30.37
T ₄ (Glyricidia application @ 3 t/ha at 30 days after sowing)	12.54	20.57	26.03	28.36
T ₅ (Cotton + FYM @ 10 t/ha at sowing)	12.53	20.25	25.51	27.84
SE ±	0.09	0.78	0.64	0.52
CD at 5%	0.28	2.29	1.87	1.51

Table 5
Mean total dry matter weight (g) per plant as influenced by different treatments at various stages of crop growth

Treatment	Days after sowing				
	30	60	90	120	150
Fertility level (kg/ha)					
F ₁ (80:40:40)	4.12	26.94	124.31	203.08	153.58
F ₂ (100:50:50)	4.25	30.02	135.92	210.21	159.61
F ₃ (120:60:60)	4.18	32.60	131.56	218.28	161.43
SE ±	0.08	0.76	0.86	1.41	0.42
CD at 5%	NS	2.21	2.50	4.12	1.24
Green Manuring					
T ₁ (Sannhemp green manuring at 45 days after sowing)	4.13	32.57	133.46	214.65	161.36
T ₂ (Dhaincha green manuring at 45 days after sowing)	4.10	30.31	129.90	209.91	157.83
T ₃ (Cowpea green manuring at 45 days after sowing)	4.22	31.62	131.68	212.03	159.00
T ₄ (Glyricidia application @ 3 t/ha at 30 days after sowing)	4.23	28.04	129.49	208.30	156.54
T ₅ (Cotton + FYM @ 10 t/ha at sowing)	4.23	26.71	128.45	207.73	156.30
SE ±	0.15	1.10	1.07	1.28	0.58
CD at 5%	NS	3.22	3.13	3.73	1.70

Table 6
Yield contributing characters and yield of cotton (kg/ha) in different treatments

Treatments	Boll weight in (g)	No. of picked boll	Yield per plant	Yield of seed cotton (kg/ha)
Fertility level (kg/ha)				
F ₁ (80:40:40)	3.17	28.02	101.47	2198.5
F ₂ (100:50:50)	3.39	33.28	126.83	2625.1
F ₃ (120:60:60)	3.61	34.28	128.14	2698.7
SE ±	0.06	0.34	1.82	104.92
CD at 5%	0.18	1.01	5.31	305.79
Green Manuring				
T ₁ (Sannhemp green manuring at 45 days after sowing)	3.64	34.88	133.87	2775.8
T ₂ (Dhaincha green manuring at 45 days after sowing)	3.15	31.84	120.67	2607.4
T ₃ (Cowpea green manuring at 45 days after sowing)	3.63	33.12	124.41	2707.6
T ₄ (Glyricidia application @ 3 t/ha at 30 days after sowing)	3.28	29.66	108.38	2234.2
T ₅ (Cotton + FYM @ 10 t/ha at sowing)	3.26	29.71	106.74	2212.3
SE ±	0.05	0.53	1.93	143.99
CD at 5%	0.13	1.56	5.62	419.63

Green Manuring

The plant height was significantly influenced by different green manuring at all days of observation. The number of functional leaves and leaf area per plant were significantly influenced by different green manuring treatments at all days of observation. More number of bolls per sympodia were observed in green manuring. The dry matter accumulation per plant at harvest was significantly influenced by different green manuring and it was highest in T₁ treatment.

The number of bolls per plant, number of picked bolls per plant and yield of seed cotton per plant were significantly influenced due to different green manuring. The highest bolls picked and highest seed cotton yield per plant was observed in (T₁) cotton + sannhemp treatment followed by treatment (T₃) cotton + cowpea.

The seed cotton yield was influenced significantly due to different green manuring treatments i.e. green manuring with sannhemp recorded significantly more yield (2775.8 kg/ha) over treatment green manuring with cowpea (T₃) (2707.6 kg/ha), T₂ i.e. green manuring with dhaincha (2607.4 kg/ha) and green manuring with (T₄) cotton + glyricidia and with (T₅) cotton + FYM.

The highest dry matter addition was recorded by sannhemp followed by cowpea, dhaincha, glyricidia and FYM.

CONCLUSION

Application of 120:60:60 kg NPK/ha to Bt cotton was found significantly superior over 80:40:40 kg NPK /ha and at par with 100:50:50 NPK kg/ha. Green manuring of sannhemp in Bt cotton was found superior over other treatments (T₂) cotton + dhaincha, (T₄) cotton + glyricidia and (T₅) cotton + FYM. However, it was at par with (T₃) cotton + cowpea.

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