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RESEARCH ARTICLE :

Effect of rainfed organic cotton on chemical properties in vertisol

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SUMMARY : The present investigation entitled "Effect of rainfed organic cotton on chemical properties in Vertisol" was conducted at the farm of Cotton Research Unit, Central Research Station, Dr. Panjabrao Deshmukh KrishiVidyapeeth, Akola, during *Kharif* 2015-16. The experiment was laid out in RBD with ten treatments and three replications. Organic sources used were FYM, Vermicompost, Sunhemp, Castor cake, *Neem* cake and Sunhemp as *in situ* green manure crop. After 6th year of organic cotton experimentation, the influence of different organic sources application of FYM @ 10 t ha $^{-1}$ reported lowest pH of soil (7.86) and same dose of FYM application reported numerically lowest value of EC (0.115 dSm^{-1}),whereas significantly highest organic carbon (0.57%) content of soil was recorded by the treatment vermicompost @ 5 t ha^{-1}, and the significantly total nitrogen content of soil was recorded by the treatment FYM @ 10 t ha^{-1}. Significantly lowest C:N ratio of soil (8.24) was recorded by the treatment received FYM @ 10 t ha^{-1}.

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BACKGROUND AND OBJECTIVES

Cotton (*Gossypium* spp.) most important fibre crop hence popularly known as "White Gold" and "King of Fibres". It belongs to malvacea family, provides fibre a raw material for textile industry along with cotton seed and plays a vital role in economy of the country. It is also a valuable source of oil. The cultivated species of cotton contain 14 to 26 per cent oil. After extraction cotton seed meal contains higher protein which is rich in essential amino acids like lysine, methionine and tryptophan and is used as manure as well as animal feed concentrate.

India has the largest cotton area of 126.5 lakh ha^{-1} with a production of 400.00 lakh bales and a productivity of 537 kg ha^{-1}. Maharashtra contribute 41.9 lakh ha^{-1} with production of 85 lakh bales and productivity of 345 kg ha^{-1}. In Vidarbha region about 87 per cent cultivable land is under rainfed farming. Irrigation sources are very meagre and about 99 per cent of cotton is grown as rainfed crop. Vidarbha contribute 15.5 lakh ha^{-1} with production 27 lakh bales and productivity of 250 kg ha^{-1} which is quite lower than average

productivity of India.(Anonymous CAB and CCI August 2015).

Organic matter has a very crucial significance for soil fertility improvement. It ensures a soft and loose soil with good porosity and thus good infiltration of water. The organic matter particles acts like tiny sponges, thus keeping the soil moist for a longer time. Organic matter takes up and slow releases nutrients so that they are available to the crop. Organic material feeds and hosts a huge number of beneficial soil organisms, from earth worms to microbes, which continuously work toward improving soil fertility (Guled *et al*., 2002).

The use of organic manures has been the traditional means of maintaining soil fertility. Most organics provide a balanced source of nutrients for crops. Organic manures also contain traces of micronutrients and also provide food for soil micro-organism. This increases activity of microbes which in turn helps to convert unavailable plant nutrients into available and fixing atmospheric nitrogen.The organic matter that is applied through organic manures has a very complex effect as soil and on plant growth as well as improves the physical, chemical and biological properties of soil. This effect is very important in case of most of our arable land.

RESOURCES AND METHODS

The field investigation entitled to "Effect of rainfed organic cotton on chemical properties in vertisol" was conducted during *Kharif* season of 2015-16 at Cotton Research Unit, Central Research Station, Dr. Panjabrao Deshmukh KrishiVidyapeeth, Akola. The details of material used and methods adopted during the period of experimentation are given below.

Experimental site:

The experimentation was superimposed on the existing organic cotton experiment at Cotton Research Unit on "Technology for organic cotton production" and this is the sixth year of experiment. Before initiation of the experiment the experimental plot was manured with common dose of FYM (5 t ha^{-1}) followed by in-situ green manuring of sunhemp and from the year 2010-11 the fixed frame plot experimentation with eight organic source treatments (out of which one absolute control) was laid out with cotton as a test crop most preferred rainfed cash crop, in the Vidarbha region (Table A).

Table A : Treatments details

Sr. No.	Treatments
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

Soils of experimental area:

The soils of the experimental area were medium deep black, clay loam texture with typical swell- shrink, deep cracks, high water holding capacity, domoinant in montmorillonite clay mineral and slickenside characteristics classified under vertisol.

Application of organic manure:

Five organic sources were used for the "Organic cotton experimentation" out of which two *viz.,* FYM and vermicompost were well decomposed bulky organic manures and castor cake, neem cake were concentrated organic manure and sunhemp was used for in-situ green

Table B : Nutrient content in organic sources used for the experimentation

Organic sources	N (%)	P (%)	K (%)
FYM	0.44	0.19	0.68
Vermicompost	1.23	1.49	0.60
Castor cake	5.15	1.46	1.24
Neem cake	5.32	1.07	1.42
Sunhemp (Oven dry basis)	1.28	0.24	2.18

Table C : Addition of nutrients from various sources (kg ha^{-1})

Sr. No.	Addition of nutrients	N (kg ha^{-1})	P (kg ha^{-1})	K (kg ha^{-1})
1.	2.5 t Vermicompost	30.5	37.5	15
2.	5 t FYM	21.5	9.25	34
3.	5 t Vermicompost	61	75	30
4.	10 t FYM	43	18.5	68
5.	500 kg castor cake	25.50	7.5	6.2
6.	500 kg *Neem* cake	26.5	5.35	7.2
7.	*In -situ* green manuring of sunhemp at 45 DAS	27	5.1	46

manuring. The major nutrient content estimated before their incorporation to the field and its treatment wise addition of nutrient (NPK) are given in Table B and C.

The sunhemp crop was raised between the rows of cotton crop which was buried *in situ* 45 DAS as a green manuring treatment. All the cultural and plant protection measures were adopted as and when required.

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

OBSERVATIONS AND ANALYSIS

The results obtained from the present study as well as discussions have been summarized under following heads:

Table 1 : Effect of organic sources on pH and electrical conductivity of soil under cotton

Treatments	pH	EC (dSm^{-1})
T_1- FYM @ 5 t ha^{-1}	7.93	0.119
T_2-Vermicompost @ 2.5 t ha^{-1}	7.96	0.117
T_3 - FYM @ 10 t ha^{-1}	7.86	0.115
T_4 -Vermicompost @ 5 t ha^{-1}	7.94	0.116
T_5-In-situ green manuring with sunhemp	7.95	0.117
T_6- Castor cake @ 500kg ha^{-1}	7.88	0.117
T_7-FYM (Source of 15 kg P_2O_5) + green manuring with sunhemp	7.89	0.116
T_8- *Neem* cake @ 500 kg ha^{-1}	7.97	0.118
T_9- FYM 5 t ha^{-1}+ *Neem* cake @ 500 kg ha^{-1}	7.96	0.117
T_{10}- Absolute control	8.06	0.122
S.E.±	0.026	0.002
C.D. (P=0.05)	0.078	NS

NS= Non-significant

Soil pH :

The data on soil reaction pH is presented in Table 1. The data showed that due to application of different organic nutrient management treatments the soil pH varied from 7.86-8.06. The pH of soil was significantly differ due to organic treatments.

The highest value of soil pH (8.06) was recorded in the absolute control (T_{10}) and it was decreased as the doses of organic nutrient sources increases and lowest value of pH (7.86) was observed in the treatment received well decompose FYM @ 10 t ha^{-1} (T_3) followed by FYM+ green manuring with sunhemp (T_7) and castor cake @ 500 kg ha^{-1}(T_6). The similar results were reported by Halemani *et al.* (2004) observed that, more reduction in pH with application of FYM alone @ 10 ton ha^{-1}. The results are in agreement with those of Pawar and Patil (2007); Katkar *et al.* (2007) and Patil *et al.* (2003).

Electrical conductivity :

The results regarding EC of soil after harvest of cotton crop was presented in Table 1. The values of EC of soil were statistically non-significant under different organic treatments.

The EC of the experimental soil ranged from 0.115 to 0.122 dSm^{-1}. The highest EC value (0.122 dSm^{-1}) was recorded in the absolute control treatment and it was decrease as the doses of organic nutrient sources

Table 2 : Effect of organic sources on C:N ratio in soil under cotton

Treatments	Organic carbon (%)	Total nitrogen (%)	C:N ratio
T_1-FYM @ 5 t ha^{-1}	0.51	0.036	14.24
T_2-Vermicompost @ 2.5 t ha^{-1}	0.53	0.032	16.42
T_3- FYM @ 10 t ha^{-1}	0.52	0.062	8.24
T_4- Vermicompost 5 t ha^{-1}	0.57	0.055	10.23
T_5-*In-situ* green manuring with sunhemp	0.54	0.044	12.31
T_6- Castor cake @ 500 kg ha^{-1}	0.53	0.047	11.33
T_7-FYM (Source of 15 kg P_2O_5) + green manuring with sunhemp	0.52	0.058	8.97
T_8-Neem cake @ 500 kg ha^{-1}	0.53	0.049	10.81
T_9- FYM 5 t ha^{-1}+ *Neem* cake @ 500 kg ha^{-1}	0.55	0.050	11.22
T_{10}-Absolute control	0.39	0.017	22.35
S.E. ±	0.01	0.001	0.59
C.D. (P=0.05)	0.03	0.005	1.74

increase and lowest value of EC (0.115 dSm^{-1}) was observed in the treatment received well decompose FYM @ 10 t ha^{-1} (T_3). The similar results as regards to EC was reported by Tyagi and Bhardwaj (1997) continuous use of manures and fertilizers had not affected the EC of soil. Results are also in line with Badanur *et al.* (1990) and Katkar *et al*. (2002).

Effect of organic sources on C:N ratio in soil under cotton:

The organic carbon and total nitrogen content of soil after the harvest of cotton crop was estimated and C:N ratio was computed and presented in Table 2.

Organic carbon :

The results regarding organic carbon after harvest of cotton was presented in (Table 2) and showed that impact of organic sources on build- up of soil organic carbon content was significant.Significantly highest build-up of organic carbon content of soil after harvest of cotton with addition of higher dose of well decomposed organic matter *i.e*. Vermicompost @ 5 t ha^{-1} (0.57%) and it was statistically at par with FYM 5 t ha^{-1}+ *Neem* cake @ 500 kg ha^{-1}(0.55%). However, lowest organic carbon (0.39%) was observed in the absolute control treatment.

Pawar and Patil (2007) reported that, organic carbon content of soil increased significantly due to application of vermicompost @ 2.5 and 5 t ha^{-1}. Similar results were also reported by Vasanthi and Kumarswamy (1999).

The organic carbon content in the soil increased after harvest of the cotton might be due to the direct addition of organic matter through vermicompost, FYM, green manuring with sunhemp thereby increasing root biomass of plant (Stolyarenko *et al.*, 1992).

Total nitrogen :

The data in respect of total nitrogen content of soil given in Table 2 showed that, total nitrogen was significantly differ due to different organic treatments.

Data revealed that, total N content of soil ranged from 0.017 to 0.062 per cent. It was observed that, total N content increased with the increase in doses of well decomposed organic manures. Significantly highest 0.062 per cent of total nitrogen content was recorded in the treatment (T_3) *i.e.* FYM @ 10 t ha^{-1}, which was at par with (T_7) FYM (source of 15 kg P_2O_5) + green manuring with sunhemp. However, lowest total N content (0.017 %) was observed in the absolute control .

These results are conformity with findings of Kukreja *et al*. (1991) reported that, application of FYM increased organic carbon and total nitrogen significantly in soils of plots receiving 90 t ha^{-1} annually for 20 years whereas, less in treatments receiving inorganic. Similar results were also reported by Badole and More (2000); Ravankar *et al.* (2005) and Bouajila and Sanaa (2011).

C:N ratio :

Most organic residues entering the soil contain a large amount of carbon and less amount of nitrogen. The values of C:N ratio of soil is fairly constant and is between those of higher plant and microbes. The factor which affects the soil organic matter and nitrogen will also affects the C:N ratio of soil. The data in respect of C:N ratio of soil given in Table 2 shows the effect of organic sources on C:N ratio of soil was significant.

From The data significantly lowest C:N ratio was observed in the treatment well decompose FYM @ 10 t ha^{-1} (8.24) which was at par with *Neem* cake @ 500 kg ha^{-1} (10.81), vermicompost @ 5 t ha^{-1} (10.23), FYM 5 t ha^{-1} + *Neem* cake @ 500 kg ha^{-1} (11.22). Highest C:N ratio was recorded in absolute control (22.35).

Amongst *in-situ* green manuring treatments lower C:N ratio was recorded with the application of FYM (source of 15 kg P_2O_5) + green manuring with sunhemp (8.97) than *in-situ* green manuring with sunhemp alone (12.31). Singh *et al*. (2000) reported that, the soil C:N ratio increased after harvest of crop where green manuring was done as compared to non-manured plot.

However, organic carbon content in the soil increased this might be due to the direct addition of organic matter through vermicompost, FYM, green manuring with sunhemp thereby increasing root biomass of plant (Stolyarenko *et al*., 1992).

Conclusion:

Based on findings after 6th year of organic cotton experimentation, significantly reduction in pH (7.86) and EC (0.115 dSm^{-1}), organic carbon,(0.52%), C:N ratio (8.24) as well as significantly improvement in Total nitrogen (0.062%) of soil was reported by the treatment FYM @ 10 t ha^{-1}.

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