Effect of Organic Nutrient Management on Growth and Yield of Foxtail Millet

ABSTRACT

The field experiment was conducted during *ZAID* (Summer) season of 2023 at Crop Research Farm, Department of Agronomy. The treatments consisting of three different organic manures *Viz*., FYM- 8 t/ha, Vermicompost- 2.5 t/ha, Poultry manure- 1.3 t/ha and three different liquid Organic manures vizVermiwash - 5%, Panchagavya - 3%, Jeevamrutha- 500 l/ha. The experiment was laid out in Randomized block design 10 treatments each replicated thrice. Application of Vermicompost- 2.5 t/ha + Panchagavya - 3% (Treatment 5) recorded highest plant height (71.00 cm), maximum plant dry weight (5.54 g), maximum number of tillers/ hill (6.67), length of ears (8.67 cm), number of grains/ear (295.67), test weight (3.37 g), grain yield (1.40 t/ha), straw yield (2.73 t/ha) were recorded in treatment Maximum gross return (INR 78,200.00), net return (INR 53.002.00) and B:C ratio (2.10) were also recorded in same treatment.

Keywords:*Economics, Foxtail millet, growth, organic manures,Panchagavya, Vermicompost, yield.*

INTRODUCTION

Foxtail millet (*Setariaitalica* L.) is known as Italian millet, German millet and Korralu, Kangu, Kangani, Koni and Kaon in different parts of India. It is one of the oldest crops cultivated for food, grain, hay and pasture. It ranks second in the total world production of millets and it continues to have an important place in world agriculture providing food for millions of people in arid and semiarid regions, Sahoo *et al*, (2020). In India, Andhra Pradesh, Karnataka and Tamil Nadu are the major foxtail miller growing states contributing about 79 per cent of the total cultivated area of about 6 lakh hectares with production of 3 lakh tones and productivity of 602 Kg/ha during 2017-2018. It has the total production of 2.29 m t from the area of 1.057 m ha in the world Grace*et al*, (2023)

Foxtail millet boasts an impressive nutritional profile, surpassing rice and wheat in protein, fiber, minerals, and vitamins content. Per 100 grams, it contains 12.3 grams of protein, 60.9 grams of carbohydrates, 4.3 grams of fat, and 8.0 grams of crude fiber, along with 3.1 grams

of calcium and 50 milligrams of thiamin. Additionally, about 8-14% oil can be extracted from its bran, suitable for use after refining. Unlike rice, foxtail millet releases glucose slowly, exhibiting a low glycemic index and minimal impact on metabolism (Grace et al., 2023).

The application of farmyard manure (FYM) enriches soil fertility by enhancing its physical condition and water holding capacity. While chemical fertilizers have gained prominence, FYM remains vital for supplying both macronutrients and micronutrients, thereby improving soil health and sustaining crop productivity (Gowthami et al., 2022).

Vermicompost, produced through the biological degradation of organic wastes by earthworms and microorganisms, offers finely divided peat-like materials with high porosity, aeration, drainage, and water-holding capacity. Its increased surface area facilitates microbial decomposition and nutrient retention. Furthermore, vermicompost tends to maintain near-neutral pH levels, possibly due to CO2 production and organic acid generation during microbial metabolism (Marjan et al., 2013).

Poultry manure stands out for its rich plant nutrient content compared to other organic manures. Its abundance in nitrogen (N) significantly influences cereal crop yield, making it an excellent nutrient source. Combining organic and inorganic fertilizers judiciously ensures long-term soil fertility and sustained productivity levels (Swaroop and Debbarma, 2023).

Vermiwash plays a crucial role in plant growth and development, stimulating rooting, root growth, and overall plant vigor. It enhances crop production by increasing soil organic matter and readily available nutrients. Vermiwash and vermi-protein find extensive use in agro-ecosystems, aquaculture, and poultry farming. Additionally, earthworm coelomic fluid exhibits antibacterial properties, further benefiting plant health. Studies demonstrate that spraying vermiwash on vegetables improves both the quality and quantity of yield significantly (Sundararasu, 2016 not listed in Ref.).

Panchagavya, an eco-friendly remedy derived from cow by-products, is widely utilized in Tamil Nadu agriculture. Its ingredients, including cow dung, urine, milk, curd, ghee, bean flour, and jaggery, are combined to form a potent solution. Panchagavya enhances field crop biological effectiveness and improves fruit and vegetable quality. Modified formulations have been successful in increasing growth regulators, essential plant nutrients, and beneficial

microbes, such as lactic acid bacteria, yeast, and actinomycetes (Kanshouwa and Mehera, 2023).

Jeevamrutha, another organic solution, is rich in nitrogen, potassium, phosphorus, and essential micronutrients crucial for plant growth. It offers pest and disease prevention while promoting beneficial bacteria. Unlike traditional organic manures, jeevamrutha can be prepared within a week, maintaining soil pH, improving aeration, and benefiting all plant types (Bhargavi and Rai, 2022).

MATERIALS AND METHODS

A field trial was conducted during the Rabi season of 2022-2023 at the crop research farm of the Department of Agronomy, Naini Agriculture Institute, Sam Higginbottom University of Agriculture Technology and Sciences (SHUATS), located in Prayagraj, Uttar Pradesh, India. The soil in the experimental plot was sandy loam, with a nearly neutral pH of 7.3 and moderate levels of available nitrogen, phosphorus, and potassium. The experiment followed a Randomized Block Design with 10 treatments, each replicated thrice.The treatments included:T1: Farmyard Manure (FYM) - 8 t/ha + Vermiwash - 5%, T2: FYM - 8 t/ha + Panchagavya - 3%, T3: FYM - 8 t/ha + Jeevamrutha - 500 l/ha, T4: Vermicompost - 2.5 t/ha + Vermiwash - 5%, T5: Vermicompost - 2.5 t/ha + Panchagavya - 3%, T6: Vermicompost - 2.5 t/ha + Jeevamrutha - 500 l/ha, T7: Poultry manure - 1.3 t/ha + Vermiwash - 5%, T8: Poultry manure - 1.3 t/ha + Panchagavya - 3%, T9: Poultry manure - 1.3 t/ha + Jeevamrutha - 500 l/ha, T10: Control (Water spray)Observations were recorded for various parameters including plant height (cm), dry weight (g), number of tillers, crop growth rate (g/m2/day), relative growth rate (g/g/day), number of ears per plant, length of ears (cm), number of grains per ear, test weight (g), grain yield (t/ha), stover yield (t/ha), and harvest index (%). Statistical analysis was performed using the analysis of variance method (Gomez and Gomez, 1976 not listed in Ref.).

RESULT AND DISCUSSION

GROWTH PARAMETERS

Plant height: At 60 days after sowing (DAS), the treatment combining Vermicompost at a rate of 2.5 t/ha with Panchagavya at 3% exhibited the highest plant height, measuring 71.00 cm. The application of vermicompost likely contributed to increased soil nutrient availability,

promoting cell division and elongation, thereby facilitating greater shoot growth. This improvement in soil properties and prolonged nutrient availability throughout the crop growth period likely contributed to the observed increase in plant height. Additionally, the foliar application of Panchagavya might have stimulated the production of growth-promoting substances, further enhancing plant height. Similar findings have been reported by Aparna et al. (2019) and Ashokh et al. (2020).

Plant dry weight: At 60 days after sowing (DAS), the treatment combining Vermicompost at a rate of 2.5 t/ha with Panchagavya at 3% demonstrated significantly the highest plant dry weight per plant, measuring 5.54 g. The direct uptake of nutrients by their target organs likely triggered a specific and rapid response, particularly increasing nitrogen content in the plant system. This could have led to enhanced synthesis of amino acids and nucleic acids in meristematic tissues, facilitating greater absorption, assimilation, translocation, and metabolism of nutrients. Consequently, increased cell division and multiplication occurred, resulting in the accumulation of more dry matter in the plants and promoting higher growth and development. Similar results have been reported by Chetan et al. (2022).

Number of tillers:At 60 days after sowing (DAS), the treatment combining Vermicompost at a rate of 2.5 t/ha with Panchagavya at 3% showed significantly the highest number of tillers per plant, reaching 6.67. However, treatments involving Vermicompost at 2.5 t/ha combined with Jeevamrutha at 500 l/ha (6.13), Poultry manure at 1.3 t/ha with Vermiwash at 5% (6.40), Poultry manure at 1.3 t/ha with Panchagavya at 3% (6.33), and the control (6.33) were statistically similar to Vermicompost at 2.5 t/ha combined with Panchagavya at 3%.The combination of vermicompost and Panchagavya spray likely increased the availability of both macro and micronutrients and harboured a high microbial load, including methylotrophic profile bacteria and effective microorganisms. This microbial composition could have enhanced the production of phytohormones such as auxins and gibberellins, resulting in better nutrient availability and ultimately leading to improved tillering. Similar observations have been reported by Priya and Sathyamoothi (2019) and Mushar et al. (2023)

Yield attributes

Length of ears: At 60 days after sowing (DAS), the treatment combining Vermicompost at a rate of 2.5 t/ha with Panchagavya at 3% demonstrated the significantly longest ear length, measuring 8.30 cm. This could be attributed to the effective utilization of growth resources due to improved availability and translocation of plant nutrients, along with the combined beneficial effects of earthworms and microorganisms. These factors likely increased the supply of plant hormones and essential nutrients, ultimately leading to enhanced ear length. Similar findings have been reported by Manoj et al. (2018).

Grains/ear: the treatment involving Vermicompost at 2.5 t/ha combined with Panchagavya at 3% showed the significantly highest number of seeds per ear, recording 295.67. Vermicompost provided continuous nutrient availability throughout the crop growth stages, while Panchagavya improved photosynthetic activity, leading to increased grain quality. These factors likely contributed to the superior grain yield observed. Bandita et al. (2022) have also reported similar observations.

Test weight: the treatment Vermicompost at 2.5 t/ha combined with Panchagavya at 3% recorded the significantly highest test weight of 3.37 g. This could be attributed to Panchagavya's rich source of beneficial microorganisms, enhancing nutrient availability and translocation, ultimately resulting in superior yield attributes. Monisha et al. (2019) and Priya and Sathyamoorthi (2019) have reported similar findings.

Grain yield: the treatment Vermicompost at 2.5 t/ha combined with Panchagavya at 3% showed the significantly highest seed yield of 1.40 t/ha. This could be attributed to the high nutrient content, growth-promoting substances, and increased rhizosphere microbial population provided by Vermicompost and Panchagavya. These factors likely led to better vegetative growth, increased grain number and weight, and ultimately higher grain yield. Similar observations have been reported by Raviraja et al. (2020), Ashokh et al. (2020), and Subha et al. (2014).

Stover yield: the treatment Vermicompost at 2.5 t/ha combined with Panchagavya at 3% recorded the significantly highest stover yield of 2.73 t/ha. This could be attributed to the influence of Vermicompost and Panchagavya on nutrient availability and soil physical condition, promoting better vegetative growth and dry matter accumulation. Similar findings have been reported by Raviraja et al. (2020) and Jothi et al. (2021) in rice.

Harvest index: the treatment Vermicompost at 2.5 t/ha combined with Panchagavya at 3% showed the significantly highest harvest index of 33.91%. This increase in harvest index could be due to enhanced translocation of photosynthates from source to sink compared to other treatments. Similar observations have been reported by Manoj et al. (2018).

Economic

The cost of cultivation (39950.00 INR/ha) was found to be highest inVermicompost- 2.5 t/ha + Jeevamrutha- 500 l/ha.

Gross returns: Significantly higher gross return (78200.00 INR/ha) was recorded with treatment Vermicompost- 2.5 t/ha + Panchagavya - 3%.

Net returns: Significantly higher net return (53002.00 INR/ha) was recorded under treatments Vermicompost- 2.5 t/ha + Panchagavya - 3%

Benefit-cost ratio: Significantly higher benefit-cost ratio (2.10) was recorded under treatment treatments Vermicompost- 2.5 t/ha + Panchagavya - 3%.

CONCLUSION

It is concluded that the application of Vermicompost- 2.5 t/ha + Panchagavya - 3%(Treatment 5) has recorded highest plant height, maximum dry weight, no of tillers, length of ears, no of grains/ear, grain yield, stover yield and benefit cost ratio in foxtail millet.

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Table :1. Effect of soil and foliar organics on growth attributes of foxtail millet

S. No	Treatments	Plantheight	Dry weight	No. of tillers
1.	FYM- 8 t/ha + Vermiwash - 5%	54.37	4.95	5.93
2.	FYM- 8 t/ha + Panchagavya - 3%	55.67	4.91	5.13
3.	FYM- 8 t/ha + Jeevamrutha- 500 l/ha	56.03	5.04	5.60
4.	Vermicompost- 2.5 t/ha + Vermiwash - 5%	57.00	5.00	5.67
5.	Vermicompost- 2.5 t/ha + Panchagavya - 3%	71.00	5.54	6.67
6.	Vermicompost- 2.5 t/ha + Jeevamrutha- 500 l/ha	63.00	4.97	6.13
7.	Poultry manure- 1.3 t/ha + Vermiwash - 5%	60.00	4.83	6.40
8.	Poultry manure- 1.3 t/ha + Panchagavya - 3%	62.33	4.91	6.33
9.	Poultry manure- 1.3 t/ha + Jeevamrutha - 500 l/ha	61.33	4.88	6.33
10.	Control (Water spray)	62.00	5.02	5.53
	S. Em (±)	1.97	0.10	0.30
	CD (p = 0.05)	5.88	0.32	0.91

Table:2.Effect of soil and foliar organics on yield attributes and yield of foxtail millet

S. No	Treatment combinations	Length of ear (Cm)	No. of grains/ear (No.)	Test weight (g)	Grain yield (t/ha)	Stover yield (t/ha)	Harvest index (%)
1.	FYM- 8 t/ha + Vermiwash - 5%	7.63	229.33	3.20	0.92	2.45	27.35
2.	FYM- 8 t/ha + Panchagavya - 3%	7.93	228.00	3.00	0.97	2.26	30.11
3.	FYM- 8 t/ha + Jeevamrutha- 500 l/ha	8.03	243.00	3.03	1.23	2.66	31.61
4.	Vermicompost- 2.5 t/ha + Vermiwash - 5%	8.07	245.33	3.03	1.08	2.43	30.85
5.	Vermicompost- 2.5 t/ha + Panchagavya - 3%	8.67	295.67	3.37	1.40	2.73	33.91
6.	Vermicompost- 2.5 t/ha + Jeevamrutha- 500 l/ha	8.30	239.00	3.00	1.23	2.41	33.76
7.	Poultry manure- 1.3 t/ha + Vermiwash - 5%	8.07	233.67	2.97	0.90	2.17	29.32
8.	Poultry manure- 1.3 t/ha + Panchagavya - 3%	8.20	234.00	3.03	0.95	1.97	32.58
9.	Poultry manure- 1.3 t/ha + Jeevamrutha - 500 l/ha	8.03	241.33	2.93	0.96	2.68	26.33
10.	Control (Water spray)	7.90	172.33	2.97	0.72	1.93	26.97

	SEm (±)	0.09	3.94	0.05	0.05	0.06	1.20
	CD (p=0.05)	0.28	11.73	0.16	0.17	0.20	3.56

S.no	Treatment combination	Cost of cultivation (INR/ha)	Gross returns (INR/ha)	Net returns (INR/ha)	B:C ratio

*Data not subjected to statistical analysis

Table 3.**Effect of soil and foliar organics on economics of foxtail millet**

1.	FYM- 8 t/ha + Vermiwash - 5%	19730.00	57880.00	38150.00	1.93
2.	FYM- 8 t/ha + Panchagavya - 3%	19698.00	57966.67	38268.67	1.94
3.	FYM- 8 t/ha + Jeevamrutha- 500 l/ha	34450.00	71400.00	36950.00	1.07
4.	Vermicompost- 2.5 t/ha + Vermiwash - 5%	25230.00	63550.00	38320.00	1.52
5.	Vermicompost- 2.5 t/ha + Panchagavya - 3%	25198.00	78200.00	53002.00	2.10
6.	Vermicompost- 2.5 t/ha + Jeevamrutha- 500 l/ha	39950.00	69033.33	29083.33	0.73
7.	Poultry manure- 1.3 t/ha + Vermiwash - 5%	18730.00	54250.00	35520.00	1.90
8.	Poultry manure- 1.3 t/ha + Panchagavya - 3%	18698.00	54190.00	35492.00	1.90
9.	Poultry manure- 1.3 t/ha + Jeevamrutha - 500 l/ha	33450.00	61556.67	28106.67	0.84
10.	Control (Water spray)	15450.00	45316.67	29866.67	1.93