International Journal of Environment and Climate Change

Volume 13, Issue 1, Page 81-88, 2023; Article no.IJECC.96053
ISSN: 2581-8627
(Past name: British Journal of Environment & Climate Change, Past ISSN: 2231–4784)

Effect of Different Organic Manures and Their Levels on Nutrient Status and Soil Microbial Activity under Rose (*Rosa bourboniana* Desportes) Cultivation

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Authors' contributions

This work was carried out in collaboration among all authors. All authors read and approved the final manuscript.

Article Information

DOI: 10.9734/IJECC/2023/v13i11636

Open Peer Review History:
This journal follows the Advanced Open Peer Review policy. Identity of the Reviewers, Editor(s) and additional Reviewers, peer review comments, different versions of the manuscript, comments of the editors, etc are available here: https://www.sdiarticle5.com/review-history/96053

Original Research Article

Received: 21/10/2022
Accepted: 29/12/2022
Published: 06/02/2023

ABSTRACT

A field experiment was conducted to study the effect of different organic manures and their levels on nutrient status and soil microbial activity in rose at Hisar during 2020-21. The treatments comprised of 3 different types of organic manures viz., farm yard manures, vermicompost and poultry manure and 4 levels control, 4 kg/m^2, 5 kg/m^2 and 6 kg/m^2. The experiment was carried out in the split plot design with three replications. Observation on organic carbon,

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dehydrogenase activity and alkaline phosphatase activity, N, P and K content in rose leaves and available N, P and K content in soil at the time of harvest were recorded. Organic carbon in soil was maximum (0.93%) with the application of vermicompost while dehydrogenase and alkaline phosphatase activity were highest with the application of farmyard manure and poultry manure, respectively. Nitrogen (2.17%) and phosphorus (0.27%) content were maximum in rose leaves at harvest stage with the application of poultry manure while Potassium (1.41%) content was maximum vermicompost. Same trend was observed in the nutrient status of soil with the application of different organic manures. It is concluded that the application of poultry manures had pronounced effect on microbial activity and nutrient status in rose.

Keywords: Alkaline phosphatase activity; dehydrogenase activity; microbial activity; organic carbon; Rose.

1. INTRODUCTION

One of the most important activities in organic agriculture is maintaining and enhancing the soil health with the soil organic matter. The organic agriculture should be based on living ecological systems and cycles., The important components for improving the soil fertility and health could be green manure, cover crops, living mulch [1]. "Different types of organic matter can bring additional positive effect on yield through amelioration of soil microflora, water retention and humus content" [2,3].

An experiment was carried out to study effect of different organic manures and their levels on microbiological activity and nutrient status (N, P and K) in the soil in rose (*Rosa bourboniana* Desportes).

2. MATERIALS AND METHODS

An investigation entitled, "Effect of different organic manures on nutrient status and soil microbial activity in rose (*Rosa bourboniana* Desportes)" was carried out at Deen Dayal Upadhayay Centre of Excellence for Organic Farming, Chaudhary Charan Singh Haryana Agricultural University, Hisar (Haryana) located in the sub tropiocs at 29°08' North latitude and 75°42' East longitude at an altitude of 215.20 meters above mean sea level.

2.1 Experimental Detail

The present investigation was conducted on one year old rose plantation during 2020-21.

The crop was planted at a spacing of 75 cm between rows and 60 cm for plant to plant. Soil analysis was determined at the initial stage of the experiment. that the soil of the experimental field was loamy in texture, basic in reaction (pH 8.0), high in organic carbon (0.85%) and low in available nitrogen (178.70 kg/ha), medium in phosphorus (23.80 kg/ha) and high in potassium (371.02 kg/ha). Microbial activities of the soil was also examined at the initial stage. Dehydrogenase activity of the soil was 43.97 TPF/g/day and phosphotase activity was 115.65 µg PNP/g/hr.

Table 1. Physico chemical properties of soil

Properties	Value
Soil Texture	Loam
Soil pH	8.00
EC(dS/m)	0.49
Organic carbon (%)	0.85
Available N (kg/ha)	178.70
Available P (kg/ha)	23.80
Available K (kg/ha)	371.02
Dehydrogenase activity (µg TPF/g/day)	43.97
Alkaline phosphatase activity (µg PNP/g/hr)	115.65

The experiment was laid out in split plot design with three replications having 12 treatment combinations 3 different organic manures viz., farm yard manures, vermicompost and poultry manures and 4 levels viz., control, 4 kg/m^2, 5 kg/m^2 and 6 kg/m^2. The gross plot size was 4.05 with 9 plants. The experimental plots were irrigated by flood irrigation method as and when required.

2.2 Soil and Microbial Activity Analysis

Soil samples were taken from experimental plots after flower harvest and dried at room temperature for 3 days and ground to pass a 30 mesh sieve. The available nitrogen, P and K were estimated by the standard procedures [4-6]. The organic carbon was estimated zed by wet digestion method [7]. The dehydrogenase activity

estimated by method given by Casida *et al*., [8] and alkaline phosphatase activity by method given by Evazi and Tabatabai [9]. Soil texture and pH were estimated by International pipette method [10] and potentiometric method [6], respectively.

2.3 Statistical Analysis

Statistical analysis of the observations recorded on different parameters were subjected to analysis of variance (ANOVA) utilizing the OPSTAT software [11] for the split plot design (SPD). Variation among different treatments were assessed at 5% probability (P= 0.05).

3. RESULTS AND DISCUSSION

3.1 Soil Organic Carbon Content (%), Dehydrognase Activity (µg TPF/g/day) and Alkaline Phosphatase Activity (µg PNP/g/hr)

Maximum organic carbon (0.93 %) was observed with the application of vermicompost and it was at par with the application of FYM (0.92 %) (Table 1). Minimum organic carbon was recorded in poultry manure (0.88 %). In case of levels of organic manures, maximum organic carbon (0.97 %) in soil was recorded when organic manure was applied @ 6 kg/m^2 followed by application of organic manure @ 5 kg/m^2 area (0.94 %). Minimum organic carbon (0.82 %) was recorded in control. Interaction between organic manures and their levels was found non-significant. However, the maximum organic carbon (0.98 %) was observed with vermicompost applied @ 6 kg/m^2 follow 1.

The maximum dehydrogenase activity was observed with FYM (61.82 µg TPF/g/day) followed by application of poultry manures (57.22 µg TPF/g/day) and minimum was recorded in vermicompost (51.93 µg TPF/g/day). Among the levels of organic manures maximum dehydrogenase activity (66.01 µg TPF/g/day) was recorded with the application of organic manure @ 6 kg/m^2 area and minimum (41.31 µg TPF/g/day) was observed in control. Interaction between the organic manures and their levels was found non-significant.

Alkaline phosphatase activity increased significantly with the application of various organic manures and their levels. Maximum alkaline phosphatase activity (154.35 µg PNP/g/hr) was observed in poultry manure followed by application of vermicompost (147.68 µg PNP/g/hr) and minimum alkaline phosphatase activity was recorded in FYM (139.86 µg PNP/g/hr).

Among the levels of organic manures maximum alkaline phosphatase activity (164.01 µg PNP/g/hr) was recorded with the application of organic manure @ 6 kg/m^2 area and minimum alkaline phosphatase activity (123.93 µg PNP/g/hr) was observed in control. Interaction between various organic manures and their level shows maximum alkaline phosphatase activity was observed with the application of poultry manure @ 6 kg/m^2 (171.20 µg PNP/g/hr) which was found significantly higher than application of vermicompost @ 6 kg/m^2 (165.33 µg PNP/g/hr). In case of FYM, maximum alkaline phosphatase activity (155.50 µg PNP/g/hr) was recorded with FYM application @ 6 kg/m^2.

The higher value of soil organic carbon content recorded with the application of vermicompost might be due to the fact that it enhanced the soil health, microbial population, biological immobilization and mineralization in soil. Soil enzymatic activities are affected by decomposition of organic matter and recycling of organic carbon. Dehydrogenase activity is the indicator of overall microbial activity as it occurs in cells of living organisms. It is possible that the greater impacts of FYM on dehydrogenase activity are related to more readily decomposable organic matter in soil and hence it influences microbial activity directly and indirectly. Application of poultry manure significantly increased alkaline phosphatase activity over control. Alkaline phosphatase activity is influenced by the quality organic matter incorporated into soil. Poultry manure have more impact on alkaline phosphatase activity might be due to the reason that it is easily decomposable. These results are in line with the findings of Rathore *et al.* [12], Malik *et al.* [13] in alkaline soils and Manna *et al.* [14] in soyabean-wheat rotation.

Interaction was found non-significant in influencing the soil organic carbon and dehydrogenase activity but found significant for alkaline phosphatase activity. The maximum organic carbon (0.98 %), dehydrogenase activity (66.33 µg TPF/g/day) and alkaline phosphatase activity (171.20 µg PNP/g/hr) were recorded with the application of poultry manure @ 6 kg/m^2. The results are in accordance with the earlier findings

of Katkar *et al*. [15] in sorghum-wheat system and Basak *et al.* [16] in maize-wheat rotation. Alkaline phosphatase activity was increased significantly by the application of poultry manure which might be due to the fact that nutrient composition of poultry manure was higher than others.

3.2 N, P and K Content (%) in Leaves of Rose

N, P and K content(%) in leaves of rose was also The increased dehydrogenase and phosphatase activity due to organic matter treatments also increased the nutrient availability (Table 3) indicating increased soil biological activity [17]. Ramesh *et al.* [18] also reported "the enhanced level of soil enzymatic activity thorugh addition of organic manures which promotes the recycling of nutrients in the soil ecosystem". The manurial effect of certain botanicals has also been observed by Knox *et al.* [19]. "It is a well-established fact that the growth and yield is the outcome of complementary interaction between vegetative and reproductive growth of crop. Thus the better performance of growth parameters seems to promote yield attributes and thereby crop productivity" [20]. Gireesh [21] also reported "the direct relationship between photosynthetic pigment chlorophyll content, and productivity of *Dunaliella salina"*.

Maximum nitrogen content in leaves of rose was observed with the application of poultry manure (2.17 %). Minimum nitrogen content was observed with the application of FYM (2.01 %). Among the different levels of organic manures maximum nitrogen content (2.23 %) in leaves was found when organic manure was applied @ 6 kg/m^2 area and minimum nitrogen content (1.92 %) was recorded in control. Among the interactions, the highest amount of nitrogen content (2.35 %) was observed with the application of poultry manure @ 6 kg/m^2. Phosphorus content in leaves was significantly increased with the application of various organic manures and their levels. The maximum phosphorus content in leaves was observed in poultry manure (0.27 %). Among the levels, the maximum phosphorus content (0.27 %) in leaves was found when organic manure was applied @ 5 kg/m^2 and found statistically at par with the application of organic manure @ 5 kg/m^2 (0.26 %). Among the interactions, the highest amount of phosphorus content was observed with the application of poultry manure @ 6 kg/m^2 (0.29 %) and it was found statistically at par with the application of poultry manure @ 5 kg/m^2 (0.28 %). Maximum potassium content was observed with the application of vermicompost (1.41 %) followed by FYM (1.37 %). Minimum potassium content (1.36 %) was observed with the application of poultry manure.

Potassium content in leaves of rose increased with the increasing doses of organic manures up to 6 kg/m^2. Maximum potassium content (1.43 %) was recorded with the application of organic manure @ 6 kg/m^2 and it was significantly higher as compared to application of organic manure @ 5 kg/m^2 (1.40 %). The minimum potassium content (1.32 %) was recorded in control irrespective of various organic manures. Among the interactions the highest potassium content was noticed with the application of vermicompost @ 6 kg/m^2 (1.47 %) and it was significantly higher with the application of vermicompost @ 5 kg/m^2 (1.43 %) followed by farm yard manure @ 6 kg/m^2 (1.42 %). All the levels of organic manures differed significantly with each other.

3.3 Available N, P and K (kg/ha) in Soil

Available N, P and K (kg/ha) in soil that the available nitrogen in soil at the time of flower harvest was maximum with the application of poultry manure (183.46 kg/ha) followed by vermicompost application (180.44 kg/ha) (Table 4).

The minimum available nitrogen in soil at harvest was recorded in FYM (178.82 kg/ha). The highest available nitrogen (184.87 kg/ha) among the different levels of organic manures was found when organic manure applied @ 6 kg/m^2. The minimum available nitrogen (174.84 kg/ha) was recorded in control. The maximum available nitrogen (189.00 kg/ha) was recorded when poultry manure was applied @ 6 kg/m^2 among the different interactions between the organic manures and their levels.

The maximum available phosphorus (27.80 kg/ha) in soil was observed with application of poultry manure followed by vermicompost application (26.09 kg/ha) and minimum was recorded with the application of FYM (24.84 kg/ha).The maximum available phosphorus (28.84 kg/ha) in soil was recorded when organic manure was applied @ 6 kg/m^2 followed by application of organic manure @ 5 kg/m^2 (27.82 kg/ha). The minimum available phosphorus (21.85 kg/ha) in soil at harvest was recorded in

Table 2. Effect of organic manures and their levels on organic carbon (%), dehydrognase activity (µg TPF/g/day) and alkaline phosphatase activity (µg PNP/g/hr) in rose

Treatments	Organic carbon (%)					Dehydrognase activity (µg TPF/g/day)					Alkaline phosphatase activity (µg PNP/g/hr)				
	Levels of Organic Manures (kg/ha)														
Organic manures (M)	**Control**	**4**	**5**	**6**	**Mean**	**Control**	**4**	**5**	**6**	**Mean**	**Control**	**4**	**5**	**6**	**Mean**
FYM	0.86	0,91	0.95	0.97	**0.92**	45.62	61.33	66.18	70.13	**61.82**	119.75	136.93	147.25	155.50	**139.86**
Vermicompost	0.82	0.94	0.96	0.98	**0.93**	35.18	53.58	57.45	61.56	**51.93**	123.08	146.50	155.80	165.33	**147.68**
Poultry manure	0.78	0.88	0.92	0.95	**0.88**	43.12	56.95	62.50	66.33	**57.22**	128.95	152.70	164.55	171.20	**154.35**
Mean	**0.82**	**0.91**	**0.94**	**0.97**		**41.31**	**57.29**	**62.04**	**66.01**		**123.93**	**145.38**	**155.87**	**164.01**	
C.D. (P= 0.05)	Organic manures (M) = 0.01					Organic manures (M) = 1.80					Organic manures (M) = 0.47				
	Organic manures levels (L) = 0.02					Organic manures levels (L) = 1.36					Organic manures levels (L) = 0.90				
	Factor (L) at same level of M = NS					Factor (L) at same level of M= NS					Factor (L) at same level of M = 1.59				
	Factor (M) at same level of L = NS					Factor (M) at same level of L = NS					Factor (M) at same level of L = 1.43				

Table 3. Effect of organic manures and their levels on N, P and K (%) content in leaves of rose

Treatments	Nitrogen content (%) in leaves					Phosphorus content (%) in leaves					Potassium content (%) in leaves				
	Levels of Organic Manures (kg/m^2)														
Organic manures (M)	**Control**	**4**	**5**	**6**	**Mean**	**Control**	**4**	**5**	**6**	**Mean**	**Control**	**4**	**5**	**6**	**Mean**
FYM	1.94	1.99	2.03	2.06	**2.01**	0.23	0.23	0.24	0.25	**0.24**	1.32	1.35	1.39	1.42	**1.37**
Vermicompost	1.95	2.15	2.23	2.27	**2.15**	0.22	0.24	0.26	0.27	**0.25**	1.33	1.39	1.43	1.47	**1.41**
Poultry manure	1.88	2.20	2.28	2.35	**2.17**	0.23	0.26	0.28	0.29	**0.27**	1.32	1.33	1.38	1.39	**1.36**
Mean	**1.92**	**2.10**	**2.18**	**2.23**		**0.23**	**0.24**	**0.26**	**0.27**		**1.32**	**1.36**	**1.40**	**1.43**	
C.D. (P= 0.05)	Organic manures (M) = 0.06					Organic manures (M) = 0.01					Organic manures (M) = 0.01				
	Level of organic manures (L) = 0.06					Organic manures levels (L) = 0.01					Organic manures levels (L) = 0.01				
	Factor (L) at same level of M = 0.13					Factor (L) at same level of M = 0.01					Factor (L) at same level of M = 0.01				
	Factor (M) at same level of L = 0.12					Factor (M) at same level of L = 0.01					Factor (M) at same level of L = 0.01				

Table 4. Effect of organic manures and their levels on available N, P and K (kg/ha) in soil at the time of harvest

Treatments	Available nitrogen(kg/ha) in soil					Available phosphorus(kg/ha) in soil					Available potassium(kg/ha) in soil				
	Levels of organic manures (kg/m^2)														
Organic manures (M)	**Control**	**4**	**5**	**6**	**Mean**	**Control**	**4**	**5**	**6**	**Mean**	**Control**	**4**	**5**	**6**	**Mean**
FYM	174.68	178.60	180.90	181.08	**178.82**	21.83	24.95	25.90	26.68	**24.84**	363.71	412.00	418.30	421.10	**403.78**
Vermicompost	174.25	180.15	182.83	184.52	**180.44**	21.85	26.55	27.50	28.45	**26.09**	364.79	421.50	422.12	425.50	**408.47**
Poultry manure	175.58	183.22	186.03	189.00	**183.46**	21.87	27.90	30.05	31.40	**27.80**	365.75	398.75	405.50	412.25	**395.56**
Mean	**174.84**	**180.66**	**183.25**	**184.87**		**21.85**	**26.47**	**27.82**	**28.84**		**364.75**	**410.75**	**415.30**	**419.61**	
C.D. (P= 0.05)	Organic manures (M) = NS					Organic manures (M) = 0.41					Organic manures (M) = 0.91				
	Level of organic manures (L) = 1.08					Organic manures levels (L) = 0.82					Organic manures levels (L) = 1.17				
	Factor (L) at same level of M = NS					Factor (L) at same level of M = 1.45					Factor (L) at same level of M = 2.12				
	Factor (M) at same level of L = NS					Factor (M) at same level of L = 1.29					Factor (M) at same level of L = 0.28				

control. Among the levels of different organic manures, maximum available phosphorus (31.40 kg/ha) was recorded with poultry manure applied @ 6 kg/m^2. Maximum available potassium (408.47 kg/ha) was observed with the application of vermicompost and it was significantly higher to FYM (403.78 kg/ha). Minimum available potassium was observed with the application of poultry manure (395.56 kg/ha). Among the different levels of organic manures, the maximum available potassium (419.61 kg/ha) was recorded with the application of organic manure @ 6 kg/m^2 and it was significantly higher than the application of organic manure @ 5 kg/m^2 (415.30 kg/ha). The minimum available potassium (364.75 kg/ha) was recorded in control.

The application of organic manures increased the N, P and K content in plant and soil as compared to control. This may be due to the release of N from poultry manure which was easily accessible to plants. Due to solubilizing action of organic acid released from vermicompost maximum K content was observed with the application of vermicompost. Organic manures enhanced the available N, P and K status in the soil, as these sources improved soil organic matter status, which improved soil physical and biological activities and hence increased the availability of plant nutrients. The results are in accordance with the results of Meena *et al.* [22] and Bandyopadhyay *et al.* [23]. Interaction was found significant in influencing the N, P and K content in plant and for available P and K in soil while available N in soil while found non-significant. This could be due to an increase in population of microorganism and the formation of organic acids after decomposition of organic manures, resulting in better availability soil nutrients and easier plant uptake or it could be due to the highest N and P content in applied poultry manure and the highest K content in vermicompost. Results are in close conformity with the findings of Kaur *et al.* [24] and Khaliq and Abbasi [25].

4. CONCLUSION

The different organic manures applied to rose improved microbial activity of the soil and increased the nutrient status as compared to control and with the initial phases. Application of vermicompost could be considered as the best treatment for increasing the nutrient content and microbial activity in soil in rose.

COMPETING INTERESTS

Authors have declared that no competing interests exist.

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Peer-review history:
The peer review history for this paper can be accessed here:
https://www.sdiarticle5.com/review-history/96053