Available online at www.ijpab.com

DOI: http://dx.doi.org/10.18782/2320-7051.7384

ISSN: 2320 – 7051

Int. J. Pure App. Biosci. **7 (2):** 73-78 (2019)

Research Article

International Journal of Pure & Applied Bioscience

OPEN ACCESS

Effect of Conventional and Organic Farming Practices on Major Nutrients of Vertisols of Bagalkot Region

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Received: 10.02.2019 | Revised: 13.03.2019 | Accepted: 20.03.2019

ABSTRACT

In order to characterize the "Effect of conventional and organic farming practices on major nutrients 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 indicated that The available nitrogen content were higher in soils under organic farming (386.60 kg ha-1) than conventional farming (341.27 kg ha-1). The surface soils recorded significantly higher nitrogen (393.17 kg/ha) than the sub-surface soils (334.70 kg/ha). Likewise phosphorus, potassium and sulphur were found to be significantly higher under organic farming system both in surface and subsurface depths than conventional farming practice. Hence, it can be concluded that organic farming practice found better for improving soil major nutrients than conventional farming practice.

Key words: *Organic manure, Green manure intercrop, Bio fertilizers, pressmud 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[9]. Thus, organic farming offers a foresighted sustainable farming system with a viable to alternative to conventional approaches to agriculture.

Cite this article: Ramanandan, L.G. and Jogan, H., Effect of Conventional and Organic Farming Practices on Major Nutrients of Vertisols of Bagalkot Region, *Int. J. Pure App. Biosci.* **7(2):** 73-78 (2019). doi: http://dx.doi.org/10.18782/2320-7051.7384

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[12]. 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[7]. 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 budded 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[21]. The organic carbon content was determined by taking finely ground sample by wet oxidation method as described by Jackson[13]. Available nitrogen was estimated by modified alkaline potassium permanganate method[18]. Available phosphorus was determined by extracting phosphorus with 0.5 M NaHCO3 pH 8.5 (Olsen's method). The content of phosphorus extracted was determined by chlorostannous reduced blue colour method in HCl system using spectrophotometer at 660 nm[13]. Available potassium was extracted with neutral normal ammonium acetate and the content of potassium in the solution was determined by flame photometer[13]. Available sulphur was determined by turbidometric method described by Sparks *et al*.[21]. 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[10] 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

Results revealed that, soils of both conventional and organic farming were slightly alkaline in reaction; there was a significant decrease in soil pH due to organic farming practice. The overall mean of the soils showed that the soil pH decreased from 7.57 in conventional farming system to 7.38 in organic farming system. Soil pH was also significantly altered with soil depths from 7.70 (20-40 cm) to 7.25 (0-20 cm) in sub surface and surface soil layers respectively (Table - 03**)**. Reduced soil pH in organic farming system might be due to formation of organic acids produced during decomposition of organic manures brought about by soil microorganisms as described by Ramaswamy and Raj[17] and Singh *et al.*[20] also made similar observations where in soil pH decreased by one unit due to application of 15 tonnes of FYM over a period of four years. Badanur *et al.*[1] observed the significant decrease in soil reaction due to organic manure application as compared to chemical fertilizer application.

The overall mean displayed in table-3 that the EC decreased from 0.44 dS m^{-1} in conventional farming system to 0.28 dS m^{-1} in organic farming system. No significant difference observed with respect to soil depths and recorded the values for surface and sub-surface depths were 0.34 dS m^{-1} and 0.38 dS m^{-1} respectively. Contribution of total soluble salts from inorganic fertilizers was probably responsible for higher salt content in those soils due to high salt index. Bajpai *et al.*[2] and Ghuman and Sur[8] observed a slight decrease in electrical conductivity values at later stage of decomposition with application of organic residue (paddy-straw) in soil.

The data on available nitrogen content in soil indicated in table-4 that its values were higher in soils under organic farming (386.60 kg ha-1) than conventional farming (341.27 kg ha-1) irrespective of the talukas of Bagalkot district. This might be attributed to production of appreciable quantities of organic acids during decomposition of organic matter that mineralize the complex organic constituents, which in turn would contribute to nitorgen pool. An increase in available nitrogen content in soil due to application of organic manures was reported earlier by Phule[16], Balaji[3] and Pawar[15]. The increased available nitrogen in soil due to organic manures application was due to greater multiplication of soil microbes as carbon present in manures serves as source of enery for them[4,22].

The data presented (table-4) on available phosphorus content in soil indicated that, its values were higher in soils under organic farming system (17.13 kg ha-1) than conventional farming system (12.96 kg ha^{-1})

and high phosphrous in surface soil (15.83 kg ha-1) than sub-surface soil (14.26 kg ha^{-1}). This increased availability of phosphorus might be due to higher quantities of phosphorus added to the soil through organics over chemical fertilizer application were observed by Bharadwaj and Omanwar[5]. The increase in available potassium content in soils of organic farming system (243.29 kg ha-1) was due to the addition of potassium to the soil from organic manures as compared to the conventional farming system (210.59 kg ha^{-1}). Further there might be solubilisation of native soil potassium minerals due to organic acids produced during decomposition of organic manures. The beneficial effect of FYM on the available potassium might be also ascribed to the reduction of potassium fixation[23]. Similar observations on increased available potassium due to organic farming were reported by Grewal *et al.*[11] and Kumar *et al.*[14].

The available sulphur content (table-4) in soils of organic farming system were higher, 18.47 kg ha-1 and 24.02 per cent, respectively than conventional farming system (17.49 kg ha-1 and 12.15% respectively). Increased available sulphur content in soils of organic farming system was due to the addition of sulphur through the organic manures. Further microbial decomposition of organic manures that lead to mineralization of organic sulphur compounds which enhanced available sulphur pool in the soil. Similar observations were reported by Saiborne *et al.*[19] and Datta *et al*.[6].

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	Available –nitrogen (kg ha^{-1})	238.3
04	Available–phosphorus(kg ha^{-1})	11.25
05	Available –potassium (kg ha^{-1})	205
06	Available –sulphur (kg ha^{-1})	14.25

Note: each values average of five field data

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

Treatments	Soil pH	EC (dS m^{-1})
Farming systems		
F1 : Organic	7.38	0.28
F2 : Conventional	7.57	0.44
SEm±	**0.02**	**0.03**
CD (p=0.05)	**0.06**	**0.09**
Soil depths		
D1 : 0-20 cm	7.25	0.34
D2 : 20-40 cm	7.70	0.38
SEm±	**0.03**	**0.03**
CD (p=0.05)	**0.06**	**NS**

Note: each values average of five field data

Table 4: Effect of conventional and organic farming systems on available major nutrients status (kg ha^{-1}) of soil in different talukas of Bagalkot district

Treatments	Nitrogen	Phosphorus (P2O5)	Potassium (K2O)	Sulphur
Farming systems				
F1 : Organic	386.60	17.13	243.29	18.47
F2 : Conventional	341.27	12.96	210.59	17.49
SEm±	0.51	0.02	0.35	0.11
CD (p=0.05)	1.49	0.06	1.01	0.31
Soil depths				
D1 : 0-20 cm	393.17	15.83	245.38	18.35
D2 : 20-40 cm	334.70	14.26	208.50	17.61
SEm±	0.51	0.02	0.35	0.11
CD (p=0.05)	1.49	0.06	1.01	0.31

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.

The soil pH and electrical conductivity were found to be significantly lesser in all the talukas of Bagalkot district in organic farming system than in the conventional farming system. In the sub surface layer, pH and electrical conductivity were slightly higher than in surface layer. The availability of nitrogen, phosphrous, potassium and sulphur were found to be significantly higher under organic farming system both in surface and sub-surface depths. Fertility status of soil were comparatively superior in organic farming practices than in conventional farming practices.

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