E-ISSN: 2618-0618
P-ISSN: 2618-060X

www.agronomyjournals.com
2024; 7(8): 102-105
Received: 26-05-2024
Accepted: 28-06-2024

Kurkutiya SR
M.Sc. Student, Department of Agronomy, BACA, AAU, Anand, Gujarat, India

Raval CH
Assistant Professor, Department of Natural Resource Management, College of Horticulture, Anand Agricultural University, Anand, Gujarat, India

Patel HK
Assistant Research Scientist, MFRS, AAU, Anand, Gujarat, India

Chavda K
M.Sc. Student, Department of Agronomy, BACA, AAU, Anand, Gujarat, India

Patel AJ
M.Sc. Student, Department of Agronomy, BACA, AAU, Anand, Gujarat, India

Corresponding Author:
Raval CH
Assistant Professor, Department of Natural Resource Management, College of Horticulture, Anand Agricultural University, Anand, Gujarat, India

Effect of different organic sources on growth, yield and economics of kodo millet (*Paspalum scrobiculatum* L.)

Kurkutiya SR, Raval CH, Patel HK, Chavda K and Patel AJ

DOI: https://doi.org/10.33545/2618060X.2024.v7.i8b.1194

Abstract
A field experiment was carried out during *kharif* season of 2023 at College Agronomy Farm, B. A. College of Agriculture, Anand Agricultural University, Anand to study the effect of different organic sources on growth and yield of kodo millet under organic condition. The experiment was conducted in Randomized Block Design with 3 replication and 10 treatments *viz.*, Absolute control (T_1), seed treatment of Bio NPK consortium (5.0 ml/kg) *fb* soil drenching at 30 and 45 DAS (1.0 L/ha) (T_2), 100% N through FYM (T_3), 100% N through vermicompost (T_4), 100% N through castor cake (T_5), 100% N through neem cake (T_6), 75% N through FYM *fb* soil drenching of Bio NPK consortium (1.0 L/ha) at 30 and 45 DAS (T_7), 75% N through vermicompost *fb* soil drenching of Bio NPK consortium (1.0 L/ha) at 30 and 45 DAS (T_8), 75% N through castor cake *fb* soil drenching of Bio NPK consortium (1.0 L/ha) at 30 and 45 DAS (T_9), 75% N through neem cake *fb* soil drenching of Bio NPK consortium (1.0 L/ha) at 30 and 45 DAS (T_{10}), (Seed treatment of Bio NPK consortium @ 5 ml/kg was given in treatments T_7, T_8, T_9 and T_{10}). According to results, Seed treatment of Bio NPK consortium (5 ml/kg) + application of 75% nitrogen through castor cake *fb* Bio NPK consortium as soil application (1 L/ha) at 30 and 45 DAS, recorded higher values of growth parameters, yield attributing parameters and yield of kodo millet as compared to absolute control (T_1).

Keywords: Kodo millet, bio NPK consortium, FYM, vermicompost, castor cake, neem cake

Introduction
Kodo millet (*Paspalum scrobiculatum* L.), is indigenous to India, and it is said to have been domesticated about 3000 years ago. (Rawat *et al*., 2021) [1]. This cereal is well known as 'varagu' in Tamil and 'kodo' in Hindi. Throughout the world's tropics and sub tropics, the species is extensively dispersed and found in moist habitats. *Paspalum scrobiculatum var. scrobiculatum* is grown as a significant crop in India, while *Paspalum scrobiculatum var. commersonii* is the wild variety native to Africa. The old-world tropical regions are home to kodo millet. (Joshi *et al*., 2021) [2]. In India, kodo millet is primarily grown in the states of Madhya Pradesh, Chhattisgarh, Maharashtra, Tamil Nadu and Karnataka. It is grown in Arunachal Pradesh's *Jhum* field as well as it has good adaptation to sub tropical and tropical climates. The crop yields varying from 250 to 1000 kg/ha and matures in 4-6 months. (Cheruku *et al.*, 2023) [3]. This crop exhibits resilience to climate change and is hardy, drought-resistant, and able to grow on marginal soils. It also affected by abiotic stresses, though it is better adapted to abiotic stresses than most other cereals (Mundada *et al*., 2022) [4]. Adoption of organic farming is essential to avoid chemical-based pesticides and fertilizers. In contrast to conventional farming, organic farming may increase the nutritious value of meals and food products. However, chemicals may leave residues in foods and products that could have disastrous effects on human health and the environment. Various methods that can enhance soil fertility organically, include using bio-fertilizers, organic manures, etc. Organic manures refer to natural components used by farmers to provide nutrients to crop plants. Various forms of organic manure exist, including green manures, FYM, vermicompost, compost manures and oil cakes, etc., which improves the soil's organic matter, water-holding capacity and drainage (Bhujel *et al*., 2023) [5]. Keeping in view the above facts, the present study was carried out on "Effect of different organic sources on growth and yield of kodo millet".

Materials and Methods

The field experiment was carried out during *kharif* of 2023 at College Agronomy Farm, B. A. College of Agriculture, Anand Agricultural University, Anand, Gujarat (22°35′ North latitude, 72°56′ East longitude and 45.1 m above mean sea level). The soil at the trial location was loamy sand in texture, low in organic carbon (0.39%) and available nitrogen (188 kg/ha), medium in available phosphorus (45 kg/ha) and potassium (239 kg/ha) and slightly alkaline (pH: 7.34) in reaction. Electrical conductivity of experimental field was (0.23 dS/m). There were ten treatments of different organic sources viz., Absolute control (T_1), seed treatment of Bio NPK consortium (0.5 ml/kg) *fb* soil drenching at 30 and 45 DAS (1.0 L/ha) (T_2), 100% nitrogen through FYM (T_3), 100% nitrogen through vermicompost (T_4), 100% nitrogen through castor cake (T_5), 100% nitrogen through neem cake (T_6), 75% N through FYM *fb* soil drenching of Bio NPK consortium (1L/ha) at 30 and 45 DAS (T_7), 75% N through vermicompost *fb* soil drenching of Bio NPK consortium (1L/ha) at 30 and 45 DAS (T_8), 75% N through castor cake *fb* soil drenching of Bio NPK consortium (1L/ha) at 30 and 45 DAS (T_9), 75% N through neem cake *fb* soil drenching of Bio NPK consortium (1L/ha) at 30 and 45 DAS (T_{10}) were tested in Randomized Block Design with 3 replications. The Bio NPK consortium was sourced from the department of microbiology at Anand Agricultural University, Anand, Gujarat. Kodo millet variety GK 4 was shown on 28th June 2023. Sowing was done by drilling method of sowing at 22.5 cm apart. Kodo millet crop was grown under rainfed conditions. Data regarding growth parameters, yield attributes and yield were recorded as per the standard procedure and economics were calculated based on yield of crop and total cost of cultivation. The RDF of kodo millet was 40:20:00 NPK kg/ha. All the organic manures were incorporated 15 days before sowing in respective treatment. For seed treatment, Bio NPK consortium was mixed with seeds @ 5ml/kg of seeds and kept in shade for 20-25 min before sowing. All the parameters underwent statistical analysis and interpretation according to procedure described by Cochran and Cox (1967) [6].

Results and Discussion

Growth Parameters

Plant population *(*per meter row length)

Plant population (per meter row length) at 20 DAS of kodo millet was found non-significant as various treatments of organic sources of nitrogen did not exert any significant impact on plant population. Thus, uniformity in plant population was observed across all experimental plots throughout the growth period. It reveals that, variations observed in results were due to treatment effects only.

Plant height (cm)

The periodical plant height was recorded at 30; 60 DAS and at harvest. At 30 days after sowing, there was no any significant difference in plant height. At 60 DAS and at harvest Treatment T_9 [Seed treatment of Bio NPK consortium @ 5 ml/kg + 75% nitrogen through castor cake *fb* Bio NPK consortium as soil application (1 L/ha) at 30 and 45 DAS] resulted higher plant height at 60 DAS as well as at harvest (92.26 cm and 94.45 cm respectively), and being at par with treatment T_8, T_{10}, T_7, T_5 and T_4. Treatment T_1 (Absolute control) exhibited lowest plant height (66.26 cm and 67.05 cm respectively), which was statistically similar to T_2 [Seed treatment of Bio NPK consortium (5.0 ml/kg) *fb* soil drenching (1.0 L/ha) at 30 and 45 DAS]. The significantly higher plant height observed in treatments T_9 can be attributed to the rapid mineralization of organic nitrogen, as castor cake have a lower C:N ratio. This increased the supply of organic carbon, promoting microbial multiplication. Consequently, increased microbial activity enhanced nitrogen and phosphorus availability in soil which enables plant to access available nutrients which resulted in higher plant growth. Similar findings were noted by Goswami *et al*. (2022) [7]. The use of the Bio NPK consortium can also be credited with the improved growth because it boosts nutrient availability and influences plant growth by producing growth hormones *viz.*, IAA, GA and cytokinin (Bana *et al.* 2012) [8].

Yield Attributes and Yield

No. of effective tillers (per meter row length) at harvest

Significantly higher number of effective tillers (58.40) per meter row length recorded from treatment T_9 [Seed treatment of Bio NPK consortium @ 5 ml/kg + 75% N through castor cake *fb* soil drenching of Bio NPK consortium (1.0 L/ha) at 30 and 45 DAS] and it remained at par with treatments T_{10}, T_8, T_7 and T_5. Whereas, lower number of effective tillers (40.43) per meter row length was noted from treatment T_1 (Absolute control) and it remained at par with T_2 [Seed treatment of Bio NPK consortium (5.0 ml/kg) *fb* soil drenching at 30 and 45 DAS (1.0 L/ha)]. The improved performance observed with T_9 can be attributed to the nutrient supply from castor cake or vermicompost along with the Bio NPK consortium. This combination likely enhanced the availability of various plant nutrients, leading to a synergistic balance between nutrient availability and plant demand. As a result, more photo assimilates were efficiently translocated from vegetative to reproductive phases, contributing to higher yield through increased attributes such as the number of effective tillers. These results align with the findings of Saiyad *et al*. (2023) [9] and Yadav *et al.* (2021) [10].

Panicle length (cm)

At harvest treatment T_9 [Seed treatment of Bio NPK consortium @ 5 ml/kg + 75% N through castor cake *fb* soil drenching of Bio NPK consortium (1.0 L/ha) at 30 and 45 DAS] showed significantly higher length of panicle (10.66 cm) and it remained at par with treatments T_8, T_7, T_{10} and T_5. While, shortest length of panicle (7.45 cm) recorded from treatment T_1 (Absolute Control) and it was at par with treatment T_2 [Seed treatment of Bio NPK consortium (5.0 ml/kg) *fb* soil drenching at 30 and 45 DAS (1.0 L/ha)]. The maximum panicle length observed under T_9 may be due to the enhanced and prolonged nutrient availability from castor cake along with Bio NPK consortium stimulated vegetative growth by promoting cell division and elongation of meristematic cells in auxiliary buds, which triggered various physiological processes and elevated the supply of photosynthesis, and increased translocation of photosynthate from source to sink, resulting in increased panicle length. These findings are in agreement with the research findings of Goswami *et al*. (2022) [7] and Susmitha *et al.* (2022) [11].

Grain yield (kg/ha)

The tabulated data revealed that treatment T_9 [Seed treatment of Bio NPK consortium @ 5 ml/kg + 75% N through castor cake *fb* soil drenching of Bio NPK consortium 1.0 L/ha at 30 and 45 DAS] recorded significantly higher grain yield (2799 kg/ha) over rest of the treatments. While, significantly lower grain yield recorded from T_1 (Absolute control) and T_2 [Seed treatment of Bio NPK consortium (5.0 ml/kg) *fb* soil drenching at 30 and 45 DAS (1.0 L/ha)], 1589 and 1708 kg/ha respectively. T_9 was

statistically at par with treatments T_8, T_{10}, T_7 and T_5. Treatment T_9 gave 76.14% higher yield over control treatment (T_1). Treatment T_9, resulted in superior growth and yield outcomes, this effectiveness can be attributed to the nutrient-rich composition of castor cake and liquid Bio NPK consortium, which provide readily available nutrients due to their lower C:N ratio. This enhanced nutrient availability stimulates vegetative growth by promoting cell division and activating various physiological processes like photosynthesis. Additionally, efficient nutrient translocation facilitated higher test weights, and ultimately increased grain yield. Similar findings were also reported by Solanki *et al.* (2022) [12] and Goswami *et al.* (2022) [7] in their respective studies on different crops.

Straw yield (kg/ha)

According to the results application of organic manures and Bio NPK consortium significantly influenced straw yield of kodo millet. Seed treatment of Bio NPK consortium @ 5 ml/kg + 75% N through castor cake and soil application Bio NPK consortium at 30 and 45 DAS (T_9) recorded significantly higher straw yield (7457 kg/ha) followed by treatments T_8, T_{10}, T_7, T_5 and T_4. While, significantly lower grain yield recorded from T_1 (Absolute control) and T_2 [Seed treatment of Bio NPK consortium (5.0 ml/kg) *fb* soil drenching at 30 and 45 DAS (1.0 L/ha)], 4514 and 4785 kg/ha respectively. Treatment T_9 gave 65.20% higher straw yield over control treatment (T_1). The enhanced straw yield of kodo millet observed with treatment T_9 can be attributed to synergistic interaction of Bio NPK consortium and castor cake. This combination facilitates rapid organic nitrogen mineralization and a gradual release of nutrients into the soil, which increase nutrient uptake of crop, translocation of photosynthates which utilized by plant. This prolonged availability of nutrients throughout the growing season improves growth parameters like plant height and the number of productive tillers, ultimately leading to increased straw yield. Earlier Ullasa *et al.* (2017) [13], Susmitha *et al.* (2022) [11] and Chauhan *et al.* (2022) [14] reported similar results in different crops.

Harvest index (%)

As per the results, Harvest Index (%) of kodo millet was not significantly influenced by different treatments of organic sources and Bio NPK consortium.

Test weight (g)

According to the results, the organic treatments evaluated did not exhibit any significant differences in the test weight of kodo millet.

Economics

Treatment T_9 recorded maximum gross and net return *i.*e. 119417 ₹/ha and 80799 ₹/ha respectively. Incase of BCR treatment T_7 recorded maximum BCR of 3.44 with gross and net return (113440 ₹/ha and 80510 ₹/ha respectively), followed by treatment T_9 with BCR of 3.09. Maximum BCR observed under treatment T_7, the reason could be the selling price of organic seeds was higher and lower cost of FYM in comparison to other organic manures *viz.*, neem cake, castor cake and vermicompost. Similar findings reported by Lakshman (2022) [15].

Table 1: Effect of different organic sources on growth, yield and economics of kodo millet

Treatments	Plant population/ meter row length	Plant height (cm)			No. of effective tillers/ meter row length	Panicle length (cm)	Test weight (g)	Grain yield (kg/ha)	Straw yield (kg/ha)	HI (%)	Total Cost of cultivation (₹/ha)	Gross realization (₹/ha)	Net realization (₹/ha)	BCR
	At harvest	30 DAS	60 DAS	At harvest										
T_1	18.07	38.79	66.26	67.05	40.43	7.45	4.57	1589	4514	26.05	24887	68074	43187	2.74
T_2	18.07	41.21	72.10	74.80	41.73	7.51	4.60	1708	4785	26.57	26222	73105	46883	2.79
T_3	17.20	45.07	77.79	80.89	45.40	8.32	4.67	2184	5706	27.43	33832	93066	59234	2.75
T_4	18.33	47.10	78.42	84.47	47.00	8.77	4.70	2262	6250	26.60	48309	96730	48421	2.00
T_5	17.47	46.70	84.06	85.38	50.67	9.13	4.83	2390	6260	27.80	41402	101860	60458	2.46
T_6	18.87	45.52	78.96	84.60	47.80	8.62	4.80	2259	5674	28.50	90163	96034	5871	1.07
T_7	17.93	42.77	84.63	87.11	51.00	9.24	4.83	2679	6280	29.98	32930	113440	80510	3.44
T_8	18.20	43.25	86.76	93.13	54.27	10.39	4.83	2785	7063	28.22	43790	118463	74673	2.71
T_9	18.00	45.43	92.26	94.45	58.40	10.66	4.87	2799	7457	27.39	38618	119417	80799	3.09
T_{10}	19.60	41.77	85.29	90.36	54.60	9.17	4.83	2770	6313	31.11	75197	117113	41916	1.56
LSD (p=0.05)	NS	NS	11.87	10.72	8.66	1.53	NS	437.6	1214.5	NS	-	-	-	-

Conclusion

Based on the results of an experiment on kodo millet, it can be concluded that, higher yield and net return can be achieved with application of 75% recommended nitrogen (kg/ha) either through castor cake or FYM along with Bio NPK consortium as seed treatment @ 5.0 ml/kg and soil application @ 1.0 L/ha.

Acknowledgement

The authors are extremely grateful to the Director of Research and Dean PG Studies, Anand Agricultural University, Principal and Dean, B. A. College of Agriculture, Anand Agricultural University for approval and support during research. Authors thankful to all the faculty members of Department of Agronomy, B. A. College of Agriculture, Anand Agricultural University for their cooperation and support.

References

1. Rawat L, Karnatat AK, Bisht TS, Kukreti A. Minor millets: profile and ethnobotanical scenario. In: Millets and millet technology. c2021, p. 51-80.
2. Joshi RP, Jain AK, Malhotra N, Kumari M. Origin, domestication, and spread. In: Millets and Pseudo Cereals. Woodhead Publishing. c2021, p. 33-38.
3. Cheruku D, Ronanki S, Amasiddha B. Kodo millet varieties released in India for cultivation. Indian Farming. 2023;73(1):53-55.
4. Mundada PS, Mali AA, Shaikh SS, Gore NT, Umdale SD, Naik AA, Ahire M. Insights into abiotic stress tolerance in

small millets through transcriptomics. In: Omics of Climate Resilient Small Millets. Singapore: Springer Nature Singapore. c2022, p. 103-123.
5. Bhuje RR, Joshi H. Organic agriculture in India: A review of current status, challenges, and future prospects. Universal Journal of Agricultural Research. 2023;11(2):306-313.
6. Cochran WG, Cox GM. Experimental designs. 3rd ed. London: John Wiley & Sons; c1967, p. 611.
7. Goswami PB, Sitapara HH, Mecwan SJ. Effect of integrated nutrient management on growth and yield of Indian bean (*Dolichos lablab* L.) cv. Gujarat papadi. The Pharma Innovation Journal. 2022;11(9):759-763.
8. Bana RS, Gautam RC, Rana KS. Effect of different organic sources on productivity and quality of pearl millet (*Pennisetum glaucum* L.) and their residual effect on wheat (*Triticum aestivum* L.). Annals of Agricultural Research. 2012;33(3):126-130.
9. Saiyad MM, Vyas RV, Mevada KD, Patel HK. Efficacy of salt tolerant plant growth promoting bacterial liquid consortium on growth and yield of wheat (*Triticum aestivum* L.). Biological Forum- An International Journal. 2023;15(11):223-229.
10. Yadav M, Jadav NJ, Kumar D, Raval CH, Chaudhari D, Chaudhary N. Effect of different nutrient management practices on growth, yield attributes and yield of transplanted pearl millet (*Pennisetum glaucum* L.). International Journal of Plant & Soil Science. 2021;33(22):260-266.
11. Susmitha K, Umesha C, Khan SA. Effect of biofertilizer and organic manure on growth and yield of pearl millet (*Pennisetum glaucum* L.). International Journal of Environment and Climate Change. 2022;12(10):425-431.
12. Solanki KR, Patel DK, Desai NA, Vala YB. Influence of different organic sources on quality, uptake, soil microbial population and economics of summer clusterbean (*Cyamopsis tetragonoloba* L.) under organic farming. Organic Farming. 2022;19:2.
13. Ullasa MY, Pradeep S, Shrikantha CD, Sridhara S. Effect of different organic nutrient management practices on growth, yield and economics of finger millet (*Eleusine coracana* L.). International Journal of Farm Sciences. 2017;7(2):10-14.
14. Chauhan ZY, Shah SN, Jangid AR, Choudhary M. Effect of integrated nutrient management on yield and quality parameter of winter maize (*Zea mays* L.) - summer sesame (*Sesamum indicum* L.) cropping sequence in middle Gujarat condition. Indian Journal of Agronomy. 2022;67(4):401-406.
15. Lakshman. Nutrient management through organics in semi-rabi green gram (*Vigna radiata* L.). M.Sc. (Ag.) Thesis. Anand Agricultural University. Anand, Gujarat; c2022.