J. Farm Sci., 30(3): (375-381) 2017

Effect of different sources of organic manures on soil arthropod population in maize ecosystem

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(Received: July, 2017 ; Accepted: September, 2017)

Abstract: *S*oil biological and chemical properties as well as habitat conditions alter drastically when there is a conversion from natural to agricultural habitat. Most nutrients available for plant growth depend on complex interaction between plant roots, microorganisms and soil fauna. The present investigation was undertaken to determine the faunal diversity under different organic manures in maize ecosystem. During the study, observations on soil mesofauna *viz.*, collembola, mites, cryptostigmatid mites, ants etc and macrofauna *viz.,* scarabids, ants and other macrofauna (carabids, dipterans, spiders) were made. Here T_9 (Vermicompost + FYM + enriched compost) recorded highest soil arthropod population followed by T_7 (Vermicompost + FYM). Collembola (12.92, 10.25/100 g of soil), other mites (12.60, 10.34/100 g of soil), cryptostigmatid mites (4.58, 3.32/100 g of soil), ants (2.53, 1.74/100g of soil) and other mesofauna (7.35, 5.72/100g of soil), scarabids (24.28, 21.42/pit fall trap), ants (3.63, 2.77/ pitfall trap) and others (4.70, 3.86/ pitfall trap) in T_9 (Vermicompost + FYM + enriched compost) and T_7(Vermicompost + FYM) respectively. Irrespective of the treatments, mites were the dominant group of mesofauna and scarabids were the dominant macrofauna.

Key words*:* Greenleaf manure, Organic manures, Soil arthropods, Vermicompost

Introduction

Soil has been described as most precious non renewable resource and is vital for productivity in terrestrial environments. Soil organisms are essential components of agro-ecosystems, making vital contributions to soil functions and processes. The soil would be a sterile medium that could not sustain crop production without soil organisms.

Soil biota provides essential benefits for the functioning of agro ecosystems which are important for the long term sustainability of agriculture. They support essential soil processes and plays a vital role in maintaining the soil quality necessary for crop productivity. Collembola and Acari in particular play an important role in the decomposition of leaf litter to organic matter and its nutrient cycling (Bardgett *et al.,* 1998). The species richness of soil fauna may represent as much as 23 per cent of all described organisms, or about 3,60,000 species, with soil arthropods comprising 85 per cent of that number. They comprise a huge proportion of the meso and macro fauna of soil. The mesofauna is a zoological category whose components live all their lives in the soil, many of these groups are bio indicators of soil stability and fertility (Alvarez and Bello, 2004). Among them mites and springtails stand out, for being the main representatives of this type of fauna and having better conditions to be used for this purpose. The soil mesofauna participates in the processes of organic matter decomposition, aeration and nutrient recycling and particularly of phosphorus and nitrogen mineralization (Alvarez and Bello, 2004). Some of the macro fauna being predatory in habit helps in maintaining ecological balance.

The present study was carried out to know the influence of different organic manures on soil arthropod population as they influence decomposition and nutrient mineralization process.

Material and methods

The experiment was carried out at Institute of Organic Farming, Main Agriculture Research Station, University of Agricultural Sciences, Dharwad, during *kharif* 2016. Different methods adopted for the studies are as described below.

Treatment details (per 10m^2 area)

T_1 = No application of organic manures or chemical fertilizers (UTC)

T_2 = Conventional method of farming -Urea: 0.23 kg, SSP: 0.4 kg, MOP: 0.04 kg, FYM:2.16 kg (RDF + OM)

T_3 = Recommended dose of fertilizers - Urea: 0.23 kg, SSP: 0.4 kg, MOP: 0.04 kg (RDF)

T_4 = Vermicompost 8.26 kg (VC)

T_5 = Farm yard manure 20.0 kg (FYM)

T_6 = Enriched compost 7.7 kg (EC)

T_7 = Vermicompost 4.13 kg + FYM 10 kg (VC + FYM)

T_8 = Vermicompost 4.13 kg + Enriched compost 2.25 kg

T_9 = Vermicompost 2.70 kg + FYM 6.63 kg + Enriched compost 0.85 kg (VC + EC)

T_{10}= Glyricidia Greenleaf manure 3.30 kg (GLM)

The quantity of different manures was worked out based on nitrogen requirement of the crop. Each treatment was laid out in 10 sq.m aread.

Sampling methods

The mesofauna was extracted from the soil samples by using modified Berleese funnel apparatus. Field collected soil samples of around 100g each were placed in the Berleese funnel apparatus for 72 hr. The apparatus consisted of the light source situated at the top and the soil containing funnel with 240 mm mesh is fitted at the bottom which directly exposed to the light source. There were series of eight funnels which were connected across the circuit with series connection and the 100 W incandescent bulbs were used as the light source. At the narrow

mouth end of the funnel the container with 70 per cent ethyl alcohol was kept which acted as a both preservative and killing agent. Since the soil arthropods are photophobic and hydrophilic in nature, the light generated from the lamp diverted them to drown in to the container.

Macro arthropods were extracted through pitfall traps. The pitfall traps were made by plastic cups of 10 cm in diameter and 15 cm in height were used to catch the actively moving surface arthropods as they fall inside the installed traps during movement. Pitfall traps were placed in maize field. Each cup was filled with 50 ml of 75 per cent ethyl alcohol as killing agent and water with bit of glycerol which was added to avoid quick evaporation. These cups were buried in the ground so as to make sure that their rim was at the soil surface and there was absolutely no difference for a fast mover. Population of each group of macro arthropods were recorded at 15 days intervals from June till the harvest of the crop (October).

Results and discussion

Mesofauna collected from different samples were grouped into following categories, collembola (1a), mites (1b: predatory mites), cryptostigmatids mites (1c: feeds on organic matter), ants and other mesofauna. Other mesofauna included pseudoscorpion (1d), diplura (1e), flies, beetles and caterpillars. Macrofauna was grouped into scarabids (1f), ants and others (carabids, spiders, dipterans).

The number of collembolans, mites, cryptostigmatids, ants, and other mesofauna varied from 2.33 to 4.33, 3.83 to 5.50, 0.33 to 1.73, 0 to 0.40 and 0.50 to 1.50/ 100 g of soil before imposing the treatment, respectively. Even though there is a significant difference in the population of some soil fauna before imposition of the treatment, the population of arthropods started increasing with respect to each treatment after imposing the treatment and reached maximum at 95 DAS and thereafter declined gradually. Highest population of Collembola (12.92, 10.25/100 g of soil), other mites (12.60, 10.34/100 g of soil), cryptostigmatid mites (4.58, 3.32/100 g of soil), ants (2.53, 1.74/100g of soil) and other mesofauna (7.35, 5.72/100g of soil) were recorded in T_9 (Vermicompost + FYM + enriched compost) followed by T_7 (Vermicompost + FYM), respectively (Table 1-5).

Population of macrofauna *viz.,* scarabids, ants and other macrofauna varied from 4 to 5.7, 0.7 to 1.00 and 1 to 1.30 per pitfall trap before imposing the treatment. After treatment imposition the population started increasing and reached maximum at 95 DAS and thereafter the population declined. Highest macrofauna was recorded in T_9 (Vermicompost + FYM + enriched compost), scarabids (24.28/pit fall trap), ants (3.63/ pitfall trap) and others (4.70/ pitfall trap), followed by T_7 (Vermicompost + FYM), scarabids (21.42/pit fall trap), ants (2.77/ pitfall trap) and other macrofauna which includes carabids, dipterans and spiders (3.86/ pitfall trap) (Table 6-8).

Table 1. Impact of organic manures on the abundance of Collembola in maize ecosystem during *kharif* 2016

	Number of Collembola /100g of soil at days after sowing								
Treatments	BAT	20 DAS	35 DAS	50 DAS	65 DAS	80 DAS	95 DAS	110 DAS	MEAN
T_1 (UTC)	2.67	3.33	4.00	4.77	4.07	4.33	3.67	3.00	3.73
	(1.76)^{a}	(1.93)^{d}	(2.11)^{e}	(2.29)^{d}	(2.12)^{f}	(2.20)^{e}	(2.04)^{e}	(1.87)^{f}	(2.04)^{d}
T_2 (RDF+ OM)	3.33	4.33	6.00	8.00	6.53	8.00	7.70	7.50	6.43
	(1.94)^{a}	(2.18)^{cd}	(2.54)^{cde}	(2.90)^{bc}	(2.64)^{e}	(2.91)^{cd}	(2.86)^{cd}	(2.83)^{de}	(2.60)^{c}
T_3 (RDF)	3.33	3.33	5.33	7.27	7.03	6.20	6.00	6.60	5.64
	(1.93)^{a}	(1.94)^{d}	(2.36)^{de}	(2.78)^{c}	(2.74)^{de}	(2.58)^{de}	(2.54)^{d}	(2.65)^{e}	(2.44)^{cd}
T_4 (VC)	4.00	6.00	8.00	9.00	9.03	9.13	9.93	8.93	8.13
	(2.04)^{a}	(2.52)^{bcd}	(2.91)^{bcd}	(3.08)^{bc}	(3.06)^{c}	(3.10)^{c}	(3.23)^{c}	(3.07)^{cd}	(2.90)^{bc}
T_5 (FYM)	4.33	5.00	8.00	8.52	8.67	9.09	9.33	8.97	7.74
	(2.16)^{a}	(2.23)^{cd}	(2.91)^{bcd}	(2.96)^{bc}	(3.02)^{c}	(3.09)^{cd}	(3.11)^{cd}	(3.08)^{cd}	(2.82)^{c}
T_6 (EC)	4.00	4.00	7.67	8.33	8.40	8.50	9.13	8.70	7.34
	(2.11)^{a}	(2.11)^{cd}	(2.85)^{bcd}	(2.96)^{bc}	(2.98)^{cd}	(3.00)^{cd}	(3.10)^{cd}	(3.02)^{cde}	(2.77)^{c}
T_7 (VC + FYM)	4.00	8.33	9.00	11.33	12.33	13.00	12.67	11.67	10.25
	(2.10)^{a}	(2.96)^{ab}	(3.08)^{ab}	(3.44)^{b}	(3.58)^{b}	(3.67)^{ab}	(3.62)^{ab}	(3.49)^{b}	(3.23)^{ab}
T_8 (VC+ EC)	2.33	7.00	8.67	9.77	10.08	10.27	11.00	10.33	8.60
	(1.68)^{a}	(2.73)^{bc}	(3.03)^{bc}	(3.20)^{bc}	(3.25)^{c}	(3.28)^{bc}	(3.39)^{bc}	(3.29)^{bc}	(2.97)^{bc}
T_9 (VC+ FYM + EC)	3.67	12.00	12.67	14.33	15.00	15.67	16.33	13.67	12.92
	(2.00)^{a}	(3.53)^{a}	(3.62)^{a}	(3.85)^{a}	(3.94)^{a}	(4.02)^{a}	(4.10)^{a}	(3.76)^{a}	(3.60)^{a}
T_{10} (GLM)	3.67	4.67	7.00	8.28	8.33	8.45	8.75	8.67	7.23
	(2.00)^{a}	(2.27)^{bcd}	(2.72)^{bcd}	(2.96)^{bc}	(2.97)^{cd}	(2.99)^{cd}	(3.04)^{cd}	(3.03)^{cde}	(2.75)^{c}
Mean	3.53	5.87	7.57	8.99	9.05	9.22	9.24	8.83	7.80
	(2.00)	(2.52)	(2.84)	(3.08)	(3.09)	(3.11)	(3.12)	(3.05)	(2.81)
S.Em. ±	0.25	0.23	0.16	0.16	0.10	0.15	0.15	0.10	0.16
C.D. (P=0.05)	NS	0.69	0.47	0.47	0.30	0.45	0.45	0.29	0.48

Note : BAT : Before application of treatments DAS : Days after sowing
Figures in the parenthesis are $\sqrt{x+0.5}$ transformed value
In a column or row, transformed values followed by the same alphabet do not differ significantly (P=0.05) by DMRT

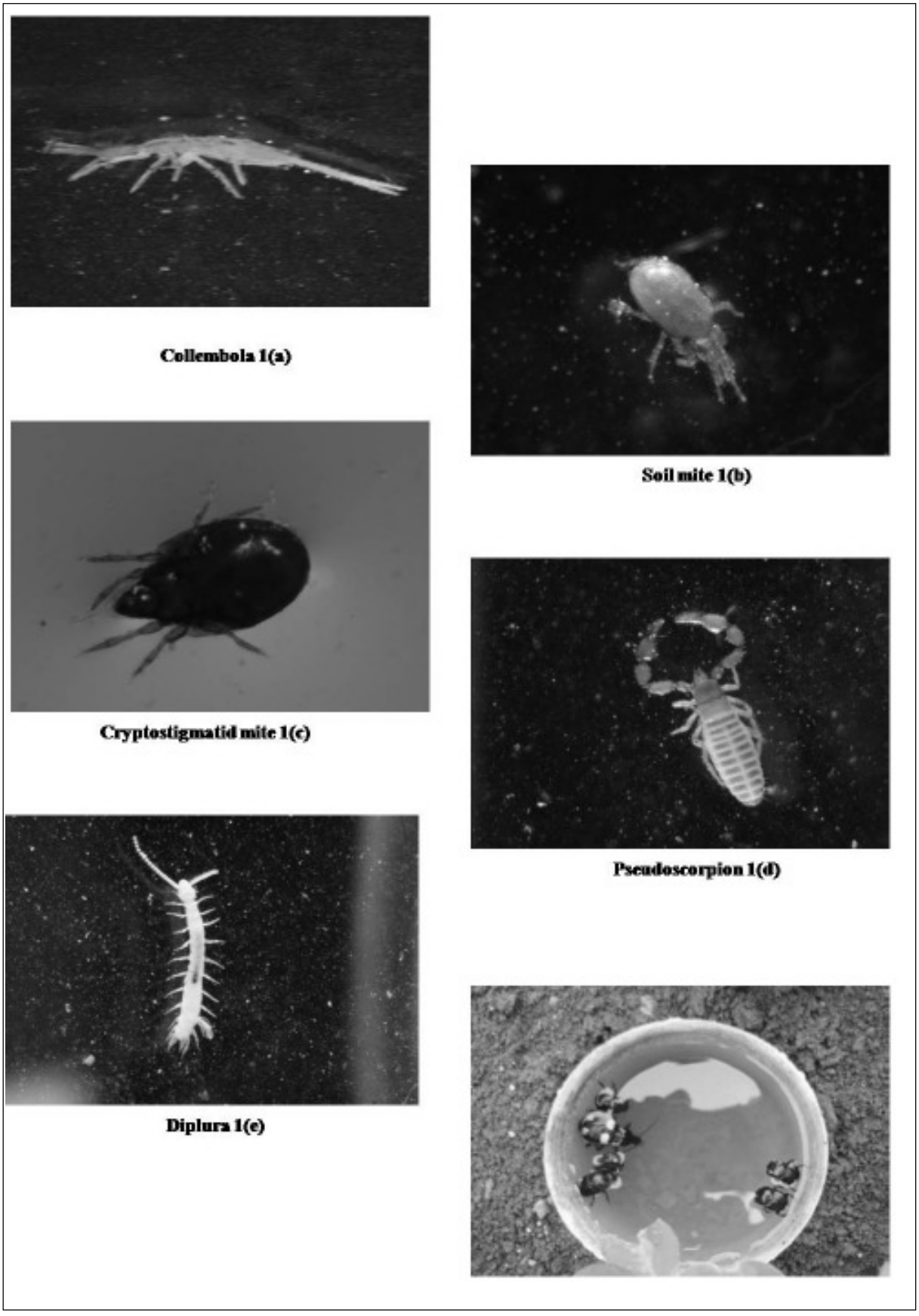

Fig. 1. Soil arthopods

Table 2. Impact of organic manures on the abundance of mites (prostigmata and mesostigmata) in maize ecosystem during kharif 2016

	Number of Mites /100g of soil at days after sowing								
Treatments	BAT	20 DAS	35 DAS	50 DAS	65 DAS	80 DAS	95 DAS	110 DAS	MEAN
T_1 (UTC)	3.83	5.43	5.60	5.43	4.33	5.33	5.37	5.00	5.04
	(2.08)^{c}	(2.40)^{d}	(2.46)^{d}	(2.42)^{d}	(2.18)^{d}	(2.38)^{d}	(2.41)^{f}	(2.34)^{d}	(2.33)^{d}
T_2 (RDF+ OM)	4.60	6.47	6.86	7.10	8.44	8.86	8.73	7.83	7.36
	(2.26)^{ab}	(2.63)^{cd}	(2.68)^{cd}	(2.75)^{cd}	(2.98)^{bc}	(3.04)^{c}	(3.04)^{de}	(2.86)^{c}	(2.78)^{cd}
T_3 (RDF)	5.33	6.20	6.60	6.69	6.80	7.20	8.01	7.30	6.77
	(2.41)^{a}	(2.59)^{cd}	(2.66)^{cd}	(2.68)^{cd}	(2.70)^{c}	(2.77)^{c}	(2.90)^{e}	(2.79)^{c}	(2.69)^{cd}
T_4 (VC)	5.50	7.00	8.51	8.50	7.97	8.30	9.87	8.56	8.03
	(2.45)^{a}	(2.74)^{bcd}	(3.00)^{bc}	(3.00)^{bc}	(2.90)^{c}	(2.96)^{c}	(3.22)^{cd}	(3.00)^{bc}	(2.91)^{bc}
T_5 (FYM)	5.47	7.20	7.90	8.33	8.50	8.80	9.33	8.53	8.01
	(2.44)^{a}	(2.77)^{bc}	(2.90)^{c}	(2.93)^{bc}	(3.00)^{bc}	(3.05)^{c}	(3.13)^{cde}	(3.00)^{bc}	(2.90)^{bc}
T_6 (EC)	4.33	7.10	7.70	8.40	8.75	9.00	10.11	8.21	7.95
	(2.19)^{bc}	(2.75)^{bc}	(2.86)^{c}	(2.98)^{bc}	(3.03)^{bc}	(3.08)^{c}	(3.25)^{cd}	(2.95)^{bc}	(2.89)^{bc}
T_7 (VC + FYM)	5.00	8.33	10.67	10.33	11.05	12.33	13.67	11.33	10.34
	(2.35)^{ab}	(2.96)^{ab}	(3.34)^{b}	(3.29)^{ab}	(3.39)^{b}	(3.58)^{b}	(3.76)^{b}	(3.44)^{ab}	(3.26)^{ab}
T_8 (VC+ EC)	4.67	7.50	8.80	8.60	8.90	10.08	11.11	8.67	8.54
	(2.27)^{ab}	(2.83)^{bc}	(3.04)^{bc}	(3.01)^{bc}	(3.06)^{bc}	(3.24)^{c}	(3.41)^{c}	(3.02)^{bc}	(2.98)^{bc}
T_9 (VC+ FYM + EC)	5.50	10.33	13.00	13.00	14.00	15.33	16.00	13.67	12.60
	(2.45)^{a}	(3.29)^{a}	(3.67)^{a}	(3.67)^{a}	(3.81)^{a}	(3.98)^{a}	(4.06)^{a}	(3.76)^{a}	(3.59)^{a}
T_{10} (GLM)	4.67	6.80	7.60	8.40	8.46	8.90	9.10	8.35	7.79
	(2.26)^{ab}	(2.70)^{bcd}	(2.84)^{cd}	(2.98)^{bc}	(2.99)^{bc}	(3.06)^{c}	(3.10)cde	(2.97)^{bc}	(2.86)^{cd}
Mean	4.89	7.24	8.32	8.48	8.72	9.41	10.13	8.74	8.24
	(2.32)	(2.77)	(2.95)	(2.97)	(3.00)	(3.11)	(3.26)	(3.03)	(2.92)
S.Em. ±	0.07	0.11	0.12	0.15	0.13	0.13	0.10	0.14	0.13
C.D. (P=0.05)	0.23	0.35	0.36	0.44	0.40	0.39	0.29	0.43	0.39

Note : BAT : Before application of treatments DAS : Days after sowing
Figures in the parenthesis are $\sqrt{x+0.5}$ transformed value
In a column or row, transformed values followed by the same alphabet do not differ significantly (P=0.05) by DMRT

Table 3. Impact of organic manures on the abundance of cryptostigmatid mites in maize ecosystem during *kharif* 2016

	Number of cryptostigmatids /100g of soil at days after sowing								
Treatments	BAT	20 DAS	35 DAS	50 DAS	65 DAS	80 DAS	95 DAS	110 DAS	MEAN
T_1 (UTC)	0.90	1.33	1.10	1.30	1.58	1.00	1.33	1.73	1.24
	(1.14)^{ab}	(1.34)^{cd}	(1.26)^{e}	(1.34)^{e}	(1.44)^{e}	(1.22)^{d}	(1.34)^{d}	(1.48)^{cd}	(1.31)^{e}
T_2 (RDF+ OM)	1.00	1.33	1.40	1.50	1.70	2.27	2.13	1.77	1.64
	(1.22)^{a}	(1.34)^{cd}	(1.38)^{de}	(1.41)^{de}	(1.48)^{de}	(1.66)^{c}	(1.62)^{cd}	(1.49)^{cd}	(1.45)^{cde}
T_3 (RDF)	0.33	1.33	1.30	1.50	1.60	2.00	2.03	1.67	1.47
	(0.88)^{b}	(1.34)^{cd}	(1.34)^{e}	(1.41)^{de}	(1.45)^{e}	(1.56)^{c}	(1.57)^{cd}	(1.44)^{cd}	(1.37)^{de}
T_4 (VC)	1.12	1.93	2.10	2.30	2.47	2.70	2.80	2.10	2.19
	(1.27)^{a}	(1.56)^{bc}	(1.61)^{cd}	(1.67)^{c}	(1.68)^{cd}	(1.79)^{c}	(1.82)^{c}	(1.59)^{bc}	(1.62)^{cd}
T_5 (FYM)	0.50	1.90	2.00	2.10	2.30	2.67	2.60	2.00	2.01
	(1.00)^{b}	(1.55)^{c}	(1.58)^{cd}	(1.61)^{cd}	(1.67)^{cd}	(1.76)^{c}	(1.77)^{c}	(1.58)^{bc}	(1.57)^{cd}
T_6 (EC)	1.00	1.60	1.90	2.00	2.10	2.43	2.50	1.90	1.93
	(1.22)^{a}	(1.44)^{cd}	(1.55)^{cde}	(1.56)^{cd}	(1.61)^{cde}	(1.71)^{c}	(1.73)^{c}	(1.53)^{cd}	(1.54)^{cde}
T_7 (VC + FYM)	0.27	3.00	3.57	3.37	4.00	4.50	4.87	3.00	3.32
	(0.85)^{b}	(1.86)^{ab}	(2.01)^{b}	(1.96)^{b}	(2.11)^{b}	(2.22)^{ab}	(2.31)^{b}	(1.87)^{b}	(1.90)^{b}
T_8 (VC+ EC)	0.67	2.07	2.33	2.50	2.67	3.30	3.00	2.33	2.36
	(1.05)^{ab}	(1.60)^{bc}	(1.66)^{c}	(1.73)^{c}	(1.77)^{c}	(1.92)^{bc}	(1.86)^{c}	(1.68)^{bc}	(1.66)^{bc}
T_9 (VC+ FYM + EC)	0.67	4.33	4.67	5.00	5.33	5.67	6.33	4.67	4.58
	(1.05)^{ab}	(2.19)^{a}	(2.27)^{a}	(2.34)^{a}	(2.41)^{a}	(2.47)^{a}	(2.60)^{a}	(2.27)^{a}	(2.20)^{a}
T_{10} (GLM)	1.12	1.60	1.80	2.00	2.10	2.21	2.30	2.19	1.91
	(1.22)^{a}	(1.44)^{cd}	(1.52)^{cde}	(1.58)^{cd}	(1.61)^{cde}	(1.67)^{c}	(1.64)^{cd}	(1.64)^{bc}	(1.54)^{cde}
Mean	0.75	2.00	2.22	2.36	2.58	2.88	2.91	2.15	2.27
	(1.13)	(1.55)	(1.62)	(1.66)	(1.72)	(1.80)	(1.84)	(1.62)	(1.62)
S.Em. ±	0.13	0.12	0.08	0.09	0.09	0.11	0.12	0.11	0.09
C.D. (P=0.05)	0.41	0.36	0.26	0.26	0.27	0.34	0.36	0.33	0.26

Note : BAT : Before application of treatments DAS : Days after sowing
Figures in the parenthesis are $\sqrt{x+0.5}$ transformed value
In a column or row, transformed values followed by the same alphabet do not differ significantly (P=0.05) by DMRT

Table 4. Impact of organic manures on the abundance of ants in maize ecosystem during *kharif* 2016

	Number of ants /100g of soil at days after sowing								
Treatments	BAT	20 DAS	35 DAS	50 DAS	65 DAS	80 DAS	95 DAS	110 DAS	MEAN
T_1 (UTC)	0.35	0.14	0.47	0.47	0.53	1.09	1.00	1.30	0.67
	(0.91)^{ab}	(0.80)^{c}	(0.97)^{ef}	(0.96)^{d}	(0.99)^{e}	(1.24)^{cd}	(1.17)^{cde}	(1.33)^{bc}	(1.05)^{de}
T_2 (RDF+ OM)	0.20	0.20	0.30	0.61	0.63	0.70	0.80	0.50	0.49
	(0.84)^{b}	(0.84)^{c}	(0.89)^{f}	(1.05)^{cd}	(1.04)^{de}	(1.10)^{cd}	(1.14)^{e}	(1.00)^{c}	(0.99)^{e}
T_3 (RDF)	0.30	0.30	0.40	0.50	0.60	0.70	0.80	0.67	0.53
	(0.89)^{ab}	(0.89)^{c}	(0.95)^{f}	(1.00)^{d}	(1.05)^{e}	(1.10)^{cd}	(1.14)^{de}	(1.05)^{c}	(1.01)^{e}
T_4 (VC)	0.40	0.83	0.90	1.00	1.20	1.30	1.40	0.70	0.97
	(0.95)^{ab}	(1.15)^{bc}	(1.18)^{cd}	(1.22)^{bc}	(1.30)^{cd}	(1.34)^{cd}	(1.38)^{cd}	(1.06)^{c}	(1.20)^{cd}
T_5 (FYM)	0.20	0.66	0.67	0.80	0.80	0.90	1.00	0.85	0.74
	(0.84)^{b}	(1.05)^{bc}	(1.05)^{de}	(1.14)^{cd}	(1.14)^{de}	(1.18)^{cd}	(1.22)^{cde}	(1.16)^{bc}	(1.10)^{de}
T_6 (EC)	0.00	0.41	0.50	0.63	0.67	0.70	0.70	0.65	0.56
	(0.71)^{b}	(0.93)^{c}	(1.00)^{ef}	(1.04)^{bcd}	(1.05)^{cde}	(1.10)^{d}	(1.10)^{de}	(1.07)^{c}	(1.01)^{e}
T_7 (VC + FYM)	0.00	1.33	1.67	1.68	2.33	2.33	2.92	1.67	1.74
	(0.71)^{b}	(1.34)^{b}	(1.46)^{b}	(1.47)^{a}	(1.68)^{b}	(1.68)^{b}	(1.83)^{ab}	(1.46)^{ab}	(1.45)^{b}
T_8 (VC+ EC)	0.67	0.82	0.97	1.17	1.53	1.63	1.67	1.03	1.19
	(1.05)^{a}	(1.09)^{bc}	(1.21)^{c}	(1.28)^{b}	(1.42)^{c}	(1.46)^{c}	(1.44)^{bc}	(1.24)^{bc}	(1.27)^{c}
T_9 (VC+ FYM + EC)	0.20	2.00	2.33	2.67	3.00	3.33	4.00	2.67	2.53
	(0.84)^{b}	(1.58)^{a}	(1.68)^{a}	(1.77)^{a}	(1.87)^{a}	(1.95)^{a}	(1.12)^{a}	(1.76)^{a}	(1.70)^{a}
T_{10} (GLM)	0.40	0.63	0.67	0.67	0.70	0.70	0.90	0.67	0.67
	(0.95)^{ab}	(1.04)^{bc}	(1.05)^{de}	(1.05)^{bcd}	(1.10)^{cde}	(1.10)^{d}	(1.18)^{de}	(1.05)^{c}	(1.06)^{de}
Mean	0.27	0.73	0.81	1.02	1.19	1.36	1.52	1.07	1.01
	(0.87)	(1.10)	(1.14)	(1.23)	(1.30)	(1.36)	(1.42)	(1.25)	(1.18)
S.Em. ±	0.08	0.10	0.07	0.11	0.09	0.10	0.11	0.12	0.06
C.D. (P=0.05)	0.25	0.32	0.23	0.35	0.27	0.29	0.35	0.37	0.18

Note : BAT : Before application of treatments DAS : Days after sowing
Figures in the parenthesis are $\sqrt{x+0.5}$ transformed value
In a column or row, transformed values followed by the same alphabet do not differ significantly (P=0.05) by DMRT

Table 5. Impact of organic manures on the abundance of other mesofauna in maize ecosystem during *kharif* 2016

	Number of other mesofauna /100g of soil at days after sowing								
Treatments	BAT	20 DAS	35 DAS	50 DAS	65 DAS	80 DAS	95 DAS	110 DAS	MEAN
T_1 (UTC)	0.67	0.89	0.89	0.96	0.89	1.12	1.00	0.70	0.89
	(1.00)^{c}	(1.18)^{b}	(1.18)^{d}	(1.15)^{d}	(1.18)^{e}	(1.27)^{e}	(1.22)^{d}	(1.10)^{d}	(1.16)^{d}
T_2 (RDF+ OM)	1.30	1.44	1.67	1.80	1.96	2.08	2.35	1.87	1.81
	(1.34)^{ab}	(1.38)^{b}	(1.46)^{bcd}	(1.52)^{cd}	(1.57)^{cd}	(1.58)^{cd}	(1.69)^{c}	(1.53)^{c}	(1.51)^{c}
T_3 (RDF)	0.80	1.33	1.40	1.54	1.60	1.76	2.00	1.90	1.54
	(1.14)^{bc}	(1.34)^{b}	(1.38)^{cd}	(1.43)^{cd}	(1.45)^{de}	(1.50)^{de}	(1.58)^{c}	(1.55)^{c}	(1.42)^{cd}
T_4 (VC)	1.10	1.67	2.00	2.03	2.08	2.53	2.68	2.43	2.07
	(1.26)^{ab}	(1.39)^{b}	(1.56)^{bc}	(1.57)^{c}	(1.58)^{cd}	(1.70)^{c}	(1.78)^{c}	(1.71)^{bc}	(1.57)^{bc}
T_5 (FYM)	0.90	1.58	1.67	1.80	1.86	2.38	2.50	2.43	1.89
	(1.18)^{abc}	(1.43)^{b}	(1.46)^{bcd}	(1.52)^{cd}	(1.54)^{cd}	(1.69)^{cd}	(1.73)^{c}	(1.71)^{bc}	(1.53)^{c}
T_6 (EC)	1.00	1.55	1.65	1.85	2.05	2.33	2.40	2.20	1.88
	(1.22)^{abc}	(1.42)^{b}	(1.47)^{bcd}	(1.53)^{cd}	(1.60)^{cd}	(1.68)^{cd}	(1.70)^{c}	(1.64)^{bc}	(1.53)^{c}
T_7 (VC + FYM)	0.80	2.20	2.67	3.33	3.45	4.00	4.00	3.00	2.93
	(1.14)^{bc}	(1.63)^{ab}	(1.77)^{b}	(1.95)^{b}	(1.98)^{b}	(2.11)^{b}	(2.11)^{ab}	(1.86)^{ab}	(1.82)^{b}
T_8 (VC+ EC)	0.50	1.71	2.04	2.54	2.51	2.58	2.67	2.53	2.14
	(1.00)^{c}	(1.48)^{b}	(1.57)^{bc}	(1.74)^{c}	(1.73)^{c}	(1.75)^{c}	(1.77)^{bc}	(1.70)^{bc}	(1.59)^{bc}
T_9 (VC+ FYM + EC)	1.00	3.67	4.00	4.67	4.67	5.33	5.33	4.33	4.13
	(1.22)^{abc}	(2.04)^{a}	(2.12)^{a}	(2.26)^{a}	(2.26)^{a}	(2.41)^{a}	(2.40)^{a}	(2.20)^{a}	(2.11)^{a}
T_{10} (GLM)	1.50	1.40	1.60	1.78	1.93	2.11	2.40	2.10	1.83
	(1.41)^{a}	(1.38)^{b}	(1.45)^{cd}	(1.51)^{cd}	(1.56)^{cd}	(1.61)^{cd}	(1.70)^{c}	(1.61)^{bc}	(1.53)^{C}
Mean	0.96	1.74	1.97	2.23	2.29	2.62	2.73	2.35	2.11
	(1.20)	(1.49)	(1.57)	(1.65)	(1.67)	(1.76)	(1.79)	(1.68)	(1.61)
S.Em. ±	0.09	0.14	0.11	0.11	0.08	0.09	0.12	0.12	0.09
C.D. (P=0.05)	0.29	0.42	0.33	0.32	0.25	0.29	0.36	0.35	0.27

Note : BAT : Before application of treatments DAS : Days after sowing
Figures in the parenthesis are $\sqrt{x+0.5}$ transformed value
In a column or row, transformed values followed by the same alphabet do not differ significantly (P=0.05) by DMRT

Table 6. Impact of organic manures on the abundance of scarabids in maize ecosystem during *kharif* 2016

Treatments	Number of scarabids / pitfall trap at days after sowing								
	BAT	20 DAS	35 DAS	50 DAS	65 DAS	80 DAS	95 DAS	110 DAS	MEAN
T_1 (UTC)	4.80	7.00	8.33	7.50	8.33	8.40	8.07	8.00	7.45
	(2.30)^{abc}	(2.74)^{g}	(2.95)^{g}	2.83)^{e}	(2.95)^{f}	(2.96)^{e}	(2.90)^{f}	(2.91)^{f}	(2.80)^{e}
T_2 (RDF+ OM)	5.30	11.53	12.93	12.30	12.90	12.93	13.20	13.00	11.73
	(2.41)^{ab}	(3.46)^{ef}	(3.65)^{ef}	(3.57)^{c}	(3.66)^{de}	(3.65)^{cd}	(3.70)^{de}	(3.67)^{de}	(3.46)^{cde}
T_3 (RDF)	4.50	9.00	9.87	10.20	10.20	11.60	12.63	11.07	9.88
	(2.23)^{bc}	(3.06)^{fg}	(3.20)^{f}	(3.27)^{d}	(3.27)^{ef}	(3.84)^{d}	(3.62)^{e}	(3.38)^{e}	(3.19)^{de}
T_4 (VC)	5.00	15.50	15.50	15.60	15.60	16.30	17.00	16.00	14.56
	(2.34)^{abc}	(4.00)^{cd}	(3.98)^{cd}	(4.00)^{c}	(4.00)^{d}	(4.10)^{c}	(4.17)^{c}	(4.06)^{c}	(3.83)^{bcd}
T_5 (FYM)	5.70	13.60	14.60	15.10	15.10	15.43	16.00	15.67	13.94
	(2.48)^{a}	(3.75)^{de}	(3.89)^{de}	(3.95)^{c}	(3.95)^{d}	(3.98)^{c}	(4.06)^{cd}	(4.01)^{cd}	(3.77)^{cde}
T_6 (EC)	5.00	12.24	14.50	14.90	14.90	15.40	15.63	15.53	13.51
	(2.34)^{abc}	(3.57)^{de}	(3.87)^{e}	(3.92)^{c}	(3.92)^{d}	(3.99)^{c}	(4.02)^{cde}	(4.00)^{cd}	(3.70)^{cde}
T_7 (VC + FYM)	5.30	22.00	22.67	24.00	24.00	24.33	25.33	24.00	21.42
	(2.41)^{ab}	(4.74)^{ab}	(4.81)^{b}	(4.95)^{b}	(4.95)^{b}	(4.97)^{ab}	(5.08)^{b}	(4.95)^{ab}	(4.60)^{ab}
T_8 (VC+ EC)	4.40	18.00	19.93	19.93	19.93	22.00	24.00	21.33	18.68
	(2.22)^{bc}	(4.30)^{bc}	(4.52)^{bc}	(4.52)^{b}	(4.52)^{c}	(4.74)^{b}	(4.95)^{b}	(4.67)^{b}	(4.30)^{abc}
T_9 (VC+ FYM + EC)	4.00	24.67	26.33	27.67	27.67	27.67	28.33	27.90	24.28
	(2.12)^{c}	(5.01)^{a}	(5.18)^{a}	(5.31)^{a}	(5.31)^{a}	(5.31)^{a}	(5.37)^{a}	(5.33)^{a}	(4.87)^{a}
T_{10} (GLM)	5.50	12.33	12.93	13.60	13.60	14.40	14.57	12.97	12.49
	(2.44)^{ab}	(3.58)^{de}	(3.66)^{e}	(3.75)^{c}	(3.75)^{d}	(3.86)^{cd}	(3.88)^{cde}	(3.67)^{de}	(3.58)^{cde}
Mean	4.96	14.59	15.75	16.08	16.23	16.84	17.47	16.54	14.79
	(2.33)	(5.82)	(4.03)	(3.95)	(4.03)	(4.10)	(4.13)	(4.11)	(3.81)
S.Em. ±	0.07	0.12	1.14	0.13	0.13	0.13	0.13	0.12	0.04
C.D. (P=0.05)	0.21	0.36	0.42	0.40	0.41	0.39	0.38	0.37	0.13

Note : BAT : Before application of treatments DAS : Days after sowing
Figures in the parenthesis are $\sqrt{x+0.5}$ transformed value
In a column or row, transformed values followed by the same alphabet do not differ significantly (P=0.05) by

Table 7. Impact of organic manures on the abundance of other macrofauna in maize ecosystem during *kharif* 2016

Treatments	Number of other macrofauna (carabids, spiders, dipterans) /pitfall trap at days after sowing								
	BAT	20 DAS	35 DAS	50 DAS	65 DAS	80 DAS	95 DAS	110 DAS	MEAN
T_1 (UTC)	1.00		2.70	2.29	2.78	2.93	2.81	2.75	2.48
	(1.22)^{a}	2.60(1.76)^{bc}	(1.79)^{de}	(1.64)^{d}	(1.80)^{e}	(1.84)^{d}	(1.80)^{e}	(1.79)^{d}	(1.00)^{c}
T_2 (RDF+ OM)	1.30	2.80	2.93	3.00	3.10	3.30	3.48	2.93	2.86
	(1.34)^{a}	(1.82)^{bc}	(1.85)^{cd}	(1.87)^{c}	(1.90)^{de}	(1.95)^{cd}	(1.99)^{cde}	(1.84)^{d}	(1.36)^{bc}
T_3 (RDF)	1.20	2.60	2.80	2.90	3.00	3.20	3.30	3.10	2.76
	(1.30)^{a}	(1.76)^{bc}	(1.82)^{de}	(1.84)^{cd}	(1.87)^{de}	(1.92)^{cd}	(1.95)^{de}	(1.90)^{cd}	(1.43)^{bc}
T_4 (VC)	1.00	3.00	3.23	3.50	3.70	3.90	4.00	3.85	3.27
	(1.22)^{a}	(1.87)^{ab}	(1.93)^{cd}	(2.00)^{bc}	(2.05)^{cd}	(2.10)^{bc}	(2.12)^{cd}	(2.08)^{bc}	(1.64)^{bc}
T_5 (FYM)	1.30	3.04	3.18	3.48	3.53	3.57	3.95	3.70	3.26
	(1.32)^{a}	(1.88)^{ab}	(1.92)^{cd}	(1.99)^{bc}	(2.01)^{cd}	(2.01)^{cd}	(2.11)^{cd}	(2.05)^{bcd}	(1.63)^{bc}
T_6 (EC)	1.30	2.43	2.60	3.20	3.55	3.80	4.01	3.80	3.09
	(1.34)^{a}	(1.71)^{cd}	(1.76)^{de}	(1.92)^{c}	(2.01)^{cd}	(2.07)^{bc}	(2.12)^{cd}	(2.07)^{bc}	(1.62)^{bc}
T_7 (VC + FYM)	1.00	3.00	3.83	4.33	4.40	4.67	5.33	4.33	3.86
	(1.22)^{a}	(1.87)^{ab}	(2.08)^{ab}	(2.20)^{ab}	(2.21)^{b}	(2.27)^{ab}	(2.41)^{ab}	(2.20)^{b}	(1.78)^{ab}
T_8 (VC+ EC)	1.00	3.10	3.40	3.55	3.80	4.00	4.15	3.90	3.36
	(1.22)^{a}	(1.90)^{ab}	(1.97)^{bc}	(2.01)^{bc}	(2.07)^{bc}	(2.12)^{bc}	(2.15)^{bc}	(2.10)^{bc}	(1.63)^{bc}
T_9 (VC+ FYM + EC)	1.30	3.67	4.33	5.33	5.33	5.67	6.12	5.67	4.70
	(1.34)^{a}	(1.90)^{a}	(1.97)^{a}	(2.01)^{a}	(2.07)^{a}	(2.12)^{a}	(2.15)^{a}	(2.10)^{a}	(2.00)^{a}
T_{10} (GLM)	1.20	2.20	2.57	3.00	3.20	3.40	3.55	3.48	2.83
	(1.30)^{a}	(2.04)^{d}	(2.20)^{e}	(2.41)^{c}	(2.41)^{de}	(2.48)^{cd}	(2.56)^{cde}	(2.48)^{bcd}	(1.62)^{bc}
Mean	1.16	2.84	3.16	3.46	3.64	3.84	4.07	3.75	3.25
	(1.28)	(1.82)	(1.91)	(1.98)	(2.02)	(2.07)	(2.12)	(2.05)	(1.57)
S.Em. ±	0.05	0.05	0.06	0.08	0.07	0.07	0.08	0.08	0.06
C.D. (P=0.05)	NS	0.15	0.18	0.24	0.23	0.23	0.26	0.25	0.18

Note : BAT : Before application of treatments DAS : Days after sowing
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In a column or row, transformed values followed by the same alphabet do not differ significantly (P=0.05) by

Table 8. Impact of organic manures on the abundance of ants in maize ecosystem during *kharif* 2016

Treatments	Number of ants / pitfall trap at days after sowing								
	BAT	20 DAS	35 DAS	50 DAS	65 DAS	80 DAS	95 DAS	110 DAS	MEAN
T_1 (UTC)	1.00	0.30	0.40	0.50	0.80	0.50	0.70	0.50	0.50
	(1.22)^{a}	(0.89)^{d}	(0.95)^{d}	(1.00)^{e}	(1.14)^{d}	(1.00)^{d}	(1.10)^{e}	(1.00)^{c}	(1.01)^{d}
T_2 (RDF+ OM)	0.70	0.33	1.50	1.70	1.90	2.03	2.18	2.00	1.49
	(1.05)^{a}	(0.88)^{d}	(1.33)^{c}	(1.48)^{cd}	(1.55)^{c}	(1.57)^{c}	(1.61)^{d}	(1.58)^{b}	(1.43)^{c}
T_3 (RDF)	1.00	1.10	1.20	1.36	1.78	2.00	2.37	1.80	1.58
	(1.22)^{a}	(1.26)^{c}	(1.30)^{c}	(1.36)^{d}	(1.49)^{c}	(1.58)^{c}	(1.69)^{cd}	(1.52)^{b}	(1.46)^{c}
T_4 (VC)	1.20	2.07	2.20	2.21	2.50	2.65	2.80	2.31	2.24
	(1.30)^{a}	(1.58)^{b}	(1.64)^{bc}	(1.62)^{bcd}	(1.73)^{bc}	(1.77)^{bc}	(1.82)^{cd}	(1.68)^{b}	(1.69)^{bc}
T_5 (FYM)	1.00	2.10	2.10	2.25	2.45	2.53	2.78	2.54	2.22
	(1.22)^{a}	(1.61)^{b}	(1.61)^{bc}	(1.66)^{bc}	(1.72)^{bc}	(1.70)^{bc}	(1.81)^{cd}	(1.74)^{b}	(1.69)^{bc}
T_6 (EC)	1.20	2.00	2.00	2.20	2.40	2.50	2.69	2.30	2.16
	(1.30)^{a}	(1.58)^{b}	(1.58)^{bc}	(1.64)^{bcd}	(1.70)^{bc}	(1.73)^{bc}	(1.78)^{cd}	(1.67)^{b}	(1.67)^{bc}
T_7 (VC + FYM)	1.00	2.33	2.73	2.77	3.10	3.48	4.00	2.73	2.77
	(1.22)^{a}	(1.68)^{ab}	(1.79)^{ab}	(1.80)^{ab}	(1.88)^{ab}	(1.99)^{ab}	(2.11)^{ab}	(1.79)^{b}	(1.86)^{ab}
T_8 (VC+ EC)	0.70	2.03	2.30	2.30	2.80	2.90	3.00	2.29	2.24
	(1.05)^{a}	(1.59)^{b}	(1.67)^{ab}	(1.67)^{bcd}	(1.82)^{b}	(1.84)^{bc}	(1.87)^{bc}	(1.64)^{b}	(1.73)^{b}
T_9 (VC+ FYM + EC)	0.70	3.53	3.53	3.60	4.00	4.67	4.67	4.00	3.63
	(1.07)^{a}	(2.00)^{a}	(1.99)^{a}	(2.02)^{a}	(2.12)^{a}	(2.27)^{a}	(2.27)^{a}	(2.12)^{a}	(2.11)^{a}
T_{10} (GLM)	1.30	2.00	2.00	2.10	2.26	2.50	2.68	2.38	2.15
	(1.34)^{a}	(1.58)^{b}	(1.58)^{bc}	(1.61)^{bcd}	(1.66)^{bc}	(1.73)^{bc}	(1.78)^{cd}	(1.70)^{b}	(1.66)^{bc}
Mean	0.97	1.77	2.00	2.10	2.40	2.58	2.79	2.29	2.10
	(1.20)	(1.49)	(1.53)	(1.58)	(1.68)	(1.72)	(1.78)	(1.64)	(1.63)
S.Em. ±	0.10	0.10	0.12	0.08	0.08	0.11	0.09	0.07	0.07
C.D. (P=0.05)	NS	0.29	0.37	0.24	0.25	0.34	0.26	0.23	0.21

Note : BAT : Before application of treatments DAS : Days after sowing

Figures in the parenthesis are $\sqrt{x+0.5}$ transformed value

In a column or row, transformed values followed by the same alphabet do not differ significantly (P=0.05) by

More abundance of mesofauna in T_9 (Vermicompost + FYM + Enriched compost) might be due to combination of different organic manures, more nutrient and biomass availability. Optimum soil moisture, temperature and availability of food (prey). These results neither can be compared nor discussed as no such work has been done with similar treatments and in same crop. However, these results can be compared with the findings of Abhilasha (2013); Narasa reddy (2012) who recorded highest mesofaunal population in 20t FYM/ha treated plot.

The reason behind higher abundance of all macro arthropods in T_9 (Vermicompost + FYM + Enriched compost) might be due to combination of different sources of nutrients and biomass availability as compared to other treatments and most of the soil macro fauna (carabids, spiders) being predatory in habit, these predators are density dependent when the meso arthropods population is more automatically that will help to increase the soil macro arthropods. Scarabids being saprophytes in nature there abundance might be due to more organic matter, microbial biomass, optimum moisture, soil temperature and food availability. These results neither can be compared nor discussed as such studies are wanting. However, these can be compared with the findings of Abhilasha (2013) and Shilpa (2012) who reported highest soil macrofauna in 20t FYM/ha treated plot.

Conclusion

In general combination of different organic manures (FYM, vermicompost, enriched compost,) recorded higher population of soil arthropods as compared to inorganic fertilizers. These soil organisms being essential components of agro-ecosystems, makes vital contributions to soil functions and processes, they also improve soil physical and biological properties. So, increased soil fauna has beneficial effect on soil health.

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