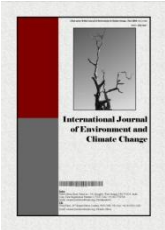

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Effect of Organic Manures on Growth and Yield of Pearl Millet (*Pennisetum glaucum* L.)

Somarowthu Akhil [a*¥] and C. Umesha [a#]

[a] *Department of Agronomy, Naini Agricultural Institute, SHUATS, Prayagraj, Uttar Pradesh, India.*

Authors' contributions

This work was carried out in collaboration between both authors. Both authors read and approved the final manuscript.

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ABSTRACT

This experimental study was conducted during *kharif* 2021 at Crop Research Farm, Department of Agronomy, SHUATS, Prayagraj (Uttar Pradesh). The soil of experimental plot was sandy loam in texture, nearly neutral in soil reaction (pH 7.6), low in organic carbon (0.51%), available N (230 kg/ha), available P (17.80 kg ha^{-1}) and available K (245.10 kg ha^{-1}). The experiment was laid out in Randomized Block Design with nine treatments each replicated thrice on the basis of one year experimentation. The treatments which are T1: Farm Yard Manure 5 t-ha^{-1} + vermicompost 3 t-ha^{-1}, T2: Farm yard manure 5 t-ha^{-1} + poultry manure 2 t-ha^{-1}, T3: Farm yard manure 5 t-ha^{-1} + vermicompost 1.5 t-ha^{-1} + poultry manure 1 t-ha^{-1}, T4: Farm yard manure 7.5 t-ha^{-1} + vermicompost 3 t-ha^{-1}, T5: Farm yard manure 7.5 t-ha^{-1} + poultry manure 2 t-ha^{-1}, T6: Farm yard manure 7.5 t-ha^{-1} + vermicompost 1.5 t-ha^{-1} + poultry manure 1 t-ha^{-1}, T7: Farm yard manure 10 t-ha^{-1} + vermicompost 3 t-ha^{-1}, T8: Farm yard manure 10 t-ha^{-1} + poultry manure 2 t-ha^{-1}, T9: Farm yard manure 10 t-ha^{-1} + vermicompost 1.5 t-ha^{-1} + poultry manure 1 t-ha^{-1}, are used. The results showed that application of Farm yard manure 10 t-ha^{-1} + vermicompost 1.5 t-ha^{-1} + poultry manure 1 t-ha^{-1} was recorded significantly higher Plant height (174.21 cm), Plant dry weight (45.67 g). Whereas significantly highest crop growth rate (16.72 g m^{-2} day^{-1}) and relative growth rate (0.0411 g/g/day) was recorded with the treatment Farm yard manure 7.5 t-ha^{-1} + vermicompost 1.5 t-ha^{-1} + poultry manure 1 t-ha^{-1}. Significantly maximum Number of earheads-m^{-2} (44.67), Number of grains/earhead (1976.67), Test weight (9.05 g), Grain yield (2.59 t-ha^{-1}), Straw yield (3.64 t-ha^{-1}),

¥M. Sc. Scholar;
#Assistant Professor;
**Corresponding author: E-mail: akhilsai3615@gmail.com;*

Gross returns (Rs.1,55,400), Net returns (Rs. 94600) and Benefit Cost ratio (1.56) were obtained with application of Farm yard manure 10 t-ha^{-1} + vermicompost 1.5 t-ha^{-1} + poultry manure 1 t-ha^{-1} as compared to other treatments.

Keywords: Farm yard manure; vermicompost; poultry manure; yield.

1. INTRODUCTION

"Pearl millet (*Pennisetum glaucum* L.) is the most widely cultivated cereal in India after rice and wheat. It is grown on more than 9.3m ha with current grain production of 9.5m tonnes and productivity of 1044 kg/ha. The major growing states in Indi are Rajasthan, Maharashtra, Gujarat, Punjab, Haryana and Uttar Pradesh where, it is grown both in Kharif and summer season. Mineral fertilization is one of the most important ways for qualitative and quantitative improving crop yield and its quality can be improved by adequate soil and crop management practices" [1].

The nutritive value of grains of pearl millet is fairly high and used for human consumption. Apart from grain, the forage and stover is an important secondary product for resource poor farmer that can be used as animal feed and fuel. Pearl millet is a tropical cereal and most drought resistant crop is extensively grown in the arid and semi-arid regions of the world.

"The application of organic sources of nutrients not only supplies all essential nutrients but also facilitates the growth and development of beneficial microbes, assists better uptake of nutrients by crop plants and counteracts the harmful effect of agrochemicals. Moreover, use of organics helps in improving water holding capacity of soil, allows better root growth and leaves residual effect on soil fertility for long period, thus organics are important for sustainable farming" [2].

"Research on use of this poultry manure resource had not been conducted. Most `of the reported studies on poultry manure use as nutrient source and to improve soil properties have been conducted in developed countries, but environmental problems have arisen" [3].

"Vermicompost improves microbial load in soil and increases microbial availability of phosphorous and nitrogen which increases yield attributes and nutrient uptake (N, P and K) by grain and stover" [4].

2. MATERIALS AND METHODS

The present examination was carried out during *Kharif* 2021 at Crop Research Farm, Department of Agronomy, SHUATS, Prayagraj, Uttar Pradesh, which is located at 25^{o}24'41.27" N latitude, 81^{o}50'56" E longitude and 98 m altitude above the mean sea level. The experiment laid out in Randomized Block Design which consisting of nine treatments with T1: Farm yard manure 5 t-ha^{-1} + vermicompost 3 t-ha^{-1}, T2: Farm yard manure 5 t-ha^{-1} + poultry manure 2 t-ha^{-1}, T3: Farm yard manure 5 t-ha^{-1} + vermicompost 1.5 t-ha^{-1} + poultry manure 1 t-ha^{-1}, T4: Farm yard manure 7.5 t-ha^{-1} + vermicompost 3 t-ha^{-1}, T5: Farm yard manure 7.5 t- ha^{-1} + poultry manure 2 t-ha^{-1}, T6: Farm yard manure 7.5 t-ha^{-1} + vermicompost 1.5 t-ha^{-1} + poultry manure 1 t-ha^{-1}, T7: Farm yard manure 10 t-ha^{-1} + vermicompost 3 t-ha^{-1}, T8: Farm yard manure 10 t-ha $^{-1}$+ poultry manure 2 t-ha^{-1}, T9: Farm yard manure 10 t-ha^{-1} + vermicompost 1.5 t-ha^{-1} + poultry manure 1 t-ha^{-1} are used.

"The experimental site was uniform in topography and sandy loam in texture, nearly neutral in soil reaction (P^{H} 7.6), low in Organic carbon (0.51%), medium available N (230 kg-ha^{-1}), higher available P (17.80 kg-ha^{-1}) and medium available K (245.10 kg-ha^{-1}). In the period from germination to harvest several plant growth parameters were recorded at frequent intervals along with it after harvest several yield parameters were recorded those parameters are growth parameters, plant height and plant dry weight are recorded. The yield parameters like earheads per m^{2}, grains per earhead, test weight, grain yield (t-ha^{-1}) and straw yield (t-ha^{-1}) were recorded and statistically analyzed using analysis of variance (ANOVA) as applicable to Randomized Block Design" (Gomez K.A. and Gomez A.A. 1984).

3. RESULTS AND DISCUSSION

3.1 Growth Attributes Plant Height

Treatment with Farm yard manure 10 t-ha^{-1} + Vermicompost 1.5 t-ha^{-1} + poultry manure 1 t-ha^{-1} recorded significantly highest plant height (174.21 cm) which was superior to all the

treatments and the treatment with Farm yard manure 7.5 t-ha^{-1} + vermicompost 1.5 t-ha^{-1} + poultry manure 1 t-ha^{-1} was statistically on par with the treatment Farm yard manure 10 t- ha^{-1} + vermicompost 1.5 t-ha^{-1} + poultry manure 1 t-ha^{-1}.

Vermicompost is known to enhance the biological and physical characteristics of soil, supplying nearly all of the nutrients needed for plant growth and development. The plants benefit from vermicompost because it contains significant levels of micronutrients and secondary elements including Ca, Mg, and S. The balanced diet brought about by the release of macro- and micronutrients from the use of FYM and vermicompost in a favourable environment may have contributed to a higher uptake of nutrients. This has ultimately boosted the plant height and dry matter accumulation by accelerating the growth of new tissues and the emergence of new shoots. The results are in conformity with those of [4] and [5] in pearl millet.

3.2 Plant Dry Weight (g/plant)

Treatment with Farm yard manure 10 t-ha^{-1} + vermicompost 1.5 t-ha^{-1} + poultry manure 1 t-ha^{-1} recorded significantly highest plant dry weight (45.67 g) which was superior to all the treatments and the treatment with Farm yard manure 7.5 t-ha^{-1} + vermicompost 1.5 t-ha^{-1} + poultry manure 1 t-ha^{-1} was statistically on par with the treatment Farm yard manure 10 t-ha^{-1} + vermicompost 1.5 t-ha^{-1} + poultry manure 1 t-ha^{-1}.

However, “maximum dry matter accumulation days to 50% flowering, were observed with vermicompost + biofertilizer. Superiority of vermicompost + biofertilizer treatment is contributed by vermicompost application enriching the supply of all the essential macro and micronutrients higher than other organic sources and secondly, the use of vermicompost had incorporated some earthworms in the field which could have worked in the soil and helped in improving the physical conditions of the soil thus increasing aeration for root development and more availability of nutrients. The vermicompost enhanced soil physical, chemical and biological properties and thus overall vegetative growth of the crop” [1].

3.3 Yield Attrubutes and Yield Number of Spikes/m^2

Maximum Number of earheads/m^2 (44.67) were recorded with treatment Farm yard manure 10 t-ha^{-1} + vermicompost 1.5 t-ha^{-1} + poultry manure 1 t-ha^{-1} which was superior over rest of all treatments and the treatment with Farm yard manure 7.5 t-ha^{-1} + vermicompost 1.5 t-ha^{-1} + poultry manure 1 t-ha^{-1} was statistically on par with the treatment Farm yard manure 10 t-ha^{-1} + vermicompost 1.5 t-ha^{-1} + poultry manure 1 t-ha^{-1}.

“The increased growth provided greater site for photosynthesis and diversion of photosynthates towards sink (ear and grain). The beneficial effect on yield attributes might also be due to the increased supply of all the essential nutrients by vermicompost and FYM that might have resulted in higher manufacture of food and its subsequent partitioning towards sink” [6].

The length of earhead, weight of earhead will be increased due to the application of poultry manure along with the recommended dose of fertilizer [7].

3.4 Number of Grains/Earhead

Maximum Number of grains/spike (1976.67) were recorded with the treatment Farm yard manure 10 t-ha^{-1} + vermicompost 1.5 t-ha^{-1} + poultry manure 1 t-ha^{-1} which was superior over rest of all treatments and the treatment with Farm yard manure 7.5 t-ha^{-1} + vermicompost 1.5 t-ha^{-1} + poultry manure 1 t-ha^{-1} was statistically on par with the treatment Farm yard manure 10 t-ha^{-1} + vermicompost 1.5 t-ha^{-1} + poultry manure 1 t-ha^{-1}.

The application of Vermicompost had significantly increased plant height, dry matter accumulation, ear length, grains/earhead, test weight, grain yield. The phosphorous content in grain was significantly increased due to application of vermicompost [8].

3.5 Test weight (g)

Highest test weight (9.05 g) was recorded with the treatment Farm yard manure 10 t- ha^{-1} + vermicompost 1.5 t-ha^{-1} + poultry manure 1 t-ha^{-1} which was superior over rest of all treatments and the treatment with Farm yard manure 7.5 t-ha^{-1} + vermicompost 1.5 t-ha^{-1} + poultry manure 1 t-ha^{-1} was statistically on par with the treatment Farm yard manure 10 t-ha^{-1} + vermicompost 1.5 t-ha^{-1} + poultry manure 1 t-ha^{-1}.

This might be due to application of Farm yard manure enhanced plant height, number of tillers, test weight, grain yield and straw yield [2].

3.6 Grain Yield (t-ha^{-1})

Highest grain yield (2.59 t-ha^{-1}) was recorded in the treatment Farm yard manure 10 t- ha^{-1} + vermicompost 1.5 t-ha^{-1} + poultry manure 1 t-ha^{-1} which was superior over rest of all treatments and the treatment with Farm yard manure 7.5 t-ha^{-1} + vermicompost 1.5 t-ha^{-1} + poultry manure 1 t-ha^{-1} was statistically on par with the treatment Farm yard manure 10 t-ha^{-1} + vermicompost 1.5 t-ha^{-1} + poultry manure 1 t-ha^{-1}.

The synergistic effect of integration of organic and inorganic sources along with biofertilizers resulted in better nutrient uptake, which accelerated the photosynthetic rate, adequate biomass production that reflected on grain and stover yield. The results were also obtained by [9,2,10].

3.7 Straw Yield (t-ha^{-1})

Highest Straw yield (3.64 t-ha^{-1}) was seen in the treatment Farm yard manure 10 t-ha^{-1} + vermicompost 1.5 t-ha^{-1} + poultry manure 1 t-ha^{-1} which was superior over rest of all treatments and the treatment with Farm yard manure 7.5 t-ha^{-1} + vermicompost 1.5 t-ha^{-1} + poultry manure 1 t-ha^{-1} was statistically on par with the treatment Farm yard manure 10 t-ha^{-1} + vermicompost 1.5 t-ha^{-1} + poultry manure 1 t-ha^{-1}.

"The use of bio-fertilizer (*Azotobacter* + PSB) along with FYM 2.5 t-ha^{-1} led to higher availability of N and P as well as promoted root growth, which is promoted yield attributes characters" [5].

3.8 Harvest Index (%)

Highest Harvest index (41.79%) was seen in the treatment Farm yard manure 10 t-ha^{-1} + vermicompost 1.5 t-ha^{-1} + poultry manure 1 t-ha^{-1} which was superior over rest of all treatments and the treatment with Farm yard manure 7.5 t-ha^{-1} + vermicompost 1.5 t-ha^{-1} + poultry manure 1 t-ha^{-1} was statistically on par with the treatment Farm yard manure 10 t-ha^{-1} + vermicompost 1.5 t-ha^{-1} + poultry manure 1 t-ha^{-1} [11-13].

Table 1. Effect of Organic manures on growth attributes of Pearl millet

Treatments	Plant height (cm)	Plant dry weight (g)
1. FYM 5t/ha + vermicompost 3t/ha	170.65	33.93
2. FYM 5t/ha + poultry manure 2t/ha	169.74	33.25
3. FYM 5t/ha + vermicompost 1.5t/ha + poultry manure 1t/ha	173.71	43.28
4. FYM 7.5t/ha + vermicompost 3t/ha	171.66	38.11
5. FYM 7.5t/ha + poultry manure 2t/ha	171.09	37.24
6. FYM 7.5t/ha + vermicompost 1.5t/ha + poultry manure 1t/ha	173.89	44.78
7. FYM 10t/ha + vermicompost 3t/ha	172.68	42.24
8. FYM 10t/ha + poultry manure 2t/ha	172.18	40.68
9. FYM 10t/ha + vermicompost 1.5t/ha + poultry manure 1t/ha	174.21	45.67
F-Test	S	S
Sem±	0.28	0.34
CD at 5%	0.85	1.01

Table 2. Effect of organic manures on yield attributes and yield of pearl millet

Treatments	No. of earheads/ m^2	No.of grains/ earhead	Test weight (g)	Grain yield (t/ha)	Straw yield (t/ha)	Harvest index (%)
1. FYM 5t/ha + vermicompost 3t/ha	36.00	1743.33	8.32	2.24	3.35	40.07
2. FYM 5t/ha + poultry manure 2t/ha	37.33	1646.67	8.17	2.18	3.25	40.14
3. FYM 5t/ha vermicompost 1.5t/ha + poultry manure 1t/ha	43.33	1928.67	8.86	2.31	3.59	39.12
4. FYM 7.5t/ha + vermicompost 3t/ha	38.33	1834.67	8.54	2.29	3.48	39.66
5. FYM 7.5t/ha + poultry manure 2t/ha	39.00	1788.00	8.41	2.25	3.44	39.61

Treatments	No. of earheads/ m^2	No.of grains/ earhead	Test weight (g)	Grain yield (t/ha)	Straw yield (t/ha)	Harvest index (%)
6. FYM 7.5t/ha + vermicompost 1.5t/ha + poultry manure 1t/ha	44.33	1947.67	8.95	2.48	3.61	40.98
7. FYM 10t/ha + vermicompost 3t/ha	40.33	1912.67	8.73	2.45	3.54	41.38
8. FYM 10t/ha + poultry manure 2t/ha	41.67	1854.00	8.59	2.35	3.51	40.12
9. FYM 10t/ha + vermicompost 1.5t/ha + poultry manure 1t/ha	44.67	1976.67	9.05	2.59	3.64	41.17
F-Test	S	S	S	S	S	S
Sem±	0.84	23.25	0.04	0.03	0.02	0.18
CD at 5%	2.51	69.71	0.11	0.09	0.05	0.53

4. CONCLUSION

The application of treatment FYM 10 t-ha^{-1} + vermicompost 1.5 t-ha^{-1} + poultry manure 1 t-ha^{-1} was recorded significantly higher grain yield (2.59 t-ha^{-1}), higher gross returns (Rs.1,55,400.00/ha), net returns (Rs.94,600.00/ha) and benefit cost ratio (1.56) as compared to other treatments. Hence the treatment Farm yard manure 10 t-ha^{-1} + vermicompost 1.5 t-ha^{-1} + poultry manure 1 t-ha^{-1} could be recommended for the Eastern U.P conditions.

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COMPETING INTERESTS

Authors have declared that no competing interests exist.

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