ISSN: 0974 - 0376

The Ecoscan : Special issue, Vol. VII: 183-187: 2015
AN INTERNATIONAL QUARTERLY JOURNAL OF ENVIRONMENTAL SCIENCES
www.theecoscan.in

EFFECT OF NUTRIENT MANAGEMENT PRACTICES THROUGH ORGANICS ON SOIL BIOLOGICAL PROPERTIES IN ORGANIC CHICKPEA (*CICER ARIETINUM* L.) CULTIVATION UNDER RAINFED CONDITION

Kiran *et al.*,

KEYWORDS

Chickpea
Organic and Liquid organic manures
Phyllosphere
Microbial Population

Proceedings of National Conference on Harmony with Nature in Context of Bioresources and Environmental Health
(HORMONY - 2015)
November 23 - 25, 2015, Aurangabad,
organized by
Department of Zoology,
Dr. Babasaheb Ambedkar Marathwada University
Aurangabad (Maharashtra) 431 004
in association with
National Environmentalists Association, India
www.neaindia.org

The Ecoscan
AN INTERNATIONAL QUARTERLY JOURNAL OF ENVIRONMENTAL SCIENCES

KIRAN*[1], SATYANARAYANA RAO[2], VIVEKANANDA REDDY[3] AND S. SHUBHA[4]
[1]Department of Agronomy,
[2]UAS, Raichur,
[3]Research Institute on Organic Farming, UAS, Raichur,
[4]Department of Agronomy, UAS, Raichur,
Deparment of Agricultural Microbiology, Dept. of Agricultural Microbiology, UAS, Raichur – 584 104
e-mail: kiranagron@gmail.com

ABSTRACT

A field experiment was conducted at Main Agricultural Research Station, Raichur on black soil during *rabi* 2013-14 to study the effect of nutrient management practices through organics on soil biological properties in chickpea (*Cicer arietinum* L.) cultivation under rainfed condition. Application of beejamrutha + jeevamrutha + vermicompost + foliar spray of panchagavya recorded significantly higher bacterial, fungal and actinomycetes population at different crop growth stages (50 DAS and at harvest) (bacterial; 91.30 & 63.33 No. X 10^7 cfu g^{-1} of soil, fungal; 63.00 and 45.67 No. X 10^4 cfu g^{-1} of soil and actinomycetes; 48.67 & 35.67 No. X 10^3 cfu g^{-1} of soil) and it was on par with treatments receiving beejamrutha + jeevamrutha + FYM + panchagavya and beejamrutha + jeevamrutha + FYM + vermicompost + panchagavya. The data on bacterial and fungal population on phyllosphere at 5th day after their first spray on chickpea crop, significantly higher bacterial and fungal population on phyllosphere was recorded in beejamrutha + jeevamrutha + vermicompost + panchagavya (22.33 and 14.00 per plate, respectively) over rest of the treatment combinations. Significantly lower bacterial and fungal population on phyllosphere was recorded with only beejamrutha + jeevamrutha treatment (13.00 and 4.00 per plate, respectively).

*Corresponding author

INTRODUCTION

Organic farming gives major emphasis on recovery and maintenance of soil fertility and for sustainable yield. Organic farming helps 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. Organic manures in agriculture add much needed organic and mineral matter. Organic systems rely on management of organic matter to enhance the soil fertility and productivity (Nail *et al.,* 2014). Organic matter has an overwhelming effect on almost all soil properties. Organic matter, a most precious component, is also considered as storehouse of many nutrients. For mineralization of organic matter, soil fauna and microorganisms are indispensible. Soil harbours a dynamic microbial population, arthropods and others (soil biota). The living phase of soil is greatly stimulated by organic manure addition which serves as a food (carbon) and energy source for soil life. Both soil and enzyme systems are associated with organic manure management which carry out a wide range of processes that are important for soil health and fertility (Deshmukh and Urkude, 2014). The proper management of these makes it possible to increase the efficiency of use of soil and added nutrients (Ramesh, 2007 and Ipsita and Singh, 2014). Soil micro-organisms play a very important role in soil fertility not only because of their ability to carry out bio-chemical transformation but also due to their importance as a source and sink for mineral nutrients. Use of organic manures is the object to accelerate microbial processes to enhance availability of nutrients in the assumable form. The microbial activities are enhanced as the fresh organic material acts as the nutrient source for the diverse soil flora and fauna. Organics modify the micro-climate, alter the environment of soil microbes, enhance soil flora and fauna activity, modify soil moisture regimes and properties associated with it and soil temperature in the root zone. Microbial biomass is the total sum of all micro-organisms present in soil. Chickpea (*Cicer arietinum* L.) is the premier pulse crop grown in *rabi* mainly under rainfed condition in Northern Karnataka. This crop though requires low amount of inputs particularly with respect to nutrients but grown on soils having low nitrogen or phosphorus with feeding less adequate quantities of nutrients or without organic sources. Owing to this the yield level of this crop is not stable and potential yield is yet to be achieved. The yield decline is mainly due to low soil fertility status. There is a need to stabilize the yield. The crop yield can be maintained on sustainable manner on long run with the use of organics. The present proposed investigation not only helps to maintain crop yields but also reduces the cost of production of chickpea cultivation. The present investigation was carried out to know the effect of organics on soil microbial population in chick pea organic production system under rainfed eco-system.

MATERIALS AND METHODS

A field experiment was conducted during *rabi* 2013-14 at Main Agricultural Research Station, Raichur which comes under North Eastern Dry Zone of Karnataka.

The soil type was black clayey soil with a pH value of 7.54 with organic carbon content of 0.51%. The soil is low in available N (160.16 kg ha^{-1}) and medium in P_2O_5 (18.90 kg ha^{-1}) and high in available K_2O (347 kg ha^{-1}).

The chickpea variety JG-11 having duration of 90 to 100 days was sown on 31st October, 2013 with a spacing of 30 cm x 10 cm. The experiment was laid out in Randomized Complete Block Design consisting of fourteen treatments each replicated thrice. The treatments consisted of application of beejamrutha + jeevamrutha alone (T_1); and along with FYM equivalent to 100% RDN (T_2); Vermicompost equivalent to 100% RDN (T_3); FYM equivalent to 50% RDN + Vermicompost equivalent to 50% RDN (T_4); FYM equivalent to 100% RDN + Foliar spray of 3% Panchagavya (T_5); Vermicompost equivalent to 100% RDN + Foliar spray of 3% Panchagavya (T_6); FYM equivalent to 50% RDN + Vermicompost equivalent to 50% RDN + Foliar spray of 3% Panchagavya (T_7); FYM equivalent to 100% RDN + Foliar spray of 10% Cow urine (T_8); Vermicompost equivalent to 100% RDN + Foliar spray of 10% Cow urine (T_9); FYM equivalent to 50% RDN + Vermicompost equivalent to 50% RDN + Foliar spray of 10% Cow urine (T_{10}); FYM equivalent to 100% RDN + Foliar spray of 10% Bio-digester solution (T_{11}); Vermicompost equivalent to 100% RDN + Foliar spray of 10% Bio-digester solution (T_{12}); FYM equivalent to 50% RDN + Vermicompost equivalent to 50% RDN + Foliar spray of 10% Bio-digester solution (T_{13}) and compared with RDF alone treatment (10:25:0 kg ha^{-1} N:P:K) (T_{14}).

Organic manures such as farmyard manure and vermicom post were calculated as per the requirements based on the nutrients contents and incorporated into the soil two weeks before sowing with respect to FYM and at the time of sowing in case of vermicompost. Foliar spray of panchagavya, cow urine and bio-digester solution was made at initiation of flowering and 15 days after first application as per the treatments. Jeevamrutha was applied to soil at the rate of 500 litres per hectare at the time of sowing in treatments from T_1 to T_{13}. Nutrient composition of FYM and Vermicompost were 0.58% N, 0.30% P_2O_5 and 0.63% K_2O and 1.50% N, 1.27% P_2O_5 and 1.83% K_2O respectively. At the time of sowing, recommended dose of fertilizer was applied. The healthy seeds were dipped in beejamrutha solution for one minute and then seeds were treated with biofertilizers - *Rhizobium* @ 20 g, PSB @ 20 g and *Trichoderma* @ 4 g per kg seed and dried in the shade. Treated and dried seeds were sown in the respective treatment plots.

The initial soil microbial population like bacteria, fungal and actinomycetes (37.94 X10^7, 13.55 X 10^4 and 12.45 X 10^3 respectively) in experimental were analysed with the Serial dilution and agar plate method (Pramer and Schmidt, 1964).

The number of nodules per plant at 40 and 60 DAS was recorded by carefully uprooting five randomly selected plants in adjacent rows of border lines in each plot and the average of five plants was expressed as a number of nodules per plant. The selected plants were saturated with water on the previous evening of observation. Next morning, selected five plants were carefully lifted along with the adhering soil mass. Enough care was taken to keep the root system intact so that none of the nodules were lost. All the nodules were collected and counted after carefully washing-off the soil. The nodules separated from five plants were oven dried at 65 to 70ºC to a constant weight and expressed in mg per plant.

RESULTS AND DISCUSSION

The essence of practicing organic farming lies in the use of naturally available resources like organic wastes, in conjunction with natural processes like decomposition biological nitrogen fixation and resistance to achieve the needs of crop production. Applying organic manures for growth of the crop, also improves the organic matter status of soil. Organic manures not only help to supply the nutrients but also act as a food for microorganisms and encourage the multiplication of their population, which inturn improve the mineralization of nutrients in soil and thus, fertility and productivity of the soil gets improved. The enhancement of soil microbial biomass is known to influence crop productivity

Table 1: Bacterial and fungal population in soil at initial and different growth stages of chickpea as influenced by nutrient management practices under organic cultivation

Treatments	Bacteria (No. X 10^7 cfu g^{-1} of soil) Initial (37.94 X 10^7 cfu g^{-1} of soil)		Fungi (No. X 10^4 cfu g^{-1} of soil) Initial (13.55 X 10^4 cfu g^{-1} of soil)	
	50 DAS	At harvest	50 DAS	At harvest
T_1:	66.00	48.33	42.33	22.00
T_2:	76.00	52.00	51.67	27.33
T_3:	79.67	57.33	55.33	31.33
T_4:	79.33	56.67	56.67	30.33
T_5:	85.33	58.00	61.33	42.00
T_6:	91.30	63.33	63.00	45.67
T_7:	82.67	57.67	56.33	35.33
T_8:	77.33	54.67	52.67	28.00
T_9:	79.00	55.33	53.67	28.67
T_{10}:	73.67	50.33	48.33	25.00
T_{11}:	69.33	49.00	46.67	23.67
T_{12}:	71.33	49.33	48.00	24.00
T_{13}:	74.33	50.67	50.00	26.00
T_{14}:	63.00	46.33	34.67	16.00
S.Em ±	2.16	2.10	2.12	1.79
C.D. at 5%	6.31	6.14	6.19	5.21

and nutrient cycling.

In the present study, significant improvement in the population of soil microorganisms *viz.*, bacteria, fungi and actinomycetes and phyllosphere microorganisms mainly bacteria and fungi on the chickpea leaves on 5th day after first spray of liquid organic manures (panchagavya, cow urine and bio-digester solution) was noticed at different stages of chickpea (Table 1, 2 and 3). The phyllosphere is a term used to refer to the total above-ground portions of plants as habitat for microorganisms. Phyllosphere microbes included majority of bacteria, fungi, yeast, actinomycetes, etc., Some of the phyllosphere microbes have antagonistic action against fungal pathogen, degrade plant surface wax cuticles, produce plant hormones, decompose plant material and active plant to produce phytoalexins.

The significant increase in microbial population was observed with the addition of organic manures in combination with fermented liquid organic manures. Application of beejamrutha + jeevamrutha + vermicompost + panchagavya, beejamrutha + jeevamrutha + FYM + panchagavya and beejamrutha + jeevamrutha + FYM + vermicompost + panchagavya recorded significantly higher bacterial, fungal and actinomycetes population in the soil at 50 DAS and at harvest (bacterial; 91.30 & 63.33 No. X 10^7 cfu g^{-1} of soil, fungal; 63.00 & 45.67 No. X 10^4 cfu g^{-1} of soil and actinomycetes; 48.67 & 35.67 No. X 10^3 cfu g^{-1} of soil, respectively). This could be due to cumulative effect of various sources of organic manures in increasing organic carbon content of soil which acted as carbon and energy source for microbes and their quick build up in the soil (Barik *et al.*, 2006 and Palekar, 2006). Lower bacterial, fungal and actinomycetes population was noticed in RDF treatment during different stages of the crop like 50 DAS and at harvest (bacterial; 63.00 and 46.33 No. X 10^7 cfu g^{-1} of soil, fungal; 34.67 and 16.00 No. X 10^4 cfu g^{-1} of soil and actinomycetes; 20.67 and 16.67 No. X 10^3 cfu g^{-1} of soil, respectively) as compared to organic manurial treatments, but it was on par with treatments receiving beejamrutha + jeevamrutha + FYM + panchagavya and beejamrutha + jeevamrutha + FYM + vermi compost + panchagavya. Because it did not cause significant changes in the soil microbial biomass, growth and functioning of soil microbial biomass as carbon substrate availability was limited. These results are in line with the findings of Sreenivasa (2007), Deshpande *et al.* (2010) Dhok and Ghodpage (2011) and Sharada (2013) who reported higher soil microbial population with combined application of organics.

Phyllosphere microbial population before spray of different liquid organic manures did not differ significantly among the treatments. Significantly higher bacterial and fungal population on phyllosphere was recorded in treatments supplemented with various organic manures along with panchagavya when compared to other treatments which might be due to presence of naturally occurring, beneficial, effective micro organisms, lactic acid bacteria, yeast, actinomycetes, photosynthetic bacteria and certain fungi in panchagavya (Xu and Xu, 2000 and Baoguo *et al.*, 2010).

Table 2: Actinomycetes population in soil at initial and different growth stages of chickpea as influenced by nutrient management practices under organic cultivation

Treatments	Actinomycetes (No. X 10^3 cfu g^{-1} of soil) Initial (12.45 X 103 cfu g^{-1} of soil)	
	50 DAS	At harvest
T_1:	22.67	20.00
T_2:	36.33	27.33
T_3:	38.00	28.67
T_4:	28.00	26.00
T_5:	46.00	33.33
T_6:	48.67	35.67
T_7:	45.67	32.33
T_8:	29.00	26.00
T_9:	37.00	28.33
T_{10}:	27.33	25.33
T_{11}:	38.33	29.33
T_{12}:	40.33	30.00
T_{13}:	38.33	29.00
T_{14}:	20.67	16.67
S.Em ±	2.13	1.65
C.D. at 5%	6.23	4.81

Number of root nodules and nodule dry weight

Table 3: Phyllosphere microflora (Bacterial and fungal population) on leaves before spray and 5th day after first spray in chickpea as influenced by nutrient management practices under organic cultivation

Treatments	Bacterial population per plate		Fungal population per plate	
	Before spray	5th day after first spray	Before spray	5th day after first spray
T_1:	12.00	13.00	3.00	4.00
T_2:	13.00	13.67	4.00	5.67
T_3:	13.33	14.00	4.33	5.00
T_4:	13.00	14.33	4.00	5.33
T_5:	12.67	21.00	4.33	13.33
T_6:	14.00	22.33	4.67	14.00
T_7:	12.67	22.00	4.00	13.67
T_8:	12.33	16.00	3.67	9.67
T_9:	12.67	16.33	3.67	10.33
T_{10}:	13.00	15.67	3.00	10.00
T_{11}:	12.67	18.00	4.00	11.67
T_{12}:	12.33	19.33	3.67	12.00
T_{13}:	12.67	19.00	4.33	12.33
T_{14}:	12.33	13.33	3.67	4.33
S.Em ±	0.46	0.50	0.39	0.55
C.D. at 5%	NS	1.47	NS	1.61

Table 4: Number of root nodules and dry weight of nodules per plant at different growth stages of chickpea as influenced by nutrient management practices under organic cultivation

Treatments	No. of root nodules per plant		Dry weight of nodules (mg plant^{-1})	
	40 DAS	60 DAS	40 DAS	60 DAS
T_1 :	12.4	15.5	29.89	35.44
T_2 :	13.6	16.6	32.17	36.30
T_3 :	14.0	17.7	32.14	35.90
T_4 :	14.6	17.8	33.27	36.70
T_5 :	13.8	15.6	32.57	35.51
T_6 :	15.7	19.0	36.01	38.20
T_7 :	14.8	17.9	33.05	36.83
T_8 :	14.7	17.3	32.50	35.66
T_9 :	15.1	18.0	35.28	36.43
T_{10}:	15.6	18.6	35.88	37.96
T_{11}:	14.2	17.0	31.33	35.60
T_{12}:	14.8	18.3	32.59	37.50
T_{13}:	14.1	17.3	31.31	35.70
T_{14}:	14.5	18.1	33.01	37.27
S.Em $\pm$	0.42	0.32	0.36	0.42
C.D. at 5%	1.23	0.95	1.05	1.23

As chickpea is a leguminous crop, number of root nodules and its dry weight are indicative of N fixing ability. Number of root nodules and dry weight of nodules per plant were significantly higher in treatment beejamrutha + jeevamrutha + vermicompost + panchagavya at 40 and 60 DAS (15.7 and 19.0 and 36.01 and 38.20 mg plant^{1}, respectively) and was on par with treatments received FYM + Vermicompost + Cow urine and Vermicompost + Cow urine in combination with beejamrutha + jeevamrutha. Significantly lower number of nodules and their corresponding weight per plant was noticed in beejamrutha + jeevamrutha treatment in both stages of crop (12.4 and 15.50 and 29.89 and 35.44 mg plant^{1}, respectively) (Table 4).

REFERENCES

Baoguo Zhang, Zhihui Bai, Daniel Hoefel, Xiaoyi Wang, Ling Zhang and Zuming, L. 2010. Microbial diversity within the phyllosphere of different vegetable species. *Current Res.* **58:** 213-220.

Barik, A. K., Arindam Das, Giri, A. K. and Chattopadhyaya, G. N., 2006. Effect of integrated plant nutrient management on growth, yield and production economics of wet season rice. *Indian J. Agric. Sci.* **76(1):** 657-660.

Deshmukh, C. K. and Urkude, R. N. 2014. Physico-chemical and microbial status of malkhed lake at chandur railway, district: Amravati. *The Bioscan.* **9(2):** 677-682.

Deshpande, H. H., Devasenapathy and Nagaraj M. Naik, 2010, Microbial population dynamics as influenced by application of organic manures in rice field. *Green Farming.* **1(4):** 356-359.

Dhok, S. P. and Ghodpage, R. M. 2011. Soil microbiota and fertility status as influenced by nutrient management modules under soybean based cropping system. *Green Farming.* **2(4):** 401-404.

Ipsita Das and Singh, A. P. 2014 Effect of PGPR and organic manures on soil properties of organically cultivated mungbean. *The Bioscan.* **9(1):** 27-29.

Naik, V. R., Patel, P. B. and Patel, B. K. 2014. Study on effect of different organics on yield and quality of organically grown onion. *The Bioscan.* **9(4):** 1499-1503.

Palekar, S. 2006. Text book on Shoonya Bandovalada naisargika Krushi, published by Swamy Anand, Agri Prakashana, Bangalore.

Pramer, D. and Schmidt, E. L. 1964. Experimental soil microbiology. *Burgers Pub. Minneapolis, Minnesota, USA.*

Ramesh, P. 2007. Organic Farming Research in Madhya Pradesh. *Organic Farming in Rainfed Agriculture: Opportunities and Constraints*, Central Research Institute for Dryland Agriculture, Hyderabad. pp. 12-20.

Sharada 2013. Studies on nutrient management practices through organics in greengram - *rabi* sorghum cropping system. *M.Sc. (Agri.) Thesis, Univ. Agric. Sci., Raichur.*

Sreenivasa, M. N. 2007. Organic Farming Research in Karnataka-outcome and lessons learnt. *Organic Farming in Rainfed Agriculture: Opportunities and Constraints, Central Research Institute for Dryland Agriculture, Hyderabad.* pp. 21-27.

Xu, Hui Lian and Xu, H. L. I. 2000. Effects of a microbial inoculants and organic fertilizers in the growth, photosynthesis and yield of sweet corn. *J. Crop Prod.* **3(1):** 183-214.