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Growth and DMP of kodomillet in T*ypic Ustifluvent* soil as influenced by bio-compost, consortia bio-fertilizer and foliar spray of panchagavya and fish amino acid

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Abstract

The field experiment was carried out at Farmer's Field, Vallampadugai Village, Chidambaram Taluk in Cuddalore District of Tamilnadu during August– November, 2022 to investigate the effect of soil application of bio-compost, consortia bio-fertilizer and foliar application of panchagavya and fish amino acid on growth and DMP of kodo millet. The soil of the experimental field was sandy loam in texture, Vertisols in order with the taxonomic classification of *Typic Ustifluvent*. 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 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. 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 DASand 60 DAS) during vegetative and reproductive stages of kodo millet crop. The crop was grown with proper cultural practices. The results revealed that signficantly highest plant height, number of leaves $plant^{-1}$, leaf area index, number of tillers $hill^{-1}$, chlorophyll content and DMP were recorded at various growth stages of kodomillet with bio-compost@10 t ha^{-1}+ CBF@2kgha^{-1}+PK@3% (T_7) than control.

Key words : Bio-compost, consortia bio-fertilizer, panchagavya, fish amino acid, growth attributes, dry matter production and kodo millet.

Kodo millet *(Paspalum scrobiculatum* L.) is a tropical small millet originated in tropical Africa and it has been cultivated in India 3000 years ago. Its grain contains 66.6% carbohydrate, 8.35% protein, 2.4% minerals, 1.45% fat and 2.95% ash. The major protein in the grain is

glutelin[10]. Bio-compost is a sugar industry solid waste which is produced by mixing pressmud and distillery spentwash in the ratio of 1:2.5. Microbial consortium is specially formulated microbial inoculants with two or more microbial group living symbiotically. These are eco-friendly, cost effective and renewable sources of plant nutrients that help to maintain long term soil fertility and sustainability. Bio-chemical properties of panchagavya possesses almost all the major nutrients like N,P,K and micro nutrients necessary for plant and growth hormones like IAA and GA required for crop growth[6]. Foliar application or a soil drenching of fish amino acid maximize uptake and minimize runoff or leaching, providing enough nitrogen to the plant for the production of chlorophyll to maintain plant health[8]. The objective of present investigation was to study the effect of bio-compost, consortium bio-fertilizer, panchagavya and fish amino acid on growth and dry matter production of kodo millet.

The field experiment was carried out at Farmer's Field, Vallampadugai Village, Chidambaram Taluk in Cuddalore District during August– November, 2022 to investigate the effect of soil application of bio-compost, consortia bio-fertilizer and foliar application of panchagavya and fish amino acid on growth of kodo millet grown in *Typic Ustifluvent soil*. The soil of the experimental field was sandy loam in texture, Vertisols in order with the taxonomic classification of *Typic Ustifluvent*. The pH, EC were 7.38 and 0.32, respectively. The soil available nitrogen, phosphorus and potassium status were 219, 10.1 and 248 kg ha^{-1}, respectively. 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 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% sprayed twice (30 DASand 60 DAS) during vegetative and reproductive stages of kodo millet crop. The kodo millet cv. CO-3 seeds were treated with consortia bio-fertilizer @ 600 gha^{-1} and sown with the spacing of 45x10 cm. The plant protection measures were taken with neem seed kernel extract. The need based irrigation was given. The data on various growth parameters *viz.,* plant height, number of leaves $plant^{-1}$, number of tillers $hill^{-1}$, LAI and DMP were recorded at three intervals (35DAS, 70 DAS and at harvest), respectively. Five plants from each net plot were selected randomly and tagged. They were used for recording all the biometric observations at different stages of crop growth.

Plant height (cm) :

The data on plant height and number of leaves $plant^{-1}$ recorded at various growth stages of kodomillet at different stages as influenced by different combinations of organic sources *viz.,* bio- compost, consortia bio-fertilizer, panchagavya and fish amino acid are presented in table-1.

The plant height at all stages progressively increased from 26.06 to 93.15 cm.At 35 DAS,

significantly the highest plant height of 41.13 cm was recorded with application of bio-compost @10 t ha^{-1}+ CBF@ 2 kg ha^{-1}+PK @3% (T_7). The second highest plant height of 39.02 cm was observed with (T_8). It was on par with application of bio-compost +PK @3%+FAA @ 0.5% (T_9) registered the plant height of 38.67 cm. The lowest plant height of 26.06 cm was observed under control (T_1).

At 70 DAS, plant height ranged from 56.43 to 76.48 cm. Application of bio-compost @10 t ha^{-1} + CBF@ 2 kg ha^{-1} + PK@3% (T_7) significantly increased the plant height of 76.48 cm over control recorded lowest plant height of 56.43 cm. The treatment T_8 was on par with T_9 were recorded the plant height of 73.55 and 72.91 cm, respectively.

At harvest stage, the treatments T_7, T_8, T_9 and T_2 significantly influenced plant height of 93.15, 89.66,89.20 and 85.79 cm, respectively. Among the treatments tried, T_8 and T_9 were on par. The lowest plant height (68.14 cm) was observed under control (T_1). The application of bio-compost improves soil aeration and drainage, promoting deeper root penetration and nutrient extraction increased growth9. It was also due to foliar spray of panchagavya promotes larger cells, thinner walls and vegetative growth. *Azotobacter* + PSB application combines atmospheric nitrogen fixation with the synthesis of growth-stimulating substances[11]. The joint effect of soil nitrogen and fish amino acid foliar spray boosts cell division and metabolic activity, leading to increased plant height[7].

Number of leaves plant^{-1}:

At 35 DAS, application of bio-compost @10 t ha^{-1} + CBF@ 2 kg ha^{-1} +PK@3% (T_7) recorded highest number of leaves $plant^{-1}$ (9.75). The next highest number of branches $plant^{-1}$ of 9.27 and 8.96 were found to be with T_8 and T_9, respectively. These two treatments were statistically on par with each other. The lowest number of leaves $plant^{-1}$ (6.11) was observed under control (T_1).

At 70 DAS, the highest number of leaves $plant^{-1}$ of 17.90 was found to be with bio-compost @10 t ha^{-1} + CBF@ 2 kg ha^{-1} +PK@3% (T_7). It was followed by 16.69, 16.52, 15.21 and 14.02 were observed in the treatments T_8, T_9,T_2 and T_5 respectively. However, lowest number of leaves $plant^{-1}$ registered in T_1 was 9.12. The beneficial microbes in panchakavya, plant growth promoting bacteria, contribute to alleviating plant stress through various mechanisms[4] resultsin production of maximum number of leaves. These findings are correlate the results of Guggari and Kalaghatagi[3].

Leaf area index :

The observations recorded on leaf area index and number of tillers $hill^{-1}$ at different stages of kodo millet *cv.* CO_3 are presented in table-2.

At 35 DAS, significantly highest leaf area index of 3.29 was recorded with T_7, which was received bio-compost@10 t ha^{-1} + CBF@ 2 kg ha^{-1} + PK@3%. Application of bio-compost @10 t ha^{-1} + CBF@ 2 kg ha^{-1} + FAA @ 0.5%

(T_8) recorded the leaf area index of 3.04 was on par with application of bio-compost @10 t ha^{-1} +PK@3% +FAA @ 0.5% registered the leaf area index of 2.91.

At 70 DAS, there was a significant increase in leaf area index from 2.65 to 5.35 was observed in T_7 compared to control. Application of 100% RDF (T_2), bio-compost @10 t ha^{-1} + PK@3% (T_4) and bio-compost @10 t ha^{-1} + FAA@0.5% (T_5) registered the leaf area index of 4.51, 3.68 and 4.10, respectively. Application of bio-compost @10 t ha^{-1} + CBF@ 2 kg ha^{-1} + FAA @ 0.5% (T_8) registered the leaf area index (4.97) was on par with bio-compost@10 t ha^{-1} +PK@3% +FAA @ 0.5% (T_9) (4.89). The positive impact of panchagavya combined with bio- compost on leaf area index is likely attributed to the liquid manure serving as a rich source of macro and micronutrients, vitamins and growth hormones like gibberellins. This enhancement in leaf area results in higher photo assimilatesas noted by Chongre *et al.*[1].

No. of tillers hill^{-1}*:*

At 35 DAS, number of tillers $hill^{-1}$ varied among the treatments and T_7 – Bio- compost @10 t ha^{-1} + CBF@ 2 kg ha^{-1} + PK@3% showed highest number of tillers $hill^{-1}$ (11.72) followed by T_8 and T_9 registered number of tillers $hill^{-1}$ of 11.19 and 11.07, respectively. The lowest number of tillers $hill^{-1}$ of 7.64 was registered in T_1 .

At 70 DAS, it is clear that application of bio-compost@10 t ha^{-1} + CBF@ 2 kg ha^{-1}

Table-1. Effect of soil application of bio-compost and consortia bio-fertilizer and foliar spray of panchagavya and fish amino acid on plant height(cm) and number of leaves $plant^{-1}$ at different growth stages of kodo millet *cv.* CO_3

T. No.	Treatment Details	Plant height (cm)			No. of leaves $plant^{-1}$	
		35 DAS	70 DAS	Harvest	35 DAS	70 DAS
T_1	Absolute Control	26.06	56.43	68.14	6.11	9.12
T_2	100% RDF	36.85	70.02	85.79	8.47	15.21
T_3	Bio-compost @ 10 t ha^{-1}	30.67	60.75	73.32	6.64	10.83
T_4	T_3+ CBF@ 2 kg ha^{-1}	32.88	63.91	78.33	7.25	12.20
T_5	T_3+ PK@3%	35.22	67.09	82.27	7.90	14.02
T_6	T_3+ FAA@0.5%	35.07	66.83	81.83	7.82	13.43
T_7	T_3+ CBF@ 2 kg ha^{-1} + PK@3%	41.13	76.48	93.15	9.75	17.90
T_8	T_3+ CBF@ 2 kg ha^{-1} + FAA @ 0.5%	39.02	73.55	89.66	9.27	16.69
T_9	T_3+PK@3%+FAA @ 0.5%	38.61	72.91	89.20	8.96	16.52
S. Ed		0.672	1.270	1.545	0.201	0.536
CD (P=0.05)		1.479	2.794	3.401	0.443	1.182

Table-2. Effect of soil application of bio-compost and consortia bio-fertilizer and foliar spray of panchagavya and fish amino acid on LAI and number of tillers hill^{-1} at different growth stages of kodo millet *cv.* CO_3

T. No.	Treatment Details	LAI		No. of leaves plant^{-1}		
		35 DAS	70 DAS	35 DAS	70 DAS	Harvest
T_1	Absolute Control	1.32	2.65	7.64	12.11	10.62
T_2	100% RDF	2.63	4.51	10.54	17.28	14.83
T_3	Bio-compost @ 10 t ha^{-1}	1.58	3.17	8.62	13.98	11.89
T_4	T_3+ CBF@ 2 kg ha^{-1}	1.93	3.68	9.23	15.03	12.87
T_5	T_3+ PK@3%	2.31	4.10	9.96	16.20	13.95
T_6	T_3+ FAA@0.5%	2.22	4.05	9.79	16.12	13.77
T_7	T_3+ CBF@ 2 kg ha^{-1} + PK@3%	3.29	5.35	11.72	19.73	16.90
T_8	T_3+ CBF@ 2 kg ha^{-1} + FAA @ 0.5%	3.04	4.97	11.19	18.67	16.01
T_9	T_3 +PK@3% +FAA @ 0.5%	2.91	4.89	11.07	18.39	15.74
S. Ed		0.109	0.175	0.19	0.463	0.27
CD (P = 0.05)		0.241	0.385	0.420	1.019	0.596

Table-3. Effect of soil application of bio-compost and consortia bio-fertilizer and foliar spray of panchagavya and fish amino acid on chlrophyll content and dry matter production at different growth stages of kodo millet *cv.* CO_3

T. No.	Treatment Details	Chlorophyll Content			DMP (kg ha^{-1})		
		35DAS	70DAS	Harvest	35 DAS	70 DAS	At Harvest
T_1	Absolute Control	25.48	31.64	23.27	891.69	1863.24	2992.79
T_2	100% RDF	34.22	42.03	30.33	1985.37	3951.42	5266.73
T_3	Bio-compost @ 10 t ha^{-1}	28.09	34.15	25.07	1043.45	2292.18	3815.83
T_4	T_3+ CBF@ 2 kg ha^{-1}	30.25	36.54	26.68	1195.67	2637.73	4281.26
T_5	T_3+ PK@3%	32.46	39.78	28.81	1488.71	2994.76	4832.08
T_6	T_3+ FAA@0.5%	31.95	38.89	28.26	1417.31	2958.18	4730.10
T_7	T_3+ CBF@ 2 kg ha^{-1} + PK@3%	38.47	47.56	34.18	2028.13	4026.79	6306.32
T_8	T_3+ CBF@ 2 kg ha^{-1} + FAA @ 0.5%	36.76	45.28	32.64	1902.33	3713.16	5866.10
T_9	T_3 + PK@3% + FAA @ 0.5%	36.13	44.37	31.91	1871.47	3642.27	5740.52
S. Ed		0.76	1.00	0.552	31.321	78.230	183.89
CD (P = 0.05)		1.672	2.216	1.216	69.220	172.89	404.56

+PK@3% (T_7) recorded highest number of tillers hill^{-1} of 19.73. The next best value of 18.67 and 18.39 were noticed in T_8 and T_9, respectively were on par with each other. Whereas control (T_1) recordedlowest number of tillers hill^{-1} (12.11). At harvest, application of bio-compost@10 t ha^{-1} + CBF@ 2 kg ha^{-1} +PK@3% (T_7) registered significantly highest number of tillers hill^{-1} (16.90). The lowest number of tillers hill^{-1} (10.62) was observed under control. Application of fish amino acid known for its potential as a source of auxin, speculated to promote vegetative growth through active cell division, cell enlargement and cell elongation. This contributes to an improvement in the number of effective tillers[5]. The results pertaining to the effect of soil application of bio-compost and consortia bio-fertilizer and foliar spray of panchagavya and fish amino acid on chlorophyll content and dry matter production of kodo millet cv. CO_3 are presented in table-2.

Chlorophyll content :

Among the treatments tried at 35 DAS, application of bio-compost@10 t ha^{-1} + CBF@ 2 kg ha^{-1} +PK@3% (T_7) recorded significantly highest chlorophyll content of 38.47. Application of bio-compost @10 t ha^{-1} + CBF@ 2 kg ha^{-1} + FAA @ 0.5% (T_8) and bio compost @10 tha^{-1} +PK@3% +FAA @ 0.5% (T_9) recorded chlorophyll content of 36.76 and 36.13, respectively. However, lowest chlorophyll content (25.48) was observed under control (T_1).

At 70 DAS, significantly highest chlorophyll content (47.56) was recorded due the application of bio-compost@10 t ha^{-1} + CBF@ 2 kg ha^{-1} +PK@3% noticed in T_7. Application of bio - compost @10 t ha^{-1} + CBF@ 2 kg ha^{-1} + FAA @ 0.5% (T_8) registered the chlorophyll content of 45.28 was on par with bio-compost @10 t ha^{-1} +PK@3% +FAA @ 0.5% (T_9)(44.37). However, control registered chlorophyll content of 31.64 which was lowest.

At harvest also, T_7 recorded highest chlorophyll content of 34.18 compared to control (23.27). There was a significant differences between the treatments. Application of bio-compost @10 t ha^{-1} + CBF@ 2 kg ha^{-1} + FAA @ 0.5% (T_8) and bio-compost @10 t ha^{-1} +PK@3% +FAA @ 0.5% (T_9) recorded the chlorophyll content of 32.64, 31.91, respectively. These two treatments were on par with each other.

Dry matter production (kg ha^{-1}) :

Among the various treatments tried, at 35 DAS, application of bio-compost@10 t ha^{-1} + CBF@ 2 kg ha^{-1} + PK@3% (T_7) recorded significantly highest dry matter production of 2028.13 kg ha^{-1}. Application of bio-compost @10 t ha^{-1} + CBF@ 2 kg ha^{-1} + FAA @ 0.5% (T_8) and bio-compost @10 t ha^{-1} +PK@3% +FAA @ 0.5% (T_9) recorded dry matter production of 1902.33 and 1871.47 kg ha^{-1}, respectively. However, lowest dry matter production (891.69 kg ha^{-1}) was observed under control treatment (T_1).

At 70 DAS, significantly highest dry matter production (4026.79 kg ha^{-1}) was recorded with T_7. Applicationof bio-compost

@10 t ha^{-1} + CBF@ 2 kg ha^{-1} + FAA @ 0.5% (T_8) registered dry matter production of 3713.16 kg ha^{-1} was on par with bio-compost @10 t ha^{-1} +PK@3% +FAA @ 0.5% (T_9) (3642.27 $kgha^{-1}$). However, control registered lowest dry matter production of 1863.24 kg ha^{-1} (T_1).

At harvest, application of bio compost @10 t ha^{-1} + CBF@ 2 kg ha^{-1} +PK@3% (T_7) recorded highest dry matter production of 6306.32 kg ha^{-1} compared to control (2992.79 kg ha^{-1}). There was a significant differences between the treatments. Application of bio compost @10 t ha^{-1} + CBF@ 2 kg ha^{-1} + FAA @ 0.5% (T_8) and bio-compost @10 t ha^{-1} +PK@3% +FAA @ 0.5% (T_9) recorded dry matter production of 5866.10, 5740.52 kg ha^{-1}, respectively. Thetreatment T_8 was on par with T_9. This might be attributed due to higher tiller production at various growth stages. The enhanced dry matter production also might be attributed to nutrient assimilation through foliar application, particularly during the flowering period, meeting the crops nutrient demands for sink development. The foliar application of panchagavya is believed to improve assimilation, translocation and nutrient metabolism, thereby enhancing photosynthetic rates[2].

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