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Effect of vermicompost and panchagavya on growth and yield of pearl millet (*Pennisetum glaucum*)

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Abstract

The present investigation entitled “Effect of vermicompost and panchagavya on growth and yield of Pearl millet” was conducted during June–September 2023 at the (SMOF), Central Research Farm, Department of Agronomy, Naini Agricultural Institute, Sam Higginbottom University of Agriculture Technology and Sciences, Prayagraj (Uttar Pradesh) Which was carried out in Statistical Design adopted for the experiment was Randomized Block Design (RBD) with three replications twelve treatments combinations. The result of present investigation shows that the treatment T₁₂ (Vermicompost 6 t/ha + Panchagavya 6%) outstands in all the aspects with significant results in growth and yield of pearl millet. Parameters like Plant height (121.70 cm), Plant Dry weight (55.14 g), Crop Growth Rate (13.14 g/m²/day), Relative Growth Rate (0.01205 g/g/day), Ear head length (18.88 cm), Number of grains/heads (1908.48), Test weight (8.64 g), Grain yield (3.19 t/ha), Stover yield (5.89 t/ha), Harvest Index (39.53%). Which was followed by T₉ (Vermicompost 4 t/ha + Panchagavya 6%). The lowest observation was recorded in T₁ (Control + Panchagavya 2%). Treatment with vermicompost and panchagavya improves growth and yield of Pearl Millet to a lesser extent as compared to the control.

Keywords: Vermicompost, panchagavya, pearl millet

Introduction

Pearl millet belongs to Gramineae family. The common name of pearl millet is Bajri in Gujarati and Bajra in Hindi. Millet is a group of small-grained cereal grown around the world for food & fodder. Millet is short day, warm weather plant and it is well adopted & cultivated under harsh environment of arid and semi-arid regions. It is highly nutritious cereal with high levels of metabolizable energy, protein (9 to 15%), fat (5%) and mineral (2 to 7%). Pearl millet is the sixth most important and widely grown potential cereal crop in the world and is the fourth in India, after rice, wheat and maize (Mushar *et al.*, 2023) ^[7]

In India, millets are produced in most of the states characterized by low to moderate precipitation (200–800 mm rainfall). An important staple cereal crop for millions of smallholder dryland farmers across Sub-Saharan Africa and Asia, millets offer nutrition, resilience, income and livelihood for farmers. They have multiple untapped uses such as food, feed, fodder, biofuels and brewing. Therefore, millets are Smart Food as they are good for consumers, good for the farmer and good for the Planet.

Vermicompost has now been advocated as good organic manure for use in integrated management practices in the field crops. Use of vermicompost as a biofertilizer and substitute for chemical fertilizers is advised by pioneers of organic farming. It was also thought that yearly application of this manure would encourage earthworm in a great and sufficient numbers. Vermicompost has approximately double the amount of nutrients as compared to FYM which improves physical and chemical properties of soil. Vermicompost improves the physical and biological properties of soil including supply of almost all that essential plant nutrients for the growth and development of plant, ultimately increased the plant height and number of effective tillers per meter row length. Vermicompost and fertility level influenced the grain weight per ear head of the Bajri crop.

Panchagavya, an organic product is the potential source to play the role for promoting growth and providing immunity in plant system.

Panchagavya is a bio promoter with a combination of five products obtained from the cow viz., cow dung, cow urine, cow milk, cow curd and cow ghee. Cow urine is a good source of nitrogen to the growth; however, its excess application to soil needs monitoring to avoid salinity and its effect on soil microflora. Cow dung which is used in most of the liquid organic manure preparations is a good source of organic matter and encourages microbial population. Milk products like curd, butter and ghee which are generally used in most of the liquid organic manures encourages variety of beneficial microorganisms during fermentation process. Panchagavya acts as growth promoter (75%) and immunity booster (25%) and exactly fills the missing link to sustain the organic farming without any field loss. Biochemical properties of Panchagavya revealed that it contains macro elements like N, P, K and micronutrients Fe, Mn and Zn. However, growth promoting substance like, IAA and GA present in Panchagavya required for crop growth as well as the predominance of fermentative microorganisms like yeast, Azotobacter, phosphobacteria and Lactobacillus. Role of foliar application or seed soaking of Panchagavya in production of many plantation crops had been well documented in India.

Materials and Methods

Experimental sites and soil

The site of the investigation comes under subtropical zone located at Central Research Farm, Department of Agronomy, Naini Agricultural Institute, Sam Higginbottom University of

Agriculture Technology and Sciences, Prayagraj (Uttar Pradesh) during the year 2022-2024.

Treatments used for the experiment

Factor 1: Levels of Vermicompost

- Control
- Vermicompost 2 t/ha
- Vermicompost 4 t/ha
- Vermicompost 6 t/ha

Factor 2: Panchagavya (Foliar application)

- Panchagavya 2%
- Panchagavya 4%
- Panchagavya 6%

The experiment was laid out in Randomized block design in three replication. The treatment was laid in the treatments (T₁) Control + Panchagavya 2%, (T₂) Control + Panchagavya 4%, (T₃) Control + Panchagavya 6%, (T₄) Vermicompost 2 t/ha + Panchagavya 2%, (T₅) Vermicompost 2 t/ha + Panchagavya 4%, (T₆) Vermicompost 2 t/ha + Panchagavya 6%, (T₇) Vermicompost 4 t/ha + Panchagavya 2%, (T₈) Vermicompost 4 t/ha + Panchagavya 4%, (T₉) Vermicompost 4 t/ha + Panchagavya 6%, (T₁₀) Vermicompost 6 t/ha + Panchagavya 2%, (T₁₁) Vermicompost 6 t/ha + Panchagavya 4%, (T₁₂) Vermicompost 6 t/ha + Panchagavya 6% each treatment carried out in three plot, total 36 plots also shown in table 1 given below:

Table 1: Each treatment carried out in three plot, total 36 plots also shown

Symbols	Treatment Details
1	Control + Panchagavya 2%
2	Control + Panchagavya 4%
3	Control + Panchagavya 6%
4	Vermicompost 2 t/ha + Panchagavya 2%
5	Vermicompost 2 t/ha + Panchagavya 4%
6	Vermicompost 2 t/ha + Panchagavya 6%
7	Vermicompost 4 t/ha + Panchagavya 2%
8	Vermicompost 4 t/ha + Panchagavya 4%
9	Vermicompost 4 t/ha + Panchagavya 6%
10	Vermicompost 6 t/ha + Panchagavya 2%
11	Vermicompost 6 t/ha + Panchagavya 4%
12	Vermicompost 6 t/ha + Panchagavya 6%

Observation Recorded

1. Plant height (cm)

For calculating the height of plant randomly 5 plants From each Plot were selected and then height was measured from the ground level with the help of measuring tape at days 20, 40, 60 and 80 after Sowing which was measured in cm.

2. Plant Dry weight (g)

For calculating the Dry weight of plant randomly 5 plants From each Plot were selected and then Weight was measured with the help of weighting balance at days 20, 40, 60 and 80 after Sowing which was measured in gram.

3. Crop Growth Rate (g/m²/day)

It represents dry weight gained by a unit area of crop in a unit time expressed as g/m²/day. The values of plant dry weight at 0-20, 20-40, 40-60 and 60-80 intervals were used for calculating the CGR. The value of CGR is expressed in (g/m²/day).

$$CGR = \frac{W_2 - W_1}{S (t_2 - t_1)}$$

Where

W₁ and W₂ were the dry matter weights per unit ground area at time T₁ and T₂, respectively S was spacing.

4. Relative Growth Rate (g/g/day)

The relative growth rate (RGR) indicates the amount of growth per unit dry weight of plant per unit time. It is expressed as g/g/day (Williams, 1946) ^[9] of existing dry matter in a day. The values were computed between 20-40, 40-60 and 60-80 DAS. The RGR was worked out with the help of following formula following formula:

$$RGR = \frac{\log_e W_2 - \log_e W_1}{t_2 - t_1}$$

Where

Loge W1 and Loge W2 are the natural logarithm of total dry weight of plant at the time interval T₂ and T₁, respectively

5. Ear head length (cm)

The length of head measured with the help of measuring scale by selecting 5 random head, this is measured from the neck of the millet up to tip of head. It is measured in cm.

6. Number of grains/heads

The number of grain means how much grains are present in each head on millet, these were counted by selected random heads which were 5 in numbers.

7. Test weight (g)

The weight of 1000 seeds is a test weight. One thousand grains were randomly counted from panicles obtained from each plot and weighed and recorded as test weight (g).

8. Grain yield (t/ha)

Five plants were selected randomly from each plot and tagged. The average grain yield (g) of this plant was recorded.

9. Stover yield (t/ha)

After removing the grain yield all leftover of the plant as organic part weighted together in tonnes, this were collected by making bundles.

10: Harvest Index (%)

$$\text{Harvest index (\%)} = \frac{\text{Economic yield (kg/ha)}}{\text{Biological yield (kg/ha)}} \times 100$$

Result and Discussion

Plant height (cm)

It is expressed through the layout of the table 2 that there was significant effect of Vermicompost and Panchagavya with various treatments on Plant height except 20 DAS. At 20 DAS the maximum (8.97) height was recorded in T₁₂ Vermicompost 6 t/ha + Panchagavya 6% was followed by T₁₁ (8.95) Vermicompost 6 t/ha + Panchagavya 4%. Whereas, the minimum (8.30) Height was recorded in T₅ Vermicompost 2 t/ha + Panchagavya 4%. At 40 DAS the maximum (37.12) height was recorded in T₁₂ Vermicompost 6 t/ha + Panchagavya 6% was followed by T₉ (35.91) Vermicompost 4 t/ha + Panchagavya 6%. Whereas, the minimum (31.08) Height was recorded in T₅ Control + Panchagavya 2%. At 60 DAS the maximum (86.24) height was recorded in T₁₂ Vermicompost 6 t/ha + Panchagavya 6% was followed by T₉ (83.89) Vermicompost 4 t/ha + Panchagavya 6%. Whereas, the minimum (72.51) Height was recorded in T₁ Control + Panchagavya 2%. At 80 DAS the maximum (121.70) height was recorded in T₁₂ Vermicompost 6 t/ha + Panchagavya 6% was followed by T₉ (119.38) Vermicompost 4 t/ha + Panchagavya 6%. Whereas, the minimum (100.53) Height was recorded in T₁ Control + Panchagavya 2%.

Plant Dry weight

It is expressed through the layout of the table 2 that there was significant effect of Vermicompost and Panchagavya with various treatments on Plant Dry weight Except 20 DAS. At 20 DAS the maximum (3.64) dry weight was recorded in T₁₂ Vermicompost 6 t/ha + Panchagavya 6% was followed by T₇

(3.16) Vermicompost 4 t/ha + Panchagavya 2%. Whereas, the minimum (2.48) Dry weight was recorded in T₁ Control + Panchagavya 2%. At 40 DAS the maximum (21.04) dry weight was recorded in T₁₂ Vermicompost 6 t/ha + Panchagavya 6% was followed by T₈ (19.52) Vermicompost 4 t/ha + Panchagavya 4%. Whereas, the minimum (16.43) Dry weight was recorded in T₁ Control + Panchagavya 2%. At 60 DAS the maximum (43.32) dry weight was recorded in T₁₂ Vermicompost 6 t/ha + Panchagavya 6% was followed by T₉ (38.95) Vermicompost 4 t/ha + Panchagavya 6%. Whereas, the minimum (33.17) Dry weight was recorded in T₁ Control + Panchagavya 2%. At 80 DAS the maximum (55.14) dry weight was recorded in T₁₂ Vermicompost 6 t/ha + Panchagavya 6% was followed by T₉ (53.88) Vermicompost 4 t/ha + Panchagavya 6%. Whereas, the minimum (43.79) Dry weight was recorded in T₁ Control + Panchagavya 4%.

Crop Growth Rate (CGR)

It is expressed through the layout of the table 2 that there was Non-significant effect of Vermicompost and Panchagavya with various treatments on CGR Except 40-60 DAS. At 0-20 DAS the maximum (4.05) CGR was recorded in T₁₂ Vermicompost 6 t/ha + Panchagavya 6% was followed by T₇ (3.52) Vermicompost 4 t/ha + Panchagavya 2%. Whereas, the minimum (2.76) CGR was recorded in T₁ Control + Panchagavya 2%. At 20-40 DAS the maximum (19.33) CGR was recorded in T₁₂ Vermicompost 6 t/ha + Panchagavya 6% was followed by T₈ (18.58) Vermicompost 4 t/ha + Panchagavya 4%. Whereas, the minimum (15.50) CGR was recorded in T₁ Control + Panchagavya 2%. At 40-60 DAS the maximum (26.62) CGR was recorded in T₉ Vermicompost 4 t/ha + Panchagavya 6% was followed by T₄ (26.05) Vermicompost 2 t/ha + Panchagavya 2%. Whereas, the minimum (18.60) CGR was recorded in T₁ Control + Panchagavya 2%. At 60-80 DAS the maximum (15.63) CGR was recorded in T₇ Vermicompost 4 t/ha + Panchagavya 2% was followed by T₁₂ (13.14) Vermicompost 6 t/ha + Panchagavya 6%. Whereas, the minimum (8.12) CGR was recorded in T₄ Vermicompost 2 t/ha + Panchagavya 2%.

Relative Growth Rate (RGR)

It is expressed through the layout of the table 2 that there was Non-significant effect of Vermicompost and Panchagavya with various treatments on RGR 0-20, 40-60, 60-80 DAS. At 20-40 DAS the maximum (0.09744) RGR was recorded in T₆ Vermicompost 2 t/ha + Panchagavya 6% was followed by T₈ (1.67) Vermicompost 4 t/ha + Panchagavya 4%. Whereas, the minimum (0.08653) RGR was recorded in T₂ Control + Panchagavya 4%. At 40-60 DAS the maximum (0.04276) RGR was recorded in T₄ Vermicompost 2 t/ha + Panchagavya 2% was followed by T₉ (0.04157) Vermicompost 4 t/ha + Panchagavya 6%. Whereas, the minimum (0.03350) RGR was recorded in T₇ Vermicompost 4 t/ha + Panchagavya 2%. At 60-80 DAS the maximum (0.01659) RGR was recorded in T₇ Vermicompost 4 t/ha + Panchagavya 2% was followed by T₅ (0.01329) Vermicompost 2 t/ha + Panchagavya 4%. Whereas, the minimum (0.00815) RGR was recorded in T₄ Vermicompost 2 t/ha + Panchagavya 2%.

Ear head Length (cm)

It is expressed through the layout of the table 3 that there was significant effect of Vermicompost and Panchagavya with various treatments on Ear head length. However, the maximum (18.88) Ear head length was recorded in T₁₂ Vermicompost 6

t/ha + Panchagavya 6% was followed by T₉ (17.84) Vermicompost 4 t/ha + Panchagavya 6%. Whereas, the minimum (14.12) Ear head length was recorded in T₁ Control + Panchagavya 2%.

Grains per Ear head

It is expressed through the layout of the table 3 that there was significant effect of Vermicompost and Panchagavya with various treatments on Grains per Ear. However, the maximum (1908.48) Grains per Ear was recorded in T₁₂ Vermicompost 6 t/ha + Panchagavya 6% was followed by T₉ (1766.22) Vermicompost 4 t/ha + Panchagavya 6%. Whereas, the minimum (1.42) Grains per Ear was recorded in T₁ Control + Panchagavya 2%.

Test Weight (g)

It is expressed through the layout of the table 3 that there was significant effect of Vermicompost and Panchagavya with various treatments on Test weight (g). However, the maximum (8.64) Test weight was recorded in T₁₂ Vermicompost 6 t/ha + Panchagavya 6% was followed by T₉ (8.30) Vermicompost 4 t/ha + Panchagavya 6%. Whereas, the minimum (5.93) Test weight was recorded in T₁ Control + Panchagavya 2%.

Seed Yield (t/ha)

It is expressed through the layout of the table 3 that there was

significant effect of Vermicompost and Panchagavya with various treatments on Seed Yield. However, the maximum (3.19) Seed Yield was recorded in T₁₂ Vermicompost 6 t/ha + Panchagavya 6% was followed by T₉ (8.30) Vermicompost 4 t/ha + Panchagavya 6%. Whereas, the minimum (1.71) Seed Yield was recorded in T₁ Control + Panchagavya 2%.

Stover yield (t/ha)

It is expressed through the layout of the table 3 that there was significant effect of Vermicompost and Panchagavya with various treatments on Stover yield. However, the maximum (5.89) Stover yield was recorded in T₁₂ Vermicompost 6 t/ha + Panchagavya 6% was followed by T₉ (5.65) Vermicompost 4 t/ha + Panchagavya 6%. Whereas, the minimum (4.21) Stover yield was recorded in T₁ Control + Panchagavya 2%.

Harvest Index (%)

It is expressed through the layout of the table 3 that there was Non-significant effect of Vermicompost and Panchagavya with various treatments on Harvest index. However, the maximum (39.53) Harvest Index was recorded in T₁₂ Vermicompost 6 t/ha + Panchagavya 6% was followed by T₅ (39.38) Vermicompost 2 t/ha + Panchagavya 4%. Whereas, the minimum (35.18) Harvest Index was recorded in T₇ Vermicompost 4 t/ha + Panchagavya 2%.

Table 2: Effect of vermicompost and Panchagavya on Pearl Millet

TR.	Plant height (cm)				Plant dry weight (g)				Crop Growth Rate (g/m ² /day)				Relative Growth Rate (g/g/day)		
	20 DAS	40 DAS	60 DAS	80 DAS	20 DAS	40 DAS	60 DAS	80 DAS	0-20 DAS	20-40 DAS	40-60 DAS	60-80 DAS	20-40 DAS	40-60 DAS	60-80 DAS
T ₁	8.53	31.08	72.51	100.53	2.48	16.43	33.17	43.79	2.76	15.50	18.60	11.79	0.09485	0.03503	0.01396
T ₂	8.94	31.90	77.56	104.39	3.05	17.13	35.56	44.79	3.39	15.65	20.47	10.26	0.08653	0.03655	0.01152
T ₃	8.85	32.97	80.37	107.21	2.92	18.05	38.45	49.31	3.24	16.82	22.66	12.07	0.09125	0.03773	0.01257
T ₄	8.65	32.69	77.45	108.64	2.83	17.35	40.79	48.09	3.15	16.13	26.05	8.12	0.09067	0.04276	0.00815
T ₅	8.30	34.44	77.93	111.43	3.02	18.64	37.82	49.44	3.35	17.36	21.31	12.91	0.09140	0.03548	0.01329
T ₆	8.79	32.71	76.57	109.88	2.65	18.54	39.12	46.78	2.95	17.66	22.86	8.52	0.09744	0.03724	0.00901
T ₇	8.37	34.51	76.09	109.30	3.16	18.18	35.47	49.53	3.52	16.68	19.22	15.63	0.08738	0.03350	0.01659
T ₈	8.86	33.33	78.93	109.02	2.80	19.52	39.22	47.05	3.11	18.58	21.89	8.70	0.09712	0.03485	0.00914
T ₉	8.75	35.91	83.89	119.38	2.89	18.52	42.48	53.88	3.21	17.37	26.62	12.67	0.09353	0.04157	0.01194
T ₁₀	8.79	34.25	77.83	111.65	2.87	18.55	38.71	49.03	3.19	17.43	22.41	11.46	0.09375	0.03685	0.01176
T ₁₁	8.95	33.51	78.22	112.63	3.10	18.53	38.64	48.83	3.44	17.15	22.34	11.32	0.08936	0.03681	0.01175
T ₁₂	8.97	37.12	86.24	121.70	3.64	21.04	43.32	55.14	4.05	19.33	24.75	13.14	0.08778	0.03611	0.01205
F test	NS	S	S	S	NS	S	S	S	NS	NS	S	NS	NS	NS	NS
S.Em	0.33	1.11	2.37	3.25	0.22	0.71	1.39	1.78	0.24	0.79	1.63	2.33	0.00392	0.00245	0.00241
CD	--	3.25	6.96	9.53	---	2.09	5.22	5.22	---	---	4.78	---	---	---	---

Table 3: Effect of vermicompost and Panchagavya on Pearl Millet

TR	Ear head Length (cm)	Grains/Ear head	Test Weight (g)	Seed yield (t/ha)	Stover yield (t/ha)	Harvest Index (%)
T ₁	14.12	1203.99	5.93	1.71	4.21	36.09
T ₂	14.24	1477.50	6.50	1.81	4.78	37.13
T ₃	15.37	1314.76	7.34	2.12	5.11	37.87
T ₄	16.29	1528.73	7.11	2.01	5.09	37.23
T ₅	15.57	1552.68	6.96	2.15	4.80	39.38
T ₆	15.56	1679.60	6.87	2.26	5.15	37.03
T ₇	15.80	1437.78	6.97	1.99	5.10	35.18
T ₈	16.47	1551.29	7.21	2.06	4.69	38.25
T ₉	17.84	1766.22	8.30	2.85	5.65	39.21
T ₁₀	16.05	1522.54	7.22	2.12	4.66	37.35
T ₁₁	16.47	1521.60	7.24	2.23	4.95	36.88
T ₁₂	18.88	1908.48	8.64	3.19	5.89	39.53
F test	S	S	S	S	S	NS
S.Em	0.72	100.04	0.42	0.26	0.24	1.64
CD	2.12	293.40	1.23	0.78	0.70	---

Conclusion

Following the results above, it came to be that treatment with in T₁₂ Vermicompost 6 t/ha + Panchagavya 6% recorded as the best treatment in terms of Growth and Yield of Pearl millet. For Vermicompost and Panchagavya application in Pearl millet, this treatment believed to be most suitable in this region which is economic with a benefit cost ratio of (2.04).

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