Response of cotton *(Gossypium hirsutum L.)* growth, yield and quality characters to different compost and inorganic fertilizer

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ABSTRACT

A field experiment was conducted at Experimental farm, Faculty of Agriculture, Annamalai University to study the Response of cotton (*Gossypium hirsutum L.*) growth, yield and quality characters to different compost and inorganic fertilizer. The soil of the experiment farm is deep clay, low in available nitrogen, medium in available phosphorus and high in available potassium. The experiment was conducted in randomized block design and replicated thrice. The experiment comprised of eight treatments which includes absolute control (No fertilizer and no organic manure), recommended dose of fertilizer nitrogen alone and graded dose of fertilizer nitrogen along with different organic manures *viz.*, farmyard manure, pressmud compost, vermicompost, poultry manure, water hyacinth compost and sugar cane trash compost. Use of different sources and combination sources of nitrogen had significant influence on growth and yield of cotton. The results of the experiment showed that 75% N through fertilizer along with 25 % N through vermicompost significantly recorded maximum growth, yield attributes, and yield of cotton over other treatments. The order of next best ranking was 75% N through fertilizer along with 25 % N through pressmud compost. As per quality characters were concerned, INM practices had not significant influence on quality parameters viz., ginning percentage, seed index, lint index, bundle strength (g tex^{-1}) and mean fibre fineness. Significantly lowest values for growth attributes, yield attributes and seed cotton yield was recorded in the control (No fertilizer and no organic manure). Based on the above results, it could be concluded that 75% N through fertilizer along with 25% N through vermicompost will be more promising combination which resulted in higher yield of seed cotton with good quality fibre.

Key words: Cotton, nitrogen, quality characters, vermicompost and yield

INTRODUCTION

Cotton is popularly called as “White Gold” and is considered as “King of fibre crops”. It is an important cash and fibre crop of global significance, which plays a dominant role in the world agriculture and industrial economy. Cotton accounts for more than 70 % of the raw fibre used by the world textile industry and handlooms. In India cotton is cultivated in an area of 12.65 million ha with a production of 40 million bales of lint. It contributes to 80 per cent of the raw material to the textile industry and provides employment to nearly 60 million people. India ranks first in area and second in global cotton production. The productivity of cotton in India is significantly lower (518 kg ha^{-1}) as compared to the four major cotton growing countries i.e China (1300 kg ha^{-1}), USA (900 kg ha^{-1}), Pakistan (700 kg ha^{-1}) and Brazil (2027 kg ha^{-1}) (CICR, 2014). Lower cotton productivity could be attributed to highly varying factors and management practices mainly low soil fertility status. Among the nutrients, nitrogen is the key element to which cotton shows a good response, as most of the soils are low in N. It is most often the major limiting factor to cotton production, after water (Fageria *et al.,* 2011). Use of chemical fertilizers alone does not sustain productivity under continuous intensive cropping, whereas inclusion of organic materials improves physical soil properties, builds up soil fertility and increases crop yield (Edwards and Hailu, 2011). So effort is needed to formulate an input package with a combination of organic and inorganic fertilizers for cotton crop. The research work on vermicompost and water hyacinth compost on cotton is meagre. Therefore, the

present study was conducted to evaluate the effect of organic and inorganic sources of nitrogen on growth, yield and quality of cotton.

MATERIALS AND METHODS

Field experiment was conducted at the Experimental farm, Department of Agronomy, Annamalai University, Annamalai nagar Tamil Nadu to study the Response of cotton *(Gossypium hirsutum L.)* growth, yield and quality characters to different compost and in organic fertilizer . The experimental soil was clay loam in texture with pH 7.7, EC 0.45 dsm^{-1}, organic carbon 0.62, and low N (218.0 Kg ha^{-1}), medium in P (24 Kg ha^{-1}) and high in K (264 Kg ha^{-1}). The experiment was laid out in a randomized block design with eight treatments and replicated thrice. The treatments were T_1 - control (no fertilizer and no organic manure), T_2 - 100% recommended dose of nitrogen through fertilizer (RDN), T_3 - 75% N through fertilizer + 25% N through FYM , T_4 -75% N through fertilizer + 25% N through pressmud compost, T_5 - 75% N through fertilizer + 25% N through vermicompost, T_6 – 75% N through fertilizer + 25% N through poultry manure, T_7 - 75% N through fertilizer + 25% N through water hyacinth compost and T_8 - 75% N through fertilizer + 25% N through sugarcane trash compost. The organic manures were applied as basal one week before sowing as per treatment schedule. The cotton variety LRA 5166 used as test variety for this experiment. The seeds were sown at a spacing of 75 X 30 cm. Recommended dose of 80:40:40 kg of N, P_2O_5 and K_2O was applied. As per treatment schedule 50 per cent of N, entire dose of P_2O_5 and K_2O were applied as basal and remaining 50 per cent N was applied on 40 DAS. N, P_2O_5 and K_2O were supplied through urea, single superphosphate and muriate of potash, respectively. Recommended cultural practices were also adopted as per need of the crop. Cotton growth and yield attributing characters such as plant height, LAI, DMP, number of sympodial branches per plant, number of bolls per plant, boll weight were recorded from 10 randomly selected plants and seed cotton yield was recorded from each plot.

Quality characters of cotton were derived by following methods.

Ginning percentage

It denotes the ratio of the weight of lint to the weight of seed cotton and expressed in percentage. Ginning percentage was calculated by employing the formula suggested by Santhanam (1976).

$$\text{Ginning percentage} = \frac{\text{Weight of fruit}}{\text{Weight of seedcotton}} \times 100$$

Lint index

Lint obtained from ginning of hundred seed cotton was weighed and expressed in g (Santhanam, 1976).

Seed index

Weight of hundred seeds selected at random after ginning and was expressed in g (Santhanam, 1976).

Bundle strength (g tex^{-1})

It is a ratio of breaking strength of a bundle of fibre to its weight. Duplicate tufts of fibre weighing one mg were fed into the "presseley strength tester" which gave reading in lb mg^{-1}. The value was expressed in g tex^{-1} by multiplying the presseley strength index with 5.36 (Sundaram, 1974).

Mean fibre fineness (Micronaire 10^{-6} g $inch^{-1}$)

Mean fibre fineness is a measure of fibre weight in mg g^{-1} unit length of fibre fineness. This was determined by air flow method using micronaire instrument (Santhanam, 1976).

The data on various studies recorded during the investigation were subjected to statistical scrutiny as suggested by Gomez and Gomez (1984).

RESULTS AND DISCUSSION

Growth attributes of cotton

Integrated application of organic and inorganic fertilizers increased the growth attributes of cotton. Application of 75% N through fertilizer + 25% N through vermicompost (T_5) recorded significantly higher plant height of 116.54 cm, LAI of 4.66 and dry matter production of 5361 kg ha^{-1}. Favourable effect of vermicompost on plant height and LAI could be attributed to sustained availability of major and micronutrients with different growth hormones like gibberellins resulting in increased plant height, LAI and DMP. This results coincides with the work of Gebaly (2011). Lesser response of cotton to other organic manures could be attributed to slow mineralization of organically bound nutrients and low population of beneficial microbes as compared to vermicompost (Katkar *et al*., 2002). The least values of growth parameters were recorded under T_1 (no fertilizer and no organic manure).

Yield attributes and seed cotton yield

The yield potential of cotton is determined by yield attributes and the values of yield attributes were in accordance with that of growth parameters. Among the INM treatments, application of 75% N through fertilizer + 25% N through vermicompost (T_5) registered higher number of sympodial branches of 11.65 $plant^{-1}$, number of 23.31 bolls $plant^{-1}$ and boll weight of 5.83 g. This might be due to higher amount of nutrients supplied through vermicompost along with inorganic fertilizer, which have increased the availability of nutrients in soil, thus more uptake of nutrients and increased photosynthetic efficiency as evident from increased LAI resulted in higher yield attributes. These results are in accordance with the reports of Ramesh (2012). The control plot T_1 (no fertilizers and no organic manure), recorded the least values of yield attributes.

Integration of 75% N through fertilizer along with 25% N through vermicompost (T_5) significantly recorded a higher seed cotton yield of 20.98 q ha^{-1} which was 193.42 per cent higher than T_1 (no fertilizer and no organic manure) and 24.43 per cent over 100% RDN (T_2). This might be due to more availability of both native and applied nutrients and better source and sink relationship, which contributed to higher yield attributes of cotton, which inturn registered maximum seed cotton yield. Besides, the constant release of N from organic manure, particularly from vermicompost supplemented with NPK fertilizers might have satisfied the demand of the crop at every phenophase of cotton crop as opined by Gawai and Pawar (2005). The superiority of inorganic fertilizer along with vermicompost over inorganic fertilizer alone on crop was earlier reported by Roy and Singh (2006). The least seed cotton yield of 7.15 q ha^{-1} was registered under T_1 (No fertilizer and no organic manure).

Quality characters of cotton yield

As per quality characters concern, Integrated nutrient management practices had not significant influence on ginning percentage, seed index, lint index bundle strength (g tex^{-1}) and mean fibre fineness. However, numerically higher values of all quality parameters were registered under 75% N through fertilizer along with 25% N through vermicompost (T_5). This might be due to fact that quality parameters are genetic character of a variety which were not influenced by fertilizer levels. The results were in accordance with the report of Srinivasulu and Hema (2007).

CONCLUSION

Thus, on the basis of the experimental results, it could be concluded that for realising higher yield of seed cotton, farmers are recommended to take up 75% N through fertilizer along with 25% N through vermicompost for achieving higher yield in seed cotton with better quality fibre.

Table. 1 - Effect of organic and inorganic sources of nitrogen on growth and yield attributes of cotton

Treatments	Plant height (cm)	Leaf area index	DMP (kg ha^{-1})	Number sympodial branches plant^{-1}	Number of bolls plant^{-1}	Boll weight (g)
T_1	71.54	2.86	2575	3.58	7.15	3.58
T_2	93.64	3.75	4307	9.36	18.73	4.68
T_3	105.38	4.22	4847	10.54	21.08	5.27
T_4	111.31	4.45	5120	11.13	22.26	5.57
T_5	116.54	4.66	5361	11.65	23.31	5.83
T_6	106.98	4.28	4921	10.70	21.40	5.35
T_7	100.86	4.03	4640	10.09	20.17	5.04
T_8	98.87	3.95	4548	9.89	19.77	4.94
SED	1.64	0.12	96	0.18	0.44	0.07
CD (P=0.05)	3.28	0.22	184	0.34	0.86	0.15

Treatment details: T_1- control (no fertilizer and no organic manure), T_2- 100% recommended dose of nitrogen (RDN), T_3- 75% N through fertilizer + 25% N through FYM , T_4 – 75% N through fertilizer + 25% N through pressmud compost, T_5 - 75% N through fertilizer + 25% N through vermicompost, T_6 – 75% N through fertilizer + 25% N through poultry manure, T_7 – 75% N through fertilizer + 25% N water hyacinth compost and T_8 – 75% N through fertilizer + 25% N sugarcane trash compost.

Table. 2 - Effect of organic and inorganic sources of nitrogen on seed cotton yield and quality characters of cotton**.**

Treatments	Seed cotton yield (q ha^{-1})	Ginning percentage	Lint index	Seed index	Bundle strength (g tex^{-1})	Mean fibre fineness (10^{-6} g inch^{-1})
T_1	7.15	36.55	4.62	9.12	29.01	3.31
T_2	16.86	36.62	5.04	10.14	29.26	3.47
T_3	18.97	36.79	5.23	10.58	29.41	3.53
T_4	20.04	36.87	5.32	10.73	29.47	3.58
T_5	20.98	36.94	5.39	10.86	29.52	3.61
T_6	19.26	36.82	5.26	10.64	29.44	3.55
T_7	18.15	36.72	5.16	10.39	29.37	3.52
T_8	17.80	36.68	5.12	10.26	29.32	3.49
SED	0.32	0.24	0.12	0.37	0.25	0.19
CD (P=0.05)	0.62	NS	NS	NS	NS	NS

Treatment details: T_1- control (no fertilizer and no organic manure), T_2- 100% recommended dose of nitrogen (RDN), T_3- 75% N through fertilizer + 25% N through FYM , T_4 – 75% N through fertilizer + 25% N through pressmud compost, T_5 - 75% N through fertilizer + 25% N through vermicompost, T_6 – 75% N through fertilizer +

25% N through poultry manure, T_7 – 75% N through fertilizer + 25% N water hyacinth compost and T_8 – 75% N through fertilizer + 25% N sugarcane trash compost.

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