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YIELD AND QUALITY OF RAINFED COTTON IN RESPONSE TO ORGANIC MANURES UNDER VERTISOL

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Abstract

The field experiment were conducted to evaluate the effect of organic manures such as FYM, Vermicompost, Sun hemp, Castor cake, Neem cake and Sun hemp as *in-situ* green manure application on cotton yield and quality under Rainfed conditions in Vertisols. The experiment was laid out in RBD with ten treatments and three replications. Results indicated the highest seed cotton yield (19.00 q ha^{-1}) was recorded by the treatment of neem cake 500 kg ha^{-1}. Whereas, highest dry matter yield (46.31q ha^{-1}) was reported by the treatment of FYM @ 10 t ha^{-1}. There is nonsignificant effects on quality parameters of such as span length, micronaire value and bundle strength and uniformity ratio were not influenced by any organic manure as well as combinations. These studies suggest that it is advantageous to apply organic manures as it improves fibre yield and dry matter yield by way of providing positive nutrient balance for the entire crop growth period.

Key words : Cotton, organic, quality, rainfed, vertisol and yield.

Introduction

In India 2015-16, cotton is grown on 118.81 lakh ha with production of 352.00 lakh bales and yield 504 kg ha^{-1}. In Maharashtra, cotton is grown on 41.92 lakh ha with production 85 lakh bales and yield 345 kg lint ha^{-1}. Cotton is the most capital intensive cash crop grown predominantly in Maharashtra, India. It covers about 34 per cent of total cotton area and contributes 17 per cent of the production (Anonymous, 2015). About 97 per cent of the cotton crop is cultivated under rainfed condition. In Vidarbha region, area under cultivation of cotton is 12.37 lakh ha with production of about 35 lakh bales and 312 kg lint ha^{-1}. Cotton is the major crop grown in the vertisols of central India occupying about 89.30 lak ha. Poor soil fertility is a major cause of the low crop productivity.

High risk associated with this rainfed agriculture is the major cause for the non-investment in manure. Importance of fertilizer N on the growth and yield of cotton is well known (Prasad and Prasad, 1998). Potassium is considered abundant in the cotton growing vertisols (Pasricha and Bansal, 2002) and most often is not included in the fertilizer recommendations. Response to P has also not been consistent (Kairon *et al*., 2002). The cotton-growing farmers, therefore, generally apply only nitrogenous fertilizers. However, application of K has been observed to improve fibre quality. Information on the effects of fertilizer and manure on fibre quality of cotton grown under rainfed conditions is generally limited.

The difference between the removal of nutrients by the crop and the addition of nutrients to soil as fertilizer or manure determines the nutrient balance of a cropping system. Construction of nutrient budgets is an important step in understanding the efficient nutrient management in agro-ecosystems of late integrated nutrient management involving organic manure and chemical fertilizer has received considerable attention (Swarup *et al*., 1998). Field studies, therefore, were conducted to assess the impact of organic manure as well as combinations on the seed cotton yield, fibre quality.

Materials and Methods

The field investigation in relation to "Yield and quality of rainfed cotton in response to organic manures under Vertisol" was conducted during *kharif* season of 2015-16 at Cotton Research Unit (CRU), Central Research

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Station (CRS), Dr. Panjabrao Deshmukh Krishi Vidyapeeth, Akola. This region has a typical semi-arid climate with most of the rainfall received between June and October. The soil was slightly alkaline in reaction (pH 8.5), low in organic C (3.6 g C kg^{-1} soil) and low to medium available of macro nutrients.

A field trial was conducted as a randomized block design with three replications. The treatments comprised application of FYM, vermicompost, castor cake and *in-situ* green leaf manuring of sunhemp was incorporated into the soil with a blade harrow. Treatment details are presented in table 1.

Observations recorded

Seed yield (q ha^{-1}) : The harvested plants of cotton from each net plot were tied in bundles and left in the open field with labelling treatment wise to complete drying. Thus, the weight of pure seeds was taken in kg and converted into q ha^{-1}.

Plant dry matter production (kg ha^{-1}) : Plants were uprooted and dried in hot air oven at 70°C till constant weight was recorded with the help of electronic balance.

Quality parameters

Staple length (mm) : The mean staple length was determined by HVI where the weight ratio method was adopted and expressed in mm (Sundaram, 1979).

Micronaire value (10^{-6} g $inch^{-1}$) : It is an important quality characteristic, which plays a prominent part in determining the spinning value of cotton especially the long staple varieties. It is the measure of fibre weight in mg per g unit length of fibre and expressed in 10^{-6} g cm^{-1} or 10^{-6} g $inch^{-1}$.

It is determined by micronaire instrument in which 50g of the sample is taken and compressed in a cylinder of specified dimension. Air at specific pressure is passed through the material. The amount of airflow is measured on a scale calibrated directly to read the weight per unit length of the fibre. Finer cottons have lower micronaire value (Sundaram, 1979).

Fibre strength (g tex^{-1}) : It is the ratio of the breaking strength of a bundle of fibres to its weight. It was expressed in tenacity at 1/8" gauge on stelometer. In metric system, this value is expressed as tenacity and it is expressed in terms of g tex^{-1}. Where, tex denotes weight in g of 1 kilometre of the fibre (Sundaram, 1979).

Uniformity ratio : It is the ratio of 50 per cent span length to the 2.5 per cent span length and expressed in percentage (Sundaram and Iyengar, 1968).

$$\text{Uniformity ratio (\%)} = \frac{\text{50 per cent span length}}{\text{2.5 per cent Span length}}$$

Statistical analysis : The data obtained various parameters were analysed in RBD statistical procedure (Panse and Sukhatme, 1984). The appropriate standard error of mean (S.Em. ±) and the critical difference (C.D.) were calculated at 5% level of probability.

Results and Discussion

Influence of organic sources on yield performance of cotton in Vertisols

Seed cotton yield : The data pertaining to seed cotton and dry matter yield presented in Table2. Seed cotton yield was found statistically significant under different organic treatments. It was in ranged 2.80 - 19.00 q ha^{-1}.

Significantly highest seed cotton yield was recorded in the treatment of concentrated organic matter *i.e.* Neem cake @ 500 Kg ha^{-1} (19.00 q ha^{-1}) which was at par with treatment Castor cake @ 500 Kg ha^{-1} (18.87 q ha^{-1}), FYM 5 t ha^{-1} + Neem cake @ 500 Kg ha^{-1} (18.23 q ha^{-1}), FYM 10 t ha^{-1} (18.06 q ha^{-1}) and vermicompost @ 5 t ha^{-1} (16.64 q ha^{-1}). This might be due to that, neem cake contain rich source of NPK as compared to other organic sources used in experimentation and it favouring more utilization of nutrients by plant and enhanced the translocation of photo synthates towards sink and increase seed cotton yield. The significantly lowest performance of cotton crop in respect of seed cotton (2.80 q ha^{-1}) was observed in the absolute control treatment over all organic sources treatments under experimentation.

These results are conformity with findings of Hemalata chitte *et al*. (2016) reported that, yield attributes and yield were significantly higher in neem cake @ 300 kgha^{-1} followed by karanj cake @ 300 kg ha^{-1} than control treatment. Similar results were reported by Solunke *et al*. (2011) states that, treatment FYM @ 10 t ha^{-1}, vermicompost @ 2 t ha^{-1} and *in-situ* green manuring of sunhemp being at par recorded significantly higher seed cotton yield $plant^{-1}$. Results are in line with Basavanneppa and Biradar (2002), Hanumanthappa and Shivaraj (2003), Prahaj *et al.* (2004), Mahavishnana (2005) and Bhalerao *et al.* (2011).

Dry matter yield : Significantly highest dry matter yield was recorded in the treatment of bulky organic matter *i.e.* FYM @ 10 t ha^{-1} (46.31 q ha^{-1}) which at par with castor cake @ 500 kg^{-1}(45.91 q ha^{-1}), Neem cake @ 500 kg ha^{-1} (45.84 q ha^{-1}), FYM + Neem cake @ 500 kg ha^{-1} (44.68 q ha^{-1}) and vermicompost @ 5 t ha^{-1} (40.01

q ha^{-1}). The lowest performance of cotton crop in respect of dry matter production (11.72 q ha^{-1}) was observed in the absolute control treatment.

These results are conformity with findings of Nawlakhe *et al.* (2010) reported that, number of bolls picked per plant, seed cotton yield per plant seed cotton yield (q ha^{-1}) and stalk yield (q ha^{-1}) were reported significantly superior by application of vermicompost at the rate of 2 t ha^{-1} over others except FYM at the rate of 5 t ha^{-1}, which was at par with it. Similar results were reported by Hanumanthappa and shivaraj (2003), Kumari *et al.* (2005), Solunke *et al.* (2011) and Hemalata Chitte *et al.* (2016).

Influence of organic sources on quality parameter of cotton fibre in Vertisols

The data pertaining to quality parameters of cotton *i.e.* staple length, micronaire, fibre strength and uniformity ratio presented in table 3 and depicted in. Different organic treatments could not significant effect on quality parameters of cotton fibre.

Table 1 : Treatments details.

S. no.	Treatment details
1.	T_1- FYM @ 5 t ha^{-1}
2.	T_2- Vermicompost @ 2.5 t ha^{-1}
3.	T_3- FYM @10 t ha^{-1}
4.	T_4- Vermicompost @ 5 t ha^{-1}
5.	T_5- In-situ green manuring with sunhemp
6.	T_6- Castor cake @ 500 kg ha^{-1}
7.	T_7- FYM (source of 15 kg P_2O_5) + green manuring with sunhemp
8.	T_8- Neem cake @ 500 kg ha^{-1}
9.	T_9- FYM 5 t ha^{-1} + Neem cake@500 kg ha^{-1}
10.	T_{10}- Absolute Control

Note: Common seed treatment of Azotobacter and PSB @ 25 g kg^{-1} seed to all treatments except Absolute control *i.e.* T_{10} treatment.

Table 2 : Effect of organic sources on yield performance of cotton in Vertisols.

Treatment	Cotton yield (q ha^{-1})	
	Seed cotton	Dry matter
T_1-FYM @ 5 t ha^{-1}	15.61	37.65
T_2- Vermicompost @ 2.5 t ha^{-1}	13.40	37.29
T_3-FYM @10 t ha^{-1}	18.06	46.31
T_4-Vermicompost @ 5 t ha^{-1}	16.64	40.01
T_5-Insitu green manuring with sunhemp	13.68	35.05
T_6-Castor cake @ 500 kg ha^{-1}	18.87	45.91
T_7-FYM + green manuring with sunhemp	15.39	37.04
T_8-Neem cake @ 500 kg ha^{-1}	19.00	45.84
T_9- FYM(5t ha^{-1})+Neem cake@500 kg ha^{-1}	18.23	44.68
T_{10}-Absolute Control	2.80	11.72
SE(m)±	0.89	2.61
CD at 5%	2.66	7.76

Staple length (mm) : The recorded data of staple length was found statistically non significant influence of various organic treatments. The staple length of cotton was ranged from 25.75mm to 26.95mm. These ranged values of staple length was recorded by the analysis of cotton fibre comes under medium fibre range (short fibre < 24.5mm, medium fibre 25.0mm - 29.0mm, long fibre 29.5mm-32.5mm and very long fibre >33.0mm). The highest and similar values of staple length (26.95 mm) was observed in the treatment received well decompose FYM @ 10 t ha^{-1} and *in-situ* green manuring with sunhemp, respectively. The lowest staple length (26.30 mm) was recorded in the absolute control.

Micronaire value (10^{-6} g inch^{-1}) : The data recorded on Micronaire value of cotton showed statistically non-significant influence of various organic treatments. The lowest Micronaire value (5.2 × 10^{-6} g inch^{-1}) was recorded in the treatment received well decompose Vermicompost @ 5 t ha^{-1}. The highest Micronaire value (5.55 x 10^{-6} g inch^{-1}) was recorded in the absolute control. These Micronaire values (5.2 × 10^{-6} g inch^{-1} to 5.55 x 10^{-6} g inch^{-1}) was recorded by the analysis of cotton fibre comes under coarse fibre range (very fine fibre <3.0, fine fibre 3.0-3.9, average 4.0-4.9, coarse fibre 5.0-5.9 and very coarse >6.0).

Table 3 : Effect of organic sources on quality parameters of cotton fibre in Vertisols.

Treatment	Staple length (mm)	Micronaire (10^{-6} g inch^{-1})	Fiber strength (g tex^{-1})	Uniformity ratio (%)
T_1- FYM @ 5 t ha^{-1}	26.70	5.40	27.10	80
T_2- Vermicompost @ 2.5 t ha^{-1}	25.95	5.45	26.90	80
T_3- FYM @10 t ha^{-1}	26.95	5.30	27.60	81
T_4- Vermicompost @ 5 t ha^{-1}	26.15	5.20	28.15	80
T_5- In-situ green manuring with sunhemp	26.95	5.50	26.95	81
T_6- Castor cake @ 500 kg ha^{-1}	26.50	5.50	27.10	80
T_7- FYM (source of 15 kg P_2O_5) + green manuring with sunhemp	25.85	5.40	27.00	80
T_8- Neem cake @ 500 kg ha^{-1}	26.40	5.50	28.10	80
T_9- FYM(5t ha^{-1})+Neem cake@500 kg ha^{-1}	26.60	5.40	27.70	81
T_{10}- Absolute control	25.75	5.55	26.75	79
SE (m)±	0.545	0.39	0.616	1.172
CD at 5%	NS	NS	NS	NS

Fibre/Bundle strength (g tex^{-1})

The recorded data of fibre strength was found statistically non-significant influence of various organic treatments. The fibre strength of cotton was ranged from 28.15 g tex^{-1} to 26.75 g tex^{-1}. This ranged value of fibre strength was recorded by the analysis of cotton fibre comes under very low category (very low < 34.5 g tex^{-1}, low 34.5 - 37.4 g tex^{-1}, average 37.5-43.0 g tex^{-1}, good 43.1-47.7 g tex^{-1} and very high >47.5 g tex^{-1}). The highest values of fibre strength (28.15 g tex^{-1}) was observed in the treatment received well decompose Vermicompost @ 5 t ha^{-1} (T_4). The lowest fibre strength (26.75 g tex^{-1}), was found in the absolute control (T_{10}).

Uniformity ratio : The data recorded on Uniformity ratio of cotton showed statistically non significant influence of various organic treatments. The higher and similar Uniformity ratio (81%) was recorded in the treatments received well decompose FYM 10 t ha^{-1}, *in-situ* green manuring with sunhemp and FYM 5 t ha^{-1}+Neem cake@500 kg ha^{-1}. The lowest Uniformity ratio (79%) was recorded in the absolute control (T_{10}). This uniformity ratio of cotton fibre was comes under medium fibre range category (high >85%, medium 75-85% and low <75%).

These results are conformity with findings of Solunke and sangita (2010) conducted experiment on effect of organic manures, inorganic fertilizers and plant protection on quality and economics of desi cotton. The results stated that quality parameters like fibre technology properties like 2.5 per cent span length, micronaire value, bundle strength and uniformity ratio were not influenced significantly due to use of different organics (FYM and Vermicompost). Similar results are reported by Satyanarayana and Janawade (2009) and Gudadhe *et al*. (2013).

Conclusion

Organics as a source of nutrients reported significant increase in biological yield performance of cotton crop over absolute control. However, their influence on quality parameters of cotton was no-significant. Thus, it can be concluded from 6th cycle of experimentation that, application of bulky organic manure *i.e.* FYM @ 10 t ha^{-1} significantly improves the physical and chemical properties of Vertisols. However, significantly highest seed cotton yield was obtained in treatment of concentrate organic manure i.e. Neem cake @ 500 Kg ha^{-1} and it was statistically equal to yield obtained under incorporation of FYM @ 10 t ha^{-1}, castor cake @ 500 kg ha^{-1} and FYM + Neem cake @ 500kg ha^{-1} of desi cotton (variety AKA-8) in rainfed condition.

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