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Effect of Conventional and Organic Farming Practices on Physical Properties of Vertisols of Bagalkot Region

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ABSTRACT

In order to characterize the "Effect of conventional and organic farming practices on soil physico-chemical properties of Vertisol in Northern Karnataka" a field survey was carried out during 2014-2015 in farmers fields of Bagalkot District, which falls in the Northern dry Agro-climatic zone of the Karnataka state. The soil was deep black clayey in nature and neutral to alkaline in reaction with low salt content. The results of the study revealed that soils under organic farming system recorded significantly higher water holding capacity (62.05%), per cent porosity (52.56) and aggregate stability (64.57%) but significantly lower bulk density (1.26 Mg m^{-3}) than soils under conventional farming system (61.23, 44.75, 55.10% and 1.46 Mg m^{-3} water holding capacity, per cent porosity, bulk density and aggregate stability, respectively) irrespective of different talukas of Bagalkot district. The soil physical properties varied with soil depths also. The surface soil recorded significantly lesser water holding capacity (52.33%), bulk density (1.13 Mg mm^{-3}) and aggregate stability (56.79%), but per cent porosity (57.47) was significantly more. Organic farming practices improved physical properties of soil in both surface and sub-surface depths. Hence, it can be concluded that organic farming practice found to be better for improving soil major nutrients than conventional farming practice.

Key words: *Organic manure, Green manure intercrop, Bio fertilizers, press-mud and FYM.*

INTRODUCTION

Organic farming as a system of farm management and agricultural production, is an in-built recycling capacity for waste accepted by environmental and health conscious people, which can achieve sustainable productivity without the use of artificial external inputs such as chemo-synthetic fertilizers and pesticides. Whereas Conventional Farming, refers to methods of farming in which include the use of synthetic chemical fertilizers, pesticides and herbicides and genetically modified organisms. Conventional farming is contrasted to organic farming as the latter responds to site-specific conditions by integrating cultural, biological, and mechanical practices that foster cycling of resources, promote ecological balance, and conserve biodiversity by the Codex Alimentarius Commission[6].

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Thus, organic farming offers a foresighted sustainable farming system with a viable to alternative to conventional approaches to agriculture. The significant difference in the approach lies in the fact that, in conventional modern farming, chemical fertilizers are used to feed the plants directly, while in organic farming the organic materials are applied to fields to improve soil structure, water holding capacity and to nourish soil life which inturn nourishes plants. Thus, organic farming concentrates on "feeding the soil rather than feeding the plants". Until the introduction of chemical fertilizers in the mid nineteenth century, organic material in the form of FYM or compost were the only recognized source of plant nutrients added to soil[8]. It is the traditional organic manure which was most readily available to the farmers. In India, it can potentially supply approximately 33 Mt of N, P and K per year[5]. The National Academy of Agricultural Sciences projected that 30-35 MT of fertilizer nutrients will be required to meet food grain demand by 2020. Therefore demand will stretch by almost 15 Mt, if requirements of horticulture, plantation, sugarcane, potato, cotton *etc.*, are included, thus making a total N, P and K requirement at 45 Mt. The behaviour of soil under intensive inorganic or organic farming practices is not well studied under irrigated conditions, Farmers, for getting higher yields, use heavy dosages of fertilizers, neglecting regular and adequate application of organic manures over the years. Consequently land loses its organic matter content leading to drastic disturbance in soil physical environment. Now there is growing awareness about soil physical and biological environment, for which organic manures are very much needed. Hence soils put continuously under inorganic fertilizers definitely differ from those put under organics.

MATERIAL AND METHODS

A field investigation was carried out to characterise the soils of sugarcane fields under conventional and organic farming practices in Bagalkot district to study the effect organic and conventional farming practices on yield and quality of sugarcane and also on soil chemical properties. The details of the materials used and the methods adopted in conducting the field experiments and laboratory analysis are presented below.

Location

The observations were recorded from Bagalkot district, which falls in the Northern dry Agro-climatic zone of the Karnataka state and experiences a semi-arid climate. Bagalkot district consists of six talukas *viz*; Bagalkot, Bilagi, Badami, Hunagund, Mudhol and Jamkhandi. Bagalkot district is bound by Vijayapur in the north, Belgaum in the west, Dharwad in the south and Raichur in the east.

Experimental details

Observations were recorded with two replications during 2014-15 from the fields of five farmers practicing organic and conventional sugarcane cultivation.

Table 1: Distinguishing between conventional and organic sugarcane cultivation practices

Sl. No	Particulars	Conventional practice	Organic practice
01	Varieties	Co-671, Co-94012, Co-8014 (Mahalaxmi), Co-86032 (Nayana), Co-740	Co-8021, Co-86032, Co-86249, Co-90063, Co-94077, Co-95071
02	Land preparation	Deep ploughing once or twice with disc plough followed by shallow ploughing three or four times using cultivar	
03	Spacing	1. Adopt minimum row spacing of 90 cm. 2. For varieties, the spacing can be increased upto 150 cm between plant to plant 30 to 45 cm spacing is maintained. 3. Furrows must be formed at 20 to 30 cm deep.	
04	Organic manure	Apply recommended dose of chemical fertilizer – NPK (250:75:190 kg/ha) + 25 t/ha FYM	Apply FYM or compost or well decomposed pressmud @ 80 t/ha in furrows, which would supply 280 kg N/ha
05	Planting material	Collect sets from 6 to 8 months old disease free nursery crop	
		Three buded sets were used	Three buded sets were Used
06	Set rate and planting	Per hectare area 25000 to 35000 three budded sets required. Similarly, per hectare area 60000 to 75000 two budded sets Required	
07	Green manure intercrop	Along with sowing green manure crop, greengram, soybean, cowpea, blackgram are practiced (60 kg seeds required per ha)	Sow green manure crop like dhiancha or sunnhemp on one side of the ridges on third or fourth day after planting sugarcane and raise it as an intercrop with sugarcane. Harvest and *in situ* incorporate the intercrop around 45 days after transplanting.
08	Weed management	Weedicides like atrazine – add 3.3 g of 50% wettable powder in 1 litre water and spray	Hand hoeing and weeding at 30, 60 and 90 days after planting (DAT), follow only non-chemical weed management technologies like hand weeding and mechanical weed control methods.
09	Biofertilizers	--------------------	Apply 5 kg each of Azospirillum and phosphobacteria respectively on 30 and 60 DAT of sugarcane, mix the biofertilizers thoroughly with 500 kg FYM to increase the bulkiness and apply.
10	Cane yield	85 to 90 t/ha	90 to 100 t/ha

The pH of soil was determined in 1: 2.5 soils to water suspension after stirring the samples intermittently for half an hour using a Systronics direct digital 331 pH meter. Electrical conductivity of the soil was determined in the supernatant of 1:2.5 soils to water suspension by using Systronics direct digital conductivity meter-304[17]. Aggregate stability by Yoder wet sieve method. Particle size analysis by Hydrometer method[14]. Bulk density by Clod method[3]. Soil porosity by percentage method and Maximum water holding capacity by Keen's cup method[14]. The data collected from the experimental field and laboratory analysis were subjected to statistical analysis by adopting Fischer's method of analysis of variance (ANOVA) as outlined by Gomez and Gomez[7] following Randomized Block Design (RBD) with factorial concept for soil, cane yield and quality parameters. The level of significance used in 'F'and't' test was P=0.05. Critical difference was calculated wherever 'F' test was found significant.

RESULTS AND DISCUSSION

The results showed that, no significant difference existed between the organic and conventional farming systems (Table-3) with respect to maximum water holding capacity. However higher water holding capacity (62.05%) was recorded in organic farming practice as compared to conventional farming system (61.23%). Water holding capacity differed significantly due to soil depths (52.33%) for 0-20 cm and (70.95%) in 20-40 cm depths. The increase in maximum water holding capacity of soils was due to organic farming system compared to conventional farming system might be due to the application of organic manures like vermicompost and FYM which might have increased WHC. Similar results were also reported by Jadhav *et al.*[12]. Build-up of soil organic matter and improvement in soil structure by application of residues and FYM were responsible for significant increase in water holding capacity of soil[15].

Significant difference existed with respect to bulk density between the organic and conventional farming systems. Significantly lower bulk density (1.26 Mg m^{-3}) was recorded (table-3) due to organic farming practice as compared to conventional farming system (1.33 Mg m^{-3}). Bulk density of soil differed significantly due to soil depths and recorded 1.13 Mg m^{-3} for 0-20 cm and 1.46 Mg m^{-3} in 20-40 cm depths. Significant difference existed between organic and conventional farming systems with respect to per cent porosity. The reduction in bulk density could be due to better soil structure as evidenced from increase in water stable aggregates. Sharma *et al.*[15] attributed the reduction in bulk density in residue and FYM incorporated soils to increase of soil organic matter and better soil structure. Srikanth *et al.*[18] also observed a significant decrease in bulk density of soil amended with compost compared to the inorganic fertilizer. A decrease in bulk density due to incorporation of FYM, vermin compost and crop residue was also reported by Bhatia and Shukla[2] Pikul and Allmarks[13] Chenkai[4] Bellakki and Badanur[1] and Itnal[11]. Significantly higher porosity (52.56%) was recorded in organic farming system as compared to conventional farming system (44.75%). The per cent porosity of soil differed significantly due to soil depths and values recorded were 57.47 per cent for 0-20 cm and 39.84 per cent for 20- 40 cm depths. Parallel trend was noticed in all the talukas of Bagalkot district. Non significant difference was observed among the different talukas of Bagalkot district. Results directed that, significant difference existed with respect to aggregate stability between the organic and conventional farming systems. Significantly highest aggregate stability (62.38%) was recorded (table-3) in organic farming practice as compared to conventional farming system (55.10%). Aggregate stability of soil also significantly differed with soil depths and the values were 56.45 per cent for 0-20 cm and 61.02 per cent for 20-40 cm depths. The improvement in aggregate stability of soils under organic farming systems could be attributed to the humic and fulvic substances released during decomposition of organic manures which bind the soil particles to form better size aggregates. Formation of larger sized water stable aggregates under long-term application of organic manures was also observed by Singh[16]. A considerable increase in water stable aggregates due to incorporation of organic manure was noticed earlier by Havanagi and Mann[9]. Hirekurubar[10] observed positive correlation between per cent aggregate stability and organic carbon in Vertisols of North Karnataka.

Table 2: Initial Soil properties before adopting conventional and organic farming practices

Sl no.	Properties	Values
01	pH (1:2.5)	7.27
02	EC (1:2.5)	0.25
03	Bulk density (Mg m^{-3})	1.10
04	MWHC (%)	58.00
05	Per cent water stable aggregates (> 0.25 mm)	54.00
06	% Porosity	44.00

Note: each values average of five field data

Table 3: Effect of conventional and organic farming systems on physical properties of soil in different talukas of Bagalkot district

Treatments	MWHC (%)	Bulk density (Mg m^{-3})	% Porosity	Per cent water stable aggregates (> 0.25 mm)
Farming systems				
F1 : Organic	62.05	1.26	52.56	62.38
F2 : Conventional	61.23	1.33	44.75	55.10
SEm±	1.00	0.01	0.35	0.37
CD (p=0.05)	NS	0.03	1.02	1.07
Soil depths				
D1 : 0-20 cm	52.33	1.13	57.47	56.45
D2 : 20-40 cm	70.95	1.46	39.84	61.02
SEm±	1.00	0.01	0.35	0.37
CD (p=0.05)	2.94	0.03	1.02	1.07

Note: each values average of five field data

CONCLUSION

A survey was conducted on characterization of sugarcane growing soils under conventional and organic farming practices in Bagalkot district of northern Karnataka. Surface and subsurface soil samples were collected from farmers' fields who practiced organic farming for the last six years in Bagalkot district. Further soil samples were also collected from those fields which are under conventional farming system (inorganics). These samples were analysed for various physical, chemical and biological properties. Water holding capacity, bulk density and aggregate stability of sub surface layer was significantly higher than the surface layer, except percent porosity which is more at surface layer. Organic farming practices improved physical properties of soil in both surface and sub-surface depths.

Physical properties of soils were comparatively superior in organic farming practices than in conventional farming practices.

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