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Effect of organic farming practices on soil physical properties

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Abstract
A survey was conducted in Bellary district Northern Dry Zone of Karnataka (zone-3). Only such of those farmers who were practicing it for more than five years were selected and the information on type and quantity of organics used by them in different cropping systems *viz.*, Groundnut, Finger millet, Onion, Drumstick and Maize was collected, Soil samples from the selected 30 organic farms and the neighboring conventional farms under the same cropping system were also collected. The results revealed that the physical properties of soils were found to be influenced favorably by the organic farming practice. A reduction in bulk density and an increase in particle density and an increase in water holding capacity and an increase in porosity was noticed in all the soils under organic farming. A reduction in pH was observed in soils under organic farming. But however, there was no appreciable change in the EC of soils. A wide variation in increase in organic carbon content in soils of organic farms over conventional farms was observed. The soils from D22 farmer recorded highest increase in porosity (6.78%) while the lowest increase was in soils of D23 farmer (1.65%). The increase in porosity might be due to better soil structure as evidenced from increase in water stable aggregates.

Keywords: Density, soil porosity, organic farming, cropping system, soil texture

Introduction

Organic manures, including animal manures, crop residues, green manures and composts were traditionally and preferentially used in developing countries until 1960's before the inorganic chemical fertilizers began to gain popularity. Chemical fertilizers became easily available and unlike organic manures, they were less bulky and thus, easier to transport, handle and store. They produced greater crop response than many organic manures. This was particularly true during the 'Green Revolution', when high yielding crop varieties were introduced that responded to heavy doses of chemical fertilizers.

The advent of high yielding varieties and increased area under assured irrigation led to a major shift from organic based nutrient application to use of chemical fertilizers. Chemical fertilizers virtually replaced sources of crop nutrients in some developing countries during early 1970's. Consequently, there was not only reduction in the consumption of organic manures but also excess use of high analysis fertilizers in an unbalanced manner resulting in additional problems of soil fertility such as acidity, alkalinity, multiple nutrient deficiencies especially of secondary and micronutrients and resulted in total loss of soil health.

Organic farming is slowly gaining importance in recent days. Farmers have experienced deterioration in soil health or due to injudicious agronomic practices. Although the benefits of adding organic residues and manures in improving soil health are well known, the information on changes in soil properties by shifting to total organic farming from conventional chemical farming is lacking. Since, some farmers have already started practicing organic farming in Karnataka during the last few years, a study was conducted in the farmers field to know the changes in soil physical, chemical and biological properties under the influence of organic farming practice in different cropping systems. Keeping these facts in mind, the present investigation was taken up with the following objective. To know the effect of organic farming practices on soil physical properties

Material and Methods

The material and methods employed to achieve the objectives of the present investigation are presented in this chapter.

A survey was conducted in Bellary district Northern Dry Zone of Karnataka (Zone-3) with the help of Department of Agriculture, NGOs, KVKs, Extension Workers to identify the farmers practicing organic farming. Only such of those farmers who were practicing it for more than five years were selected and the information on type and quantity of organics used by them in major cropping systems was collected.

Location of study area

The agro-climatic zone-3 is mainly spread on the black soils of North Karnataka and it is the largest of all the zones in the state. It has a total geographical area of 48.74 lakh hectares. It is primarily agrarian in character with about 76.60 per cent of its geographical area under cultivation.

Northern Dry zone is located at 17^0 25' N latitude, 76^0 65' E longitude at an altitude of 300-460 m above mean sea level. It is characterized by the lowest rainfall in Karnataka state with an average annual rainfall of 613 mm. It has the most fertile soils and is predominated by medium black soils followed by deep and shallow black soils.

Soil sampling

Soil samples from the selected 30 organic farms under different crops/cropping systems spread out in different taluks of Bellary district Northern Dry Zone of Karnataka were collected during winter season, (December 2020 and January 2021). Soil samples from the neighbouring conventional farms under the same crop/cropping system were also collected and treated as control to understand the changes in soil properties as influenced by organic farming.

Preparation and storing of the soil samples

The collected soil samples were air dried in shade. The airdried samples were ground with wooden pestle and mortar and passed through 2 mm sieve to separate the coarse fragments (>2 mm). The sieved soil samples were stored in separate clean and dry containers and used for various physical and chemical analysis.

Physical properties

Soil texture

Particle size analysis of the soil sample was carried out by International Pipette method using 1N sodium hydroxide as a dispersing agent as described by Piper (1966).

Bulk density

Bulk density of the soil sample was determined by core sampler method (Dastane, 1970).

Maximum water holding capacity

Maximum water holding capacity of soil was determined by using Keen-Raczkowaski brass cup as described by Piper (1966).

$$\text{MWHC (\%)} = \frac{(\text{Weight of saturated soil} - \text{Weight of oven dry soil})}{\text{Weight of oven dry soil}} \times 100$$

Particle density

Particle density of the soil samples was determined by Keen-Raczkowaski brass cup as described by Piper (1966).

Porosity (%)

Porosity of soil was computed by substituting the values of particle (PD) and bulk (BD) densities in the following equation.

$$\text{Porosity (\%)} = 1 - \frac{\text{BD}}{\text{PD}} \times 100$$

Results

Soil texture

Particle size distribution of groundnut-based cropping system of four organic farming soil samples revealed that the average sand, silt and clay content were 52.58, 28.06 and 19.35 per cent, respectively. While in the conventional farming, they were 50.13, 21.88 and 27.98 per cent, respectively.

Table 2: Particle size distribution and texture of soils

Code	Organic farming				Conventional farming			
	Sand (%)	Silt (%)	Clay (%)	Textural class	Sand (%)	Silt (%)	Clay (%)	Textural class
Groundnut based cropping system								
G1	56.2	29.8	14.0	sandy loam	52.4	19.5	28.1	sandy clay loam
G2	47.5	25.0	27.5	sandy clay loam	48.9	21.3	29.8	sandy clay loam
G3	57.6	30.5	11.9	sandy loam	50.3	23.2	26.5	sandy clay loam
G4	54.2	33.6	12.2	sandy loam	51.6	22.4	26.0	sandy clay loam
G5	46.5	17.5	36.0	sandy clay	49.7	20.3	30.0	sandy clay loam
G6	53.5	32.0	14.5	sandy loam	47.9	24.6	27.5	sandy clay loam
Mean	52.58	28.06	19.35		50.13	21.88	27.98	
Finger millet (Ragi) based cropping system								
R7	46.4	23.5	30.1	sandy clay loam	47.5	13.9	38.6	sandy clay
R8	45.5	26.5	28.0	sandy clay loam	49.8	11.7	38.5	sandy clay
R9	48.3	24.0	27.7	sandy clay loam	52.6	7.9	39.5	sandy clay
R10	48.6	13.0	38.4	sandy clay	48.5	12.6	38.9	sandy clay
R11	45.7	13.0	41.3	sandy clay	50.6	11.2	38.2	sandy clay
R12	44.5	19.5	36.0	sandy clay	47.9	11.9	40.2	sandy clay
Mean	46.5	19.91	33.53		49.48	11.53	38.98	
Onion based cropping system								
O13	29.2	24.3	46.5	clay	28.5	21.2	50.3	clay
O14	28.5	22.3	49.2	clay	24.5	21.4	54.1	clay
O15	25.9	23.5	50.6	clay	25.9	22.5	51.6	clay
O16	31.3	24.2	44.5	clay	29.6	23.5	46.9	clay
O17	47.5	12.0	40.5	sandy clay	24.2	23.2	52.6	clay
O18	49.6	10.8	39.6	sandy clay	23.7	22.9	53.4	clay

Mean	35.33	19.51	45.15		26.06	22.45	51.48	
	Drumstick based cropping system							
D19	48.2	23.6	28.2	sandy clay loam	53.7	34.7	11.6	sandy loam
D20	49.6	22.6	27.8	sandy clay loam	52.9	36.5	10.6	sandy loam
D21	46.5	24.8	28.7	sandy clay loam	54.2	37.9	7.9	sandy loam
D22	45.5	23.8	30.7	sandy clay loam	55.3	34.3	10.4	sandy loam
D23	27.9	25.3	46.8	clay	53.2	35.4	11.4	sandy loam
D24	26.8	21.9	51.3	clay	56.2	37.2	6.6	sandy loam
Mean	40.75	23.66	35.58		54.25	36.00	9.75	
	Maize based cropping system							
M25	49.1	24.5	26.4	sandy clay loam	48.2	22.3	29.5	sandy clay loam
M26	48.5	23.8	27.7	sandy clay loam	49.9	21.5	28.6	sandy clay loam
M27	49.3	23.7	27.0	sandy clay loam	47.5	20.3	32.2	sandy clay loam
M28	47.6	22.5	29.9	sandy clay loam	48.5	22.6	28.9	sandy clay loam
M29	48.6	25.2	26.2	sandy clay loam	51.6	21.7	26.7	sandy clay loam
M30	47.2	26.6	26.2	sandy clay loam	51.2	21.5	27.3	sandy clay loam
Mean	48.38	24.38	27.23		49.48	21.65	28.86	

In finger millet-based cropping system, soil samples of two organic farms on an average, recorded sand, silt and clay content of 46.5, 19.91 and 33.53 per cent, respectively, while in the conventional farming, they were 49.48, 11.53 and 38.98 per cent, respectively.

In onion-based cropping system, the average of four organic farm soils accounted for sand, silt and clay content of 35.33, 19.51 and 45.15 per cent, respectively as compared to 26.06, 22.45 and 51.48 per cent, respectively in soils of conventional farms.

In drum stick cropping system, the average of sand, silt and clay content of soils of organic farms was 40.75, 23.66 and 35.58 per cent, respectively. While in the conventional farming, they were 54.25, 36.00 and 9.75 per cent, respectively.

In maize cropping system, the average of sand, silt and clay content of soils of organic farms was 48.38, 24.38 and 27.23 per cent, respectively. While in the conventional farming, they were 49.48, 21.65 and 28.86 per cent, respectively.

The texture of soils under different cropping system studied was clay in onion cropping system, sandy clay in finger millet cropping system and sandy clay loam in groundnut and maize based cropping system in both conventional and organic farms (Table 2). The soil texture, being inherent property of soil was not affected by shifting from conventional farming to organic farming practice.

Bulk density

The data on the effect of organic farming on bulk density of soils under different cropping systems is given in (Table 3).

Under groundnut based cropping system (Table 3), on an average, the soils of six farms showed a reduction in bulk density of 1.56 Mg m^{-3} in conventional farms to 1.43 Mg m^{-3} in organic farms. The average decrease in bulk density was to the extent of 7.83 per cent respectively. Among the soils of six organic farms, the highest decrease in bulk density was observed in soils of G6 farmer (10.19%) followed by G3 farmer (8.28%) and lowest reduction was observed in soils of G5 farmer (5.10%) (Figure 1).

In finger-millet based cropping system (Table 3), the average of six soils indicated a reduction in bulk density from 1.51 to 1.37 Mg m^{-3} soils, respectively. The overall reduction in bulk density of soil due to organic farming worked to 9.45 per cent in soil. The highest decrease in bulk density of soil was observed in soils of R11 farmer (11.31%) (Figure 1).

In onion based cropping system (Table 3), the average of six soils indicated a reduction in bulk density from 1.56 to 1.41 Mg m^{-3} soils, respectively. The overall reduction in bulk density of soil due to organic farming worked to 9.74 per cent in soil. The highest decrease in bulk density of soil was observed in soils of O16 farmer (10.63%) (Figure 1).

In drum stick based cropping system (Table 3), the average decrease in bulk density due to organic farming was from 1.53 to 1.45 Mg m^{-3} in these soils The highest decrease in bulk density was observed in soils of D22 farmer (13.72%) and lowest was noticed in soils of D21 farmer (10.00%). The overall reduction in bulk density of sugar cane soils under organic farming worked out to 11.52 per cent over conventional farming (Figure 1).

In maize cropping system (Table 3), the average of six organic farms indicated a reduction in bulk density of soil from 1.57 to 1.43 Mg m^{-3} soils, respectively. The highest and lowest reduction in bulk density of soil was recorded in soils of M27 farmer (12.65%) and M25 farmer (5.00%), respectively. The overall reduction in bulk density of maize soils under organic farming worked out to 9.38 per cent over conventional farming (Figure 1).

The soils under organic farming recorded lower values of bulk density than soils under conventional farming irrespective of cropping system followed (Table 3). The reduction in bulk density of soil under organic farming was to the tune of 5.00 per cent (M25) to 13.72 per cent (D22). This was attributed to application of organic manures. Improved the soil structure and soil aggregation, help in lower BD. (Gedam *et al*., 2008) [1]. Sharma *et al*. (2000) [2] attributed the reduction in bulk density in residue and FYM incorporated soils to build up of soil organic matter and better soil structure.

There was variation in reduction of bulk density due to organic farming from farmer to farmer within the same type of cropping system, which could be ascribed to the variation in number of years of organic farming practice and quantity of organics applied to soil. The reduction in bulk density of soil was highest in soils of G6 farmer under groundnut (10.19%), R11 farmer under finger millet (11.31%), O16 farmer under onion (10.63%), D22 farmer under drumstick (13.72%) and M27 farmer under maize (12.65%). A longer period of organic farming (more than 5 years) and application of larger quantities of organic manures by above farmers were responsible for higher reduction in bulk density of soil. Srikanth *et al*. (2000) [10] also observed a significant decrease in bulk density of soil amended with compost compared to the inorganic fertilizer applied to soil.

Organic matter loosened the soil, which in turn increase the volume and reduced the bulk density (Gajanana *et al*., 2005; Bellakki and Badanur, 1994; Ghuhan and Sur, 2006; Ikemura *et al*., 2009; Ewulo *et al*., 2008) [3, 5, 7, 8, 9].

T test was conducted for above cropping system for both organic and conventional farming methods and there is significant difference among them.

Table 3: Physical properties of soils under different cropping system

Code	Bulk density (Mg m^{-3})				Maximum water holding capacity (%)			
	Organic farming	**Conventional farming**	**%Decrease over conventional farming**	**T-test statistic**	**Organic farming**	**Conventional farming**	**%Increase over conventional farming**	**T-test statistic**
		Groundnut based cropping system						
G1	1.46	1.58	7.34	11.24	39.52	30.40	29.96	6.70
G2	1.32	1.44	8.06		37.72	32.80	14.96	
G3	1.44	1.57	8.28		40.60	35.30	14.89	
G4	1.45	1.58	8.04		37.38	32.50	14.69	
G5	1.49	1.57	5.10		36.11	31.40	14.96	
G6	1.43	1.59	10.19		39.90	36.60	8.95	
Mean	1.43	1.56	7.83		38.54	33.17	16.40	
		Ragi based cropping system						
R7	1.31	1.45	10.00	6.92	37.84	32.90	14.96	10.54
R8	1.40	1.57	11.02		35.19	30.60	15.01	
R9	1.36	1.46	7.05		40.44	37.10	8.99	
R10	1.41	1.52	7.50		37.39	34.30	8.79	
R11	1.36	1.53	11.31		36.52	33.50	9.11	
R12	1.41	1.56	9.87		34.10	31.00	9.98	
Mean	1.37	1.51	9.45		36.91	33.23	11.14	
		Onion based cropping system						
O13	1.35	1.48	9.05	6.92	40.26	36.6	9.89	26.77
O14	1.47	1.63	9.69		40.81	37.1	10.01	
O15	1.33	1.48	10.14		34.32	31.2	10.12	
O16	1.41	1.58	10.63		32.78	29.8	10.08	
O17	1.41	1.56	9.87		35.86	32.6	9.78	
O18	1.52	1.67	9.10		34.54	31.4	9.85	
Mean	1.41	1.56	9.74		36.42	33.11	9.95	
		Drumstick based cropping system						
D19	1.50	1.68	10.65	38.76	37.62	34.2	9.69	30.82
D20	1.37	1.54	11.17		40.59	36.9	10.08	
D21	1.54	1.71	10.00		35.53	32.3	10.09	
D22	1.42	1.64	13.72		40.81	37.1	10.11	
D23	1.46	1.63	10.25		34.98	31.8	10.07	
D24	1.41	1.63	13.37		42.46	38.6	9.89	
Mean	1.45	1.63	11.52		38.66	35.15	9.98	
		Maize based cropping system						
M25	1.48	1.56	5.00	10.41	39.49	35.9	9.87	23.73
M26	1.47	1.66	11.45		43.67	39.7	9.68	
M27	1.42	1.62	12.65		34.21	31.1	9.87	
M28	1.43	1.61	11.18		33.88	30.8	9.89	
M29	1.37	1.49	8.00		36.08	32.6	10.96	
M30	1.39	1.51	8.01		34.68	31.53	9.89	
Mean	1.43	1.57	9.38		37.00	33.60	10.02	

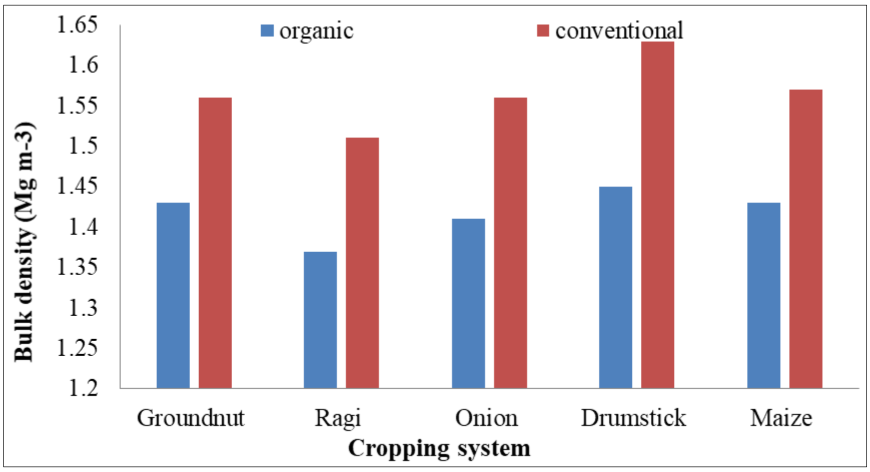

Fig 1: Bulk density of soils under different cropping system

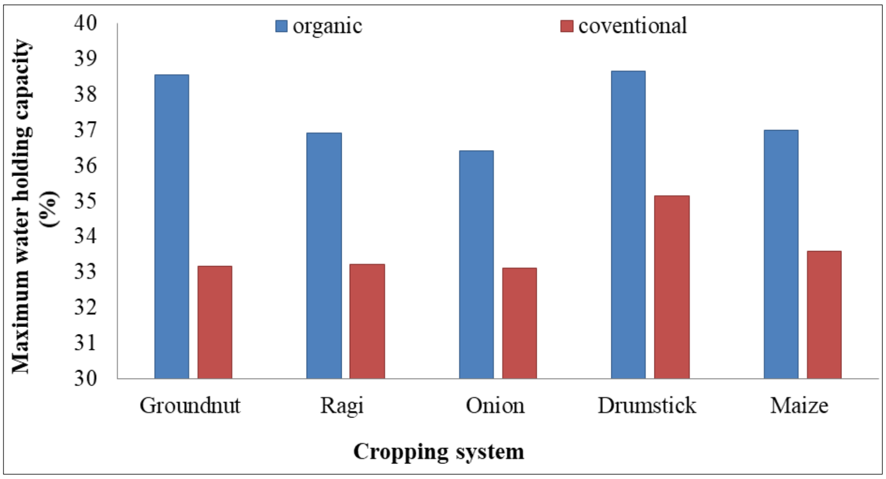

Fig 2: Maximum water holding capacity of soils under different cropping system

Maximum water holding capacity

The results on maximum water holding capacity (MWHC) of soils as influenced by organic farming are presented in Table 3.

The results from ground nut based cropping system (Table 3) showed that there was an increase in MWHC due to organic farming. The soils of G1 farmer showed highest increase in MWHC (29.96%), followed by soils of G2 and G5 farmer (14.96%) and lowest increase was observed in soils of G6 farmer (8.95%). On an average, MWHC increased from 33.17 per cent in conventional farming to 38.54 per cent in organic farming, accounting for an increase by 16.40 per cent (Figure 2).

In finger millet based cropping system (Table 3), the average of six soils indicated an increase in MWHC from 33.23 to 36.91 per cent in these soils, respectively. The average increase in MWHC due to organic farming was 11.14 per cent in these soils The highest increase in MWHC was observed in soils of R8 farmer (15.01%) (Figure 2).

In onion cropping system (Table 3), the average of six soils showed an increase in MWHC of these soils from 33.11 per cent in conventional farm to 36.42 per cent in organic farm Among six soils, the highest increase in MWHC over conventional farming was observed in the soils of O15 farmer (10.12%) and lowest increase was in the soils of O17 farmer (9.78%) (Figure 2).

In drum stick based cropping system (Table 3), an increase in MWHC due to organic farming practice was observed in all the farms. The average increase in MWHC of soils of organic farms over conventional farms was 9.98 per cent in these soils, respectively. The highest increase in MWHC was noticed in the soils of D22 farmer (10.11%) and lowest was in soils of D19 farmer (9.69%) (Figure 2).

In maize cropping system (Table 3) the MWHC of soils on an average, was 37.00 per cent in these soils, respectively under organic farming compared to 33.60 per cent in conventional farming. The average increase in MWHC worked out to 10.02 per cent in these soils, The soils from M29 farmer recorded highest increase in MWHC (10.96%) while the lowest increase was in soils of M26 farmer (9.68%) (Figure 2).

Irrespective of cropping system followed, the (MWHC) of soils (Table 3) were higher under organic farming than conventional farming, The increase in MWHC of soils due to organic farming ranged from 8.79 per cent (R10) to 29.96 per cent (G1). Build-up of soil organic matter and improvement in soil structure by application of residue and FYM to soil were responsible for significant increase in water holding capacity of soil. (Sharma *et al*., 2000) [2]. This was attributed the increase in MWHC per cent in residue and FYM incorporated soils to build up of soil organic matter and better soil structure. (Gedam *et al*., 2008) [1].

T test was conducted for above cropping system for both organic and conventional farming methods and there is significant difference among them.

Particle density (PD)

The results from ground nut based cropping system (Table 4) showed that there was an increase in particle density due to organic farming. The soils of G1 farmer showed highest decrease in PD (5.01%), followed by soils of G3 farmer (4.76%) and lowest decrease was observed in soils of G4 farmer (2.32%). On an average, PD decreased from 2.85 per cent in conventional farming to 2.75 per cent in organic farming, accounting for an increase by 3.62 per cent (Figure 3).

In finger millet based cropping system (Table 4), the average of six soils indicated a decrease in PD from 2.68 to 2.55 per cent in these soils, respectively. The average decrease in PD due to organic farming was 4.76 per cent in these soils. The highest decrease in PD was observed in soils of R11 farmer (7.39%) (Figure 3).

In onion cropping system (Table 4), the average of six soils showed a decrease in PD of these soils from 2.81 per cent in conventional farm to 2.59 per cent in organic farm, among six soils, the highest increase in PD over conventional farming was observed in the soils of O17 farmer (8.26%) and lowest increase was in the soils of O15 farmer (7.35%) (Figure 3).

In drum stick based cropping system (Table 4), a decrease in PD due to organic farming practice was observed in all the farms. The average decrease in PD of soils of organic farms over conventional farms was 8.96 per cent in these soils, respectively. The highest decrease in PD was noticed in the soils of D24 farmer (10.71%) and lowest was in soils of D20 farmer (8.26%) (Figure 3).

Table 4: Physical properties of soils under different cropping system

Code	Particle density (gcm^{-3})				Porosity%			
	Organic farming	Conventional farming	%Decrease over conventional farming	T-test statistic	Organic farming	Conventional farming	%Increase over conventional farming	T-test statistic
		Groundnut based cropping system						
G1	2.75	2.90	5.01	7.77	46.76	45.42	2.95	10.09
G2	2.74	2.85	3.86		51.68	49.47	4.46	
G3	2.76	2.90	4.76		47.83	45.82	4.37	
G4	2.75	2.82	2.32		47.16	43.88	7.49	
G5	2.76	2.84	2.89		46.01	44.76	2.81	
G6	2.74	2.82	2.91		47.88	43.66	9.68	
Mean	2.75	2.85	3.62		47.88	45.50	5.29	
		Ragi based cropping system						
R7	2.56	2.64	2.88	5.08	49.02	44.99	8.96	14.95
R8	2.55	2.63	2.89		45.22	40.21	12.44	
R9	2.57	2.65	2.91		47.20	44.85	5.25	
R10	2.56	2.70	5.13		45.08	43.67	3.22	
R11	2.57	2.78	7.39		47.20	44.86	5.20	
R12	2.52	2.72	7.39		44.21	42.67	3.61	
Mean	2.55	2.68	4.76		46.32	43.54	6.44	
		Onion based cropping system						
O13	2.53	2.73	7.39	31.26	46.80	45.83	2.12	14.53
O14	2.68	2.89	7.39		45.07	43.68	3.20	
O15	2.52	2.72	7.35		47.22	45.59	3.58	
O16	2.53	2.76	8.23		44.19	42.69	3.51	
O17	2.70	2.94	8.26		47.93	46.99	1.99	
O18	2.58	2.81	8.25		41.16	40.61	1.36	
Mean	2.59	2.81	7.81		45.39	44.23	2.62	
		Drumstick based cropping system						
D19	2.61	2.84	8.23	21.20	42.49	40.93	3.82	44.15
D20	2.60	2.83	8.26		47.38	45.66	3.78	
D21	2.62	2.86	8.39		41.26	40.21	2.61	
D22	2.61	2.87	9.09		45.79	42.88	6.78	
D23	2.62	2.88	9.09		44.16	43.44	1.65	
D24	2.60	2.91	10.71		45.69	44.02	3.79	
Mean	2.61	2.87	8.96		44.46	42.85	3.73	
		Maize based cropping system						
M25	2.75	2.83	2.83	5.87	46.11	44.88	2.75	12.51
M26	2.58	2.88	10.42		43.02	42.36	1.56	
M27	2.78	2.94	5.44		49.10	44.90	9.36	
M28	2.75	2.92	5.66		48.00	44.77	7.22	
M29	2.60	2.76	5.66		47.28	45.94	2.92	
M30	2.71	2.87	5.66		48.75	47.43	2.76	
Mean	2.69	2.87	6.11		47.04	45.04	4.42	

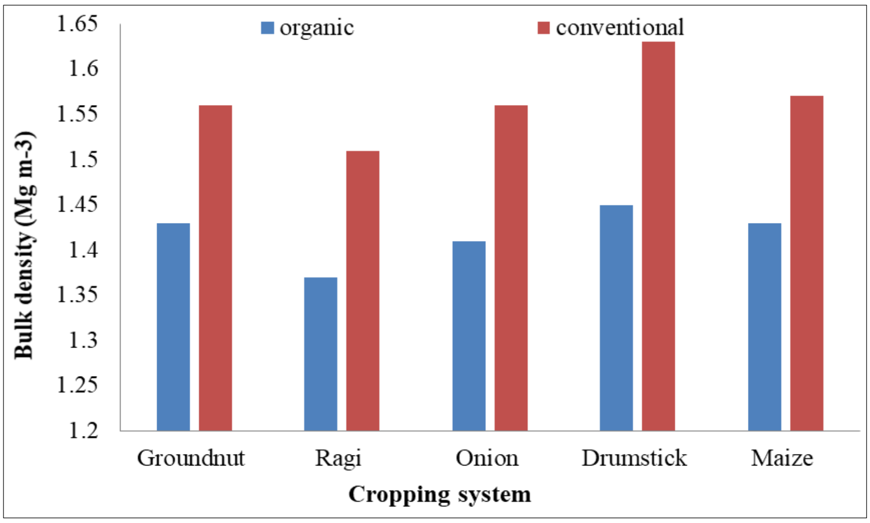

Fig 3: Particle density of soils under different cropping system

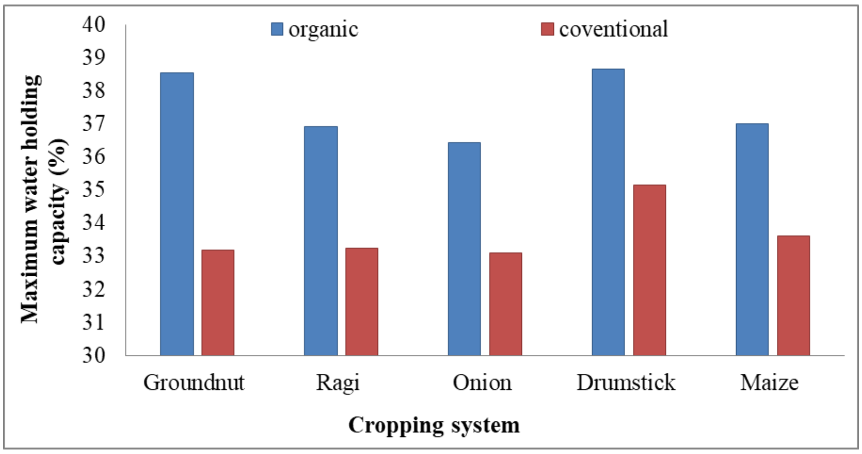

Fig 4: Porosity of soils under different cropping system

In maize cropping system (Table 4), the PD of soils on an average was 2.87 per cent in these soils, under organic farming when compared to 2.69 per cent in conventional farming. The average decrease in PD worked out to 6.11 per cent in these soils. The soils from M26 farmer recorded highest decrease in PD (10.42%) while the lowest decrease was in soils of M25 farmer (2.83%) (Figure 3).

Irrespective of cropping system followed the soils under organic farming recorded higher values of PD than soils under conventional farming (Table 4). The decrease in particle density of soil under organic farming was to the tune of 2.32 per cent (G4) to 10.71 per cent (D24). The decrease in particle density could be due to better soil structure as evidenced from increase in water stable aggregates. (Sharma *et al*., 2000) [2].

T test was conducted for above cropping system for both organic and conventional farming methods and there is significant difference among them.

Soil Porosity (%)

Porosity per cent of groundnut based cropping system of six organic farming soil samples revealed that the average increase in porosity was to the extent of 5.29. The soils from G6 farmer recorded highest increase in porosity (9.68%) while the lowest increase was in soils of G5 farmer (2.81%) (Figure 4).

In finger millet cropping system, an average increase in porosity was to the extent of 6.44 per cent soils of six organic farms. The soils from R8 farmer recorded highest increase in porosity (12.44%) while the lowest increase was in soils of R10 farmer (3.22%) (Figure 4).

In onion based cropping system, the average of six soils showed an increase in PD of these soils from 44.23 per cent in conventional farm to 45.39 per cent in organic farm, the highest increase in porosity over conventional farming was observed in the soils of O15 farmer (3.58%) and lowest increase was in the soils of O18 farmer (1.36%) (Figure 4).

In drum stick cropping system, soils of six organic farms on an average increased the porosity to the extent of 3.73 per cent. The soils from D22 farmer recorded highest increase in porosity (6.78%) while the lowest increase was in soils of D23 farmer (1.65%) (Figure 4).

In maize cropping system, the porosity of soils on an average, was 47.04 per cent in these soils, under organic farming compared to 45.04 per cent in conventional farming. The average increase in porosity worked out to 4.42 per cent in these soils, The soils from M27 farmer recorded highest increase in PD (9.36%) while the lowest increase was in soils of M26 farmer (1.56%) (Figure 4).

Irrespective of cropping system followed, the soils under organic farming recorded lower values of porosity than soils under conventional farming (Table 4). The increase in porosity of soil under organic farming was to the tune of 1.36 per cent (O18) to 12.44 per cent (R8). The increase in porosity might be due to better soil structure as evidenced from increase in water stable aggregates (Sharma *et al*., 2000) [2]. This was attributed the increase in MWHC per cent in residue and FYM incorporated soils to build up of soil organic matter and better soil structure. (Gedam *et al*., 2008) [1].

Conclusion

The physical properties of soils were found to be influenced favorably by the organic farming practice. A reduction in bulk density and an increase in particle density and an increase in water holding capacity and an increase in porosity was noticed in all the soils under organic farming. A reduction in pH was observed in soils under organic farming. But however, there was no appreciable change in the EC of soils. A wide variation in increase in organic carbon content in soils of organic farms over conventional farms was observed. The soils from D22 farmer recorded highest increase in porosity (6.78%) while the lowest increase was in soils of D23 farmer (1.65%). The increase in porosity might be due to better soil structure as evidenced from increase in water stable aggregates.

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