Int.J.Curr.Microbiol.App.Sci (2020) *9*(8): 1087-1094

EXCELLENT PUBLISHERS

International Journal of Current Microbiology and Applied Sciences
ISSN: 2319-7706 **Volume 9 Number 8 (2020)**
Journal homepage: http://www.ijcmas.com

IJCMAS

Original Research Article https://doi.org/10.20546/ijcmas.2020.908.119

Soil Microbial Dynamics and Enzyme activities as Influenced by Organic Nutrient Management in Sunflower (*Helianthus annuus* L.)

M. Chaithra and G. M. Sujith*

Department of Agronomy, University of Agricultural Sciences, GKVK, Bangalore, India

**Corresponding author*

A B S T R A C T

A field experiment was conducted at Zonal Agricultural Research Station, University of Agricultural Sciences, Gandhi Krishi Vignana Kendra, Bangalore during 2017 to study the effect of nutrient management practices through organics on soil biological properties of sunflower grown on alfisols of eastern dry zone of Karnataka. There were nine treatment combinations laid out in factorial randomized complete block design and replicated thrice. Among different treatment combinations application of FYM at 150 per cent N equivalent and jeevamrutha at 1500 L ha^{-1} recorded significantly higher bacterial, fungal, actinomycetes, P-solubilizer and N-fixer population at harvest of sunflower (37.67 × 10^6, 28.33 × 10^4, 48.50 × 10^3, 30.10 × $10^5$and 24.50 × 10^5CFU g^{-1}respectively). The dehydrogenase activity was also examined at peak flowering stage of crop growth and it was found to be higher with application of FYM at 150 per cent N equivalent and jeevamrutha at 1500 l ha^{-1} (50.11 µg TPF formed/ g of soil/ day). Seed yield and oil content of Sunflower were found higher at increased level of FYM and jeevamrutha application.

Keywords

FYM, Jeevamrutha, Dehydrogenase, Sunflower, Oil content, Microbes

Article Info

Accepted:
10 July 2020
Available Online:
10August 2020

Introduction

With increasing population and shrinking resource base, our future need is to increase the agricultural production on a sustainable basis without degrading the resource base. Due to tropical climate, higher temperature has reduced the organic carbon content of the soil as a result microbial activity is also limited to certain extent. So there is a need of use of combined organic sources of nutrients, which help to maintain the healthy crop growth, improve the soil properties and helps to obtain sustainable yield and quality. To achieve all these objectives organic farming serves as a tool to improve the physical, chemical and biological properties of soil and maintains the ecological balance as well as productivity of life supporting systems for the future generations on sustainable basis. Organic production relies on microbially derived ecosystem functions including decomposition, mineralization of plant available nutrients, and nutrient retention and thus, may be a model system for ecological intensification of agriculture (Jackson *et al.*, 2012).

Organic matter serves as a nutrient source (carbon) and energy for diverse soil flora and fauna. For mineralization of organic matter, soil fauna and microorganisms have indispensible role to play and they improves the availability of nutrients to the plants. Use of organic liquid products such as beejamrutha, jeevamrutha and panchagavya results in improving the soil physico-chemical and biological properties apart from better growth, yield and quality of crops as they contain macro nutrients, essential micro nutrients, many vitamins, essential amino acids, growth promoting factors like IAA, GA and beneficial microorganisms (Devakumar *et al*., 2008 and Tharmaraj *et al*., 2011).

Sunflower (*Helianthus annuus* L.) is a major oilseed crop and has gained importance because of its wider adaptability to different agro-climatic regions and cropping pattern, shorter duration, photo insensitiveness and excellent oil quality. Although crop has the yield potential of 2.3 to 2.5 tonnes ha^{-1} under favourable conditions, but the average productivity is only 0.79 t ha^{-1}. The crop yield can be stabilized and maintained on sustainable manner on long run with the use of organics. With this background, the present experimentation was carried out to study the biological properties of the soil as influenced by the conjunctive use of organic sources – farmyard manure and jeevamrutha in Sunflower under irrigated conditions on *alfisols* of eastern dry zone of Karnataka state.

Materials and Methods

A field experiment was carried out during *kharif*2017 at Zonal Agricultural Research Station, University of Agricultural Sciences, Gandhi Krishi Vignana Kendra, Bengaluru. Soil of the experimental site was red sandy loam classified as *Alfisols*. Organic carbon, available nitrogen, phosphorus and potassium content of the soil were medium (0.58%, 329 kg ha^{-1}, 44 kg ha^{-1} and 214 kg ha^{-1} respectively.). The experiment was laid out in factorial randomized complete block design (FRCBD) having farm yard manure and jeevamrutha as two factors and tried each at three levels leading to nine treatment combinations which were replicated thrice. FYM was applied three weeks before sowing and jeevamrutha was applied as soil application at 20, 40, 60 and 80 days after sowing.

Jeevamrutha preparation and application: Jeevamrutha was prepared by mixing 10 kg cow dung, 10 litre cow urine, 2 kg local jaggery, 2 kg pigeon pea flour and hand full of soil. All these were put in 200 litre capacity drum and mixed thoroughly and volume was made up to 200 litre. The mixture was stirred well in clock wise direction and kept in shade covered with wet jute bag. The solution was regularly stirred clockwise in the morning, afternoon and in the evening continuously for 10 days and it was then used for soil application. Jeevamrutha was applied when the soil was wet near the root zone of the crop.

Nutrient composition of FYM was 0.49% N, 0.25% P_2O_5 and 0.51% K_2O and the nutrient composition of jeevamrutha was found to be 725 ppm, 175 ppm and 135 ppm of total nitrogen, phosphorus and potassium respectively. The initial soil microbial population -bacteria, fungi, actinomycetes, P-solubilizer and N-fixer (Soil extract agar, Martin'rose Bengal agar, Kusters agar, Pikovaskaya's and Jensen agar media respectively) in experimental were analysed with the serial dilution plate count technique and as per the procedure outlined (Allen, 1959).

Sunflower hybrid KBSH-53 which is moderately resistant to powdery mildew was used for the field experiment. Sunflower crop was sown on 1st October 2017 with seed rate of 5 kg ha^{-1} and seeds were sown at spacing of 60 cm and seed to seed spacing of 30 cm (60 cm X 30 cm). Irrigation was provided at 10-15 days interval depending on the stage of crop and soil condition. Necessary aftercare operations were followed as per the recommendations. No major pest and disease incidences were noticed during crop growth. Observations on growth parameters were recorded at regular intervals *viz*., 30 and 60 days after sowing and at harvest. Experimental data collected was subjected to statistical analysis by adopting Fisher's method of Analysis of Variance (ANOVA) as outlined by Gomez and Gomez (1984). Critical Difference (CD) values were calculated whenever the 'F' test was found significant at 5 per cent level.

Results and Discussion

As evident from the table 1 and 2, increase in microbial population *viz*. bacteria, fungi, actinomycetes, P-solubilizer and N-fixer was observed with increase in the nitrogen equivalent dose of FYM and higher rates of jeevamrutha application.

Microbial Population

In the present study, among the different levels of FYM, significantly higher bacterial, fungal and actinomycetes population (30.65 × 10^6, 20.41 × 10^4 and39.00 × 10^3 CFU g^{-1}, respectively)was recorded with FYM at 150 per cent N-equivalent and whereas significantly lower bacterial, fungal and actinomycetes population (23.57 × 10^6, 13.57 × 10^4 and 26.60 × 10^4 CFU g^{-1} respectively) was observed with FYM at 100 per cent N-equivalent (Table 1).

Among the different levels of jeevamrutha, application of jeevamrutha at 1500 L ha^{-1} was recorded significantly higher bacterial, fungal and actinomycetes (31.18 × 10^6, 20.07 × 10^4 and 39.84 × 10^3CFU g^{-1} respectively) and significantly lower bacterial, fungal, actinomycetes population (21.76 × 10^6, 16.76 × 10^4 and 23.00 × 10^4, CFU g^{-1} respectively) was recorded with no jeevamrutha application (Table.1).

Among the interaction effects, significantly higher bacterial, fungal and actinomycetes (37.67 × 10^6, 28.33 × 10^4 and 39.00 × 10^3 CFU g^{-1} respectively) was recorded with FYM at 150 per cent N equivalent and jeevamrutha at 1500 L ha^{-1} and significantly lower bacterial, fungal and actinomycetes population was recorded with FYM at 100 per cent N equivalent and without jeevamrutha application (20.77 × 10^6, 10.89 × 10^4 and 22.09 × 10^3, CFU g^{-1} respectively) (Table 1).

Similarly, among the different levels of FYM, significantly higher P-solubilizer and N-fixers population (27.85 × 10^5 and 21.67 × 10^5CFU g^{-1}respectively) was recorded with FYM at 150 per cent N-equivalent and application of jeevamrutha at 1500 L ha^{-1} was recorded significantly higher P-solubilizer and N-fixers (28.44 × 10^5 and 22.10 × 10^5 CFU g^{-1} respectively) when compared to FYM at 100 per cent N-equivalent and with no jeevamrutha application (Table.2). Among the interaction effects, significantly higher P-solubilizer and N-fixer (8.20 × $10^5$and 5.48 × 10^5 CFU g^{-1} respectively) was recorded with FYM at 150 per cent N equivalent and jeevamrutha at 1500 L ha^{-1} and significantly lower P-solubilizer and N-fixers population was recorded with FYM at 100 per cent N equivalent and without jeevamrutha application (18.21 × 10^5 and 15.48 × 10^5 CFU g^{-1} respectively) (Table 2).

Increased microbial population is an indicator of soil fertility and soil health. In the present study, application of FYM and jeevamrutha at different levels significantly influenced the bacteria, fungi, actinomycetes, P- solubilizer and N-fixer population in the soil. This is due to the increased organic carbon content upon application of FYM which acted as carbon and energy source for microbes and their quick build up in the soil. These findings are in conformity with the findings of Kiran *et al*., (2015).

Among the different levels of jeevamrutha, application of jeevamrutha at 1500 L ha^{-1} recorded significantly higher bacteria, fungi, actinomycetes, P-solubilizer and N-fixer population followed by jeevamrutha at 1000 L ha^{-1} and lower microbial population was recorded with no jeevamrutha application. This might be due to presence of enormous amount of microbial load in jeevamrutha which multiplies in the soil and acts as a tonic to enhance the microbial activity in the soil. Use of handful of soil for jeevamrutha preparation serves as source of initial inoculum for the growth of bacteria, fungi, actinomycetes, N- fixers and P- solubilizers. Hence, more number of beneficial microorganisms were usually found in organic liquid manure formulations as was reported by Devakumar *et al*., (2014).

Table.1 Effect of FYM and jeevamrutha on bacteria, fungi and actinomycetes population in rhizophere soil after harvest of sunflower

Treatment	Bacteria (No.×10^{6}CFU g^{-1})	Fungi (No.×10^4 CFU g^{-1})	Actinomycetes (No.×10^3 CFU g^{-1})
FYM			
F_1- 100% N*	23.57	13.57	26.60
F_2- 125% N*	26.74	15.14	32.38
F_3- 150% N*	30.65	20.41	39.00
S.Em ±	0.67	0.38	0.72
C.D at 5 %	2.01	1.14	2.16
Jeevamrutha			
J_0- Control	21.76	12.29	23.00
J_1- 1000 litre ha^{-1}	28.02	16.76	35.14
J_2- 1500 litre ha^{-1}	31.18	20.07	39.84
S.Em ±	0.67	0.38	0.72
C.D at 5 %	2.01	1.14	2.16
FYM X Jeevamrutha			
F_1J_0	20.77	10.89	22.09
F_1J_1	23.74	14.78	26.20
F_1J_2	26.20	15.04	31.51
F_2J_0	22.22	12.63	23.29
F_2J_1	28.33	15.95	34.36
F_2J_2	29.67	16.83	39.49
F_3J_0	22.29	13.35	23.62
F_3J_1	32.00	19.55	44.87
F_3J_2	37.67	28.33	48.50
S.Em ±	1.16	0.66	1.25
C.D at 5 %	3.48	1.97	3.74

FYM: Farm yard manure, * Nitrogen equivalent, DAS: Days after sowing, NS: Non significant

Table.2 Effect of FYM and jeevamrutha on P-solubilisers, N-fixers population& dehydrogenase enzyme activity in rhizophere soil after harvest of sunflower

Treatments	P-solubilizer (No.× 10^5 CFU g^{-1})	N-fixer (No.× 10^5 CFU g^{-1})	Dehydrogenase activity (µg TPF formed/ g of soil/ day)
FYM			
F1- 100% N*	19.91	17.93	26.98
F2- 125% N*	26.23	19.83	32.74
F3- 150% N*	27.85	21.67	40.27
S.Em ±	0.80	0.76	1.27
C.D at 5 %	2.40	2.29	3.80
Jeevamrutha			
J0- Control	18.21	16.30	24.01
J1- 1000 litre ha-1	27.34	21.02	35.86
J2- 1500 litre ha-1	28.44	22.10	40.12
S.Em ±	0.80	0.76	1.27
C.D at 5 %	2.40	2.29	3.80
FYM X Jeevamrutha			
F1J0	8.20	15.48	21.65
F1J1	24.74	18.59	28.61
F1J2	26.78	19.71	30.68
F2J0	22.58	16.18	23.64
F2J1	27.67	21.21	35.03
F2J2	28.44	22.09	39.57
F3J0	23.84	17.25	26.75
F3J1	29.60	23.27	43.95
F3J2	30.10	24.50	50.11
S.Em ±	1.38	1.32	2.19
C.D at 5 %	4.15	3.89	6.46

FYM: Farm yard manure, * Nitrogen equivalent, DAS: Days after sowing, NS: Non significant

Table.3 Seed yield (kg/ha) and oil content of sunflower as influenced by different levels of FYM and jeevamrutha

Treatment	Seed yield(kg/ha)	Oil content (%)
FYM		
F_1- 100% N*	1959	41.86
F_2- 125% N*	2168	42.10
F_3- 150% N*	2335	42.45
S.Em ±	30.03	0.16
C.D at 5 %	90.03	NS
Jeevamrutha		
J_0- Control	1886	41.99
J_1- 1000 litre ha^{-1}	2227	42.14
J_2- 1500 litre ha^{-1}	2349	42.27
S.Em ±	30.03	0.16
C.D at 5 %	90.03	NS
FYM X Jeevamrutha		
F_1J_0	1737	40.02
F_1J_1	2032	41.84
F_1J_2	2108	41.61
F_2J_0	1894	41.92
F_2J_1	2243	41.99
F_2J_2	2367	42.01
F_3J_0	2028	41.85
F_3J_1	2405	42.06
F_3J_2	2573	42.89
S.Em ±	52.01	0.27
C.D at 5 %	156.03	NS

FYM: Farm yard manure, * Nitrogen equivalent, DAS: Days after sowing, NS: Non significant

Dehydrogenase activity

Application of FYM at 150 per cent N-equivalent was recorded significantly higher dehydrogenase activity (40.27 µg TPF formed/ g of soil/ day) and whereas significantly decreased dehyrogenase activity was observed with FYM application at 100 per cent N equivalent (26.98 µg TPF formed/ g of soil/ day)at flowering stage of the crop growth (Table 2). Among the different levels of jeevamrutha, application of jeevamrutha at 1500 L ha^{-1} recorded significantly higher dehydrogenase activity(40.12 µg TPF formed/ g of soil/ day) followed by jeevamrutha at 1000 L ha^{-1} (35.86 µg TPF formed/ g of soil/ day). Whereas significantly decreased dehyrogenase activity was observed with no jeevamrutha application (24.01 µg TPF formed/ g of soil/ day). Among the treatment combinations, integrated application of FYM at 150 per cent N equivalent and jeevamrutha at 1500 L ha^{-1} recorded significantly higher dehydrogenase activity (50.11 µg TPF formed/ g of soil/ day) which was on par with FYM at 150 per cent N equivalent and jeevamrutha at 1000 L ha^{-1}(43.95 µg TPF formed/ g of soil/ day) and significantly decreased dehydrogenase activity was observed with FYM application at 100 per cent N equivalent and without jeevamrutha application (21.65 µg TPF formed/ g of soil/ day) at flowering stage of the crop growth (Table 2).

Increased soil organic matter status and microbial population known to stimulate the dehydrogenase activity in the soil. The increased dehydrogenase activity in the present investigation upon addition of FYM at different levels is due to increased microbial population. Tejada *et al*., (2010) recorded maximum dehydrogenase activity with 100 per cent substitution of RDN with FYM, vermicompost, poultry manure and biogas slurry and concluded that higher dehydrogenase enzyme activity in soil is due to greater labile fraction of organic matter in the soil and similar findings have been reported by Jaffar Basha *et al*., (2017).

Irrespective of jeevamrutha levels, FYM at 150 % N equivalent recorded significantly higher seed yield (2335 kg ha^{-1}) (Table 3) which was an increase of 7.15 and 16.10 per cent over FYM at 125 % N equivalent and FYM at 100 % N equivalent, respectively and may be attributed to stimulation of activity of microorganisms and subsequent mineralization of nutrients and enhanced nutrient use efficiency that has helped to make the plant nutrients readily available to sunflower crop. Similarly, increase in seed yield of Sunflower in jeevamrutha at 1500 l ha^{-1} could be due to better availability of nutrients throughout the crop growth and this has been evidenced by improved microbial activity in the soil (Table 1 & 2). These findings are in conformity with Manjunath *et al*., (2009), Ravi Kumar (2009), Guriqbalsingh *et al*., (2012). Beneficial effects of jeevamrutha due to huge quantity of microbial load and growth hormones leading to sustaining the availability and uptake of applied as well as native soil nutrients resulting in enhanced growth and yield of crops has been well documented by Sharma and Thomas (2010). Oil content of sunflower was non-significant.

Thus, it is evident that combined application of FYM and jeevamrutha resulted in higher microbial population which was due to the fact that FYM serves as a source of carbon for microbes and the liquid organic manure i.e. jeevamrutha contains higher number of bacteria, fungi, actinomycets, N-fixers and P-solubilizers. These organic manures not only supply the nutrients but it also serves as a source of organic carbon for the microbes, there by improves the microbial population in the soil which inturn helps to improves the mineralisation of nutrients in soil thus, fertility and productivity of the soil gets improved. Application of these organic sources like FYM and jeevamrutha would supplement the application of bio-fertilizers and these can be prepared easily by locally available materials by the farmers.

References

Allen, O.N., 1959, The isolation of Azotobacter species. In: *Experiments in soil microbiology*, Burgess Publishing Company, Minneapolis, 15-Minnesota, Pp.46- 47.

Devakumar, N., Shubha, S., Gouder, S. B. andRao, G. G. E., 2014, Microbial analytical studies of traditional organic preparations beejamrutha and jeevamrutha, *Proc. Building Organic Bridges.* 4th ISOFAR Scientific Conference, Istanbul, Turkey, p. 639.

Devakumar. N., Rao, G. G. E., Shubha, S., Imrankhan, Nagaraj and Gowda, S. B., 2008, Activities of Organic farming research centre, Navile, Shimoga, *Univ. Agril. Sci., Bengaluru*, Karnataka, India.

Gomez, K. A. andGomez, A. A., 1984, Statistical procedures agricultural research, (2/e) *an international rice* *research institute book*, A Willey Inter Science Publication, John Willey and Sons, New York.

Guriqbal Singh, Sekhon, H. S. and Harpreeth K., 2012, Effect of farmyard manure, vermicompost and chemical nutrients on growth and yields of chickpea (*Cicer arietinum* L.). *Int. J. Agric. Res.*, 7(2): 93-99.

Jackson, L. E., Bowler, T. M., Hodson, A. K. and Lazcano, C., 2012 Soil microbial and microbial rhizosphere processes to increase nitrogen availability and retention in agroecosystems. *Curr.Opin. Environ. Sustain.*, 4, 517-522.

JaffarBasha, S., Basavarajappa, R., Geeta Shirnalli and Babalad, H. B. 2017, Soil microbial dynamics and enzyme activities as influenced by organic and inorganic nutrient management in vertisols under aerobic rice cultivation. *J.env. Bio.* 38(9): 131-138.

Kiran, SatyanarayanaRao, Vivekananda Reddy and Shubha, S., 2015, Effect of nutrient management practices through organics on soil biological properties in organic chickpea (*Cicer arietinum* L.) cultivation under rainfed condition. An *Int. quarterly J. Environmental Sci.*Vol VII: 183-187.

Manjunatha, G. S., Upperi, S. N., Pujari, B. T., Yeledahalli, N. A. and Kuligoda, V. B., 2009, Effect of farm yard manure treated with jeevamrutha on yield attributes and economics of sunflower (*Helianthus annuus* L.). *Karnataka J. Agric. Sci.*,22 (1):342-348.

Ravi Kumar, H. S., 2009, Comparative performance of integrated organic nutrient supply systems on growth and yield of groundnut (*Arachis hypogaea* L.).*M.Sc.(Agri.) Thesis*, Univ. Agric. Sci., Bengaluru.

Sharma, V. andThomas, A., 2010, Response of blackgram (*Phaseolus mungo* L.) to nitrogen, zinc and farm yard manure. *Legume Res.*, 33 (4):295-298.

Tejada, M., Gomez, I. H. Teresaand Garcia, C., 2010, Utilization of vermicompost in the soil restoration: effects on soil biological properties. *Soil Sci. Soc. American J.*, 74, 525-532.

Tharmaraj, G. P., Suresh, R., Anandan, A. and Kolanjinathan, K., 2011, A Critical Review on Panchagavya – A Boon Plant Growth. *Int J. Pharmaceutical & Biological Archives,* 2(6): 1611-1614.

How to cite this article:

Chaithra, M. and Sujith, G. M. 2020. Soil Microbial Dynamics and Enzyme activities as Influenced by Organic Nutrient Management in Sunflower (*Helianthus annuus* L.). *Int.J.Curr.Microbiol.App.Sci.* 9(08): 1087-1094. doi: https://doi.org/10.20546/ijcmas.2020.908.119