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Effect of bio-compost, consortia bio-fertilizer, panchagavya and fish amino acid on yield attributes and yield of kodo millet

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Abstract

To study the effect of bio-compost, consortium bio-fertilizer, panchagavya and fish amino acid on yield attributes and yield of kodo millet cv. CO_3, the field experiment was conducted at Farmer's Field, Vallampadugai Village, Chidambaram Taluk in Cuddalore District, Tamil Nadu, India during August – November, 2022. This study consists of nine treatments and three replications in randomized block design (RBD). The recommended dose of fertilizers to kodo millet was 44:22:0 kg N: P_2O_5: K_2O ha^{-1} were applied to the field through Urea, SSP and MOP, respectively. The full dose of nitrogen and phosphorus were given as basal. Based on treatments, bio-compost @ 10 t ha^{-1}, consortia bio-fertilizer@ 2 kg ha^{-1} were applied one week before sowing. As per the treatment schedule, panchagavya @3% and fish amino acid @ 0.5% sprayed twice (30 DAS and 60 DAS) during vegetative and reproductive stages of kodo millet crop. The crop was grown with proper cultural practices and yield attributes and yield were recorded from respective tagged plants from each treatments at harvest. The results revealed that application of bio - compost@10 t ha^{-1} + CBF@ 2 kg ha^{-1} +PK@3% (T_7) significantly increased the yield attributes viz., number of panicle $hill^{-1}$ (46.37), number of grains $panicle^{-1}$ (197.16), panicle length (14.97 cm) and 1000 grain weight (6.72 g) than control. The same treatment registered highest grain yield (2110.74 kg ha^{-1}) and straw yield (4195.58 kg ha^{-1}) compared to control (T_1).

Key words : Bio-compost, consortium bio-fertilizer, panchagavya and fish amino acid, kodo millet.

Millets are unique among cereals because of their richness in calcium, dietary fibre, poly phenols and protein[3]. The area, production and productivity of minor millets in

India during 2021-2022 were 4.23 million hectares, 3.75 million tonnes and 885 kg ha^{-1}, respectively. In Tamilnadu, area, production and productivity during 2021-2022 were 0.23 million hectares, 0.27 million tonnes and 1179 kg ha^{-1}, respectively. Madhya Pradesh ranks first in kodo millet cultivation in our country. It contributes about 50% area and 35% production of total millet in the country[1]. The continuous intake of kodo millet prevents cardiovascular diseases and reducing blood pressure and high cholesterol[2]. Organic farming is a production system that sustains soil health, ecosystem and people by relaying on ecological processes, biodiversity and natural cycles and adapted to local conditions than use of inputs with adverse effects. It lies in a simple principle of utilizing cheap and local inputs with zero utilization of chemicals[9]. Bio-compost is a sugar industry solid waste consists of pressmud and distillery spentwash in the ratio of 1:2.5. Consortia bio-fertilizer is available in powder and liquid inoculants. It is having immense benefit in terms of improved seed germination, seed establishment, crop stand and disease and drought resistance. Panchagavya is an organic formulation with a blend of five products obtained from cow *i.e.* milk, ghee, curd, dung and urine. It is a mixed culture of naturally occurring, beneficial microbes mostly lactic acid bacteria (*Lactobacillus*), yeast (*Saccharomyces),* actinomyces (*Streptomyces*), photosynthetic bacteria (*Rhodopsuedomonas*) and certain fungi (*Aspergillus)*, which promotes the growth and yield of crops. Fish amino acid contains a rich quantity of amino acids which induces the protein synthesis of plant. The productivity of millets is very low due to improper nutrient management, cultivation under dry land conditions and less number of improved varieties. Among them, inadequate supply of nutrients greatly affects the yield of kodo millet. Thereby organic nutrient management under taken to improve the soil fertility, crop productivity and reduce usage of inorganic fertilizers and input cost. Considering these facts, the field investigation was carried out to study the effect of bio-compost, consortium bio-fertilizer, panchagavya and fish amino acid on yield attributes and yield of kodo millet.

The field experiment was conducted at Farmer's Field, Vallampadugai Village, Chidambaram Taluk in Cuddalore District, Tamil Nadu, India. The soil of the experimental field was sandy loam in texture, Vertisols in order with the taxonomic classification of *Typic Ustifluvent*. The kodo millet crop was grown as test crop during August – November, 2022. The field experiment was carried out with nine treatments and three replications in randomized block design (RBD). The treatments were imposed randomly on the plots in each replication. The kodo millet cv. CO-3 seeds were sown by adopting seed rate of 10 kg ha^{-1}. The seeds were stored in gunny bag, soaked in water for 12 hours and the seeds were treated with consortia bio- fertilizer @ 600 gha^{-1}. The treated seeds were sown with the spacing of 45x10 cm. The recommended dose of fertilizers (44:22:0 kg N: P_2O_5: K_2O ha^{-1}) were applied to the field through Urea, SSP and MOP, respectively. The full dose of nitrogen and phosphorus were given as basal. Based on treatments, bio-compost @ 10 t ha^{-1}, consortia bio-fertilizer @ 2 kg ha^{-1} were applied one week before sowing. As per the treatment schedule, panchagavya @3% and fish amino acid @ 0.5% was sprayed twice (30 DASand 60 DAS) during the vegetative

and reproductive stage of kodo millet crop. The plant protection measures were taken with neem seed kernel extract and need based irrigation given. The crop grown with proper cultural practices and yield attributes were recorded from respective tagged plants of kodo millet at harvest. The grain yield of kodo millet was recorded from the net plot area and is expressed in kg ha^{-1} at 14 per cent moisture level. The straw yield of kodo millet was recorded from the eachnet plot area after enough sun drying and expressed in terms of kg ha^{-1}.

Yield attributes :

The data on number of tillers $panicle^{-1}$, number of grains $panicle^{-1}$, panicle length and 1000 grain weight due to soil application of bio-compost, consortia bio fertilizer and foliar spray of panchagavya and fish amino acid are presented in the table-1.

Number of panicle $hill^{-1}$:

The number of panicle $hill^{-1}$ ranged from 12.16 to 46.37 due to different treatments. The number of panicle $hill^{-1}$ was significantly high in T_7 (46.37) and was followed by T_8 (41.76) and T_9 (40.37) which received bio-compost @10 t ha^{-1} + CBF@ 2 kg ha^{-1} + FAA @ 0.5 % and bio compost @10 t ha^{-1} + PK @ 3% + FAA @ 0.5%, respectively. These two treatments were on par with each other. The control treatment (T_1) recorded least number of panicle $hill^{-1}$of 12.16. However, treatment T_5 statistically on par with T_6.

The enhanced number of panicle $hill^{-1}$ is attributed to the microbial stimulation effect of bio-compost, gradually providing essential nutrients throughout the growth period and sustained nutrient supply improves photosynthate assimilation, fostering a better source and sink relationship[10]. Application of consortia bio-fertilizer contribute to the rise in number of panicles $hill^{-1}$ by fixing atmospheric nitrogen, producing growth-promoting substances *viz.,* indole acetic acid (IAA) and indole butyric acid (IBA)[5].

Number of grains $panicle^{-1}$:

The number of grains $panicle^{-1}$ was maximum in T_7 (197.16). The next best number of grains $panicle^{-1}$ values 188.14, 186.25 and 177.84 were found to be with T_8, T_9 and T_2, respectively. The treatment T_8 was on par with T_9. Similarly, T_5 was on par with T_6. Whereas (T_1) control registered minimum number of grains $panicle^{-1}$ of 134.21. This might also be due to application of consortia bio-fertilizer contributes to an increased sink portion results in higher number of grains. The bacteria residing within the root zone promotes plant growthreproduction and nutrient uptake by releasing auxins and gibberellins[5].

Panicle length (cm) :

The panicle length significantly increased from 10.25 to 14.97 cm due to different treatments. Application of bio-compost @10 t ha^{-1} + CBF@ 2 kg ha^{-1} + PK @3% (T_7) registered highest panicle length of 14.97 cm over control (10.25 cm). Application of bio-compost @10 t ha^{-1} + CBF@ 2 kg ha^{-1} + FAA @ 0.5% (T_8) recorded the panicle length of 14.31 cm was on par with T_9 (13.90 cm) which was received bio-compost @10 t ha^{-1} + PK @

Table–1. Effect of organic nutrient management on yield attributes *viz.,* number of panicles hill^{-1}, number of grains panicle^{-1}, panicle length (cm) and 1000 grain weight of kodo millet *cv.* CO_3

T. No.	Treatment Details	No. of pani-cleshill^{-1}	No. of grains panicle^{-1}	Panicle length (cm)	1000 grain weight (g)
T_1	Absolute Control	12.16	134.21	10.25	6.55
T_2	100% RDF	35.69	177.84	13.21	6.66
T_3	Bio-compost @ 10 t ha^{-1}	20.36	148.66	10.95	6.59
T_4	T_3+ CBF@ 2 kg ha^{-1}	25.44	157.98	11.69	6.61
T_5	T_3+ PK@3%	31.12	169.38	12.54	6.64
T_6	T_3+ FAA@0.5%	30.35	167.24	12.37	6.62
T_7	T_3+ CBF@ 2 kg ha^{-1} + PK@3%	46.37	197.16	14.97	6.72
T_8	T_3+ CBF@ 2 kg ha^{-1} + FAA @ 0.5%	41.76	188.14	14.31	6.70
T_9	T_3 +PK@3% +FAA @ 0.5%	40.37	186.25	13.90	6.69
S. Ed		1.954	3.22	0.243	NS
CD (P = 0.05)		4.299	7.093	0.535	NS

Table–2. Effect of organic nutrient management on grain and straw yield (kg ha^{-1}) of kodo millet cv. CO_3

T. No.	Treatment Details	Yield		Harvest Index
		Grain Yield (kg ha^{-1})	Straw Yield (kg ha^{-1})	
T_1	Absolute Control	982.56	2010.23	32.83
T_2	100% RDF(44:22:0 kg N: P_2O_5: K_2O ha^{-1})	1785.31	3481.42	33.90
T_3	Bio-compost @ 10 t ha^{-1}	1301.87	2513.96	34.12
T_4	T_3+ CBF@ 2 kg ha^{-1}	1471.12	2810.14	34.36
T_5	T_3+ PK@3%	1641.44	3190.64	33.97
T_6	T_3+ FAA@0.5%	1625.38	3104.72	34.35
T_7	T_3+ CBF@ 2 kg ha^{-1} + PK@3%	2110.74	4195.58	34.36
T_8	T_3+ CBF@ 2 kg ha^{-1} + FAA @ 0.5%	1962.27	3903.83	33.45
T_9	T_3 +PK@3% +FAA @ 0.5%	1949.27	3791.25	33.96
S. Ed		65.18	129.21	-
CD (P = 0.05)		143.41	284.28	-

3% + FAA @ 0.5%. However, lowest panicle length of 10.25 was noticed in control (T_1). This might be due to complementary effects of distillery spentwash that provides potash, trace elements and major nutrients likely contributing to the length of the panicle[6]. The foliar application of fish amino acid (FAA) cause organic nutrition is speculated to enhance protoplasmic constituents expediting the processes of cell division and elongation. Similar outcomes have been reported by Muthukumar *et al.,*[7].

1000 grain weight (g) :

Among the different treatments tested, application of bio-compost@10 t ha^{-1} + CBF@ 2 kg ha^{-1} + PK@3% (T_7) registered-highest 1000 grain weight of 6.72 g. Thiswas non-significantly differed with next best 1000 grain weight of 6.70 found to be with T_8 which received bio-compost @10 t ha^{-1} + CBF@ 2 kg ha^{-1} + FAA @ 0.5%. The treatment T_8 was on par with T_9 (6.69 g). Application of 100% RDF (44:22:0 kg N: P_2O_5: K_2O ha^{-1}) (T_1) registered the 1000 grain weight of 6.66 g followed by T_5, T_6,T_4,T_3, T_1, respectively.

The incorporation of bio-compost into the soil not only reduces evaporation but also conserves water for optimal root growth. The presence of water softening agents in organic manure facilitates rapid root expansion in moist soil conditions[8]. The higher moisture content contributes to increase 1000-grain weightas observed by Garg and Bahla[4].

Yield :

The data on grain yield(kg ha^{-1}), straw yield (kg ha^{-1}) and harvest index due to soil application of bio-compost, consortia bio fertilizer and foliar spray of panchagavya and fish amino acid are presented in the table-2.

Grain yield(kg ha^{-1}):

The data on grain and straw yield (kg ha^{-1}) of kodo millet cv. CO_3 due to different treatments are presented in table-2. The highest grain yield of 2110.74 kg ha^{-1} was found to be with bio - compost@10 t ha^{-1} + CBF@ 2 kg ha^{-1} +PK@3% (T_7). The second best value (1962.27 kg ha^{-1}) found to be with T_8 which received bio-compost @10 t ha^{-1} + CBF@ 2 kg ha^{-1} + FAA @ 0.5% which was statistically on par with T_9-Bio - compost @10 t ha^{-1} + PK @ 3% +FAA @ 0.5% (1949.27 kg ha^{-1}). Application of 100% RDF (44:22:0 kg N: P_2O_5: K_2O ha^{-1}) (T_2) registered grain yield of 1785.31 kg ha^{-1}. The lowest grain yield (982.56 kgha^{-1}) was observed in control (T_1). This might be due to application of bio-compost enhanced continuous nutrient supply, improved soil conditionsand increased root proliferation. This might be also due to application of consortia bio-fertilizer and followed by panchagavya spraycontributed to increase yield[11]. Application of consortia bio-fertilizers enhanced growth by increasing nutrients leading to improved growth and higher yields.

Straw yield (kg ha^{-1}) :

Among the various treatments tried, application of bio-compost@10 t ha^{-1} + CBF@ 2 kg ha^{-1} +PK@3% (T_7) recorded highest straw yield (4195.58 kg ha^{-1}). This was followed by T_8 and T_9 registered the straw yield of 3903.83

and 3791.25 kg ha^{-1}, respectively were on par with each other. The treatments T_2, T_5 and T_6 recorded straw yield of 3481.42, 3190.64 and 3104.72 $kgha^{-1}$, respectively. However, the treatment T_1(Control) recorded lowest straw yield (2010.23 kg ha^{-1}). The combined application of bio-compost and consortia bio-fertilizer increased soil fertility and nutrient availability. This enhancement likely led to increased translocation and production of photosynthates at the source, utilized by plants to boost yield. The increased nutrient uptake promoted root growth, enabling better nutrient absorption and consequently enhanced straw yield[12].

Harvest index :

The harvest index is a measure of reproductive efficiency of crop. Among the different treatments tried in the present study, application of bio-compost @10 t ha^{-1} + CBF @ 2 kg ha^{-1} +PK @ 3% (T_7) recorded highest harvest index of 34.36. This might be due to higher biological yield combined higher nutrient efficiencies. The lowest harvest index of 32.83 was recorded in control (T_1) might be due to poor translocation of photosynthates into grain. Similar result was corroborate with the findings of Van Herwaarden *et al.,*[13].

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