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Effect of Phosphorus Enriched Biocompost on Nutrient Use Efficiency, Growth and Yield of Finger Millet (*Eleusine coracana* G.)

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Abstract

A field experiment was conducted to study the effect of phosphorus enriched biocompost on nutrient use efficiency, growth and yield of finger millet. Biocompost was enriched with RP-PSB as well as SSP fertilizer. The experiment was laid out in randomized complete block design (RCBD) with nine treatments and three replications. The results of the field experiment revealed that application of 100 per cent NPK + RP-PSB enriched biocompost @ 10 t ha^{-1} significantly increased the plant growth, grain and straw yield (3752 and 6386 kg ha^{-1} respectively) of finger millet and other yield attributes like number of fingers per ear head and test weight. Whereas application of 100 per cent NPK + SSP enriched biocompost at 10 t ha^{-1} is beneficial in obtaining higher income per rupee invested (B:C ratio : 2.46).

Keywords: Phosphorus, Enriched biocompost, Rock phosphate, PSB

The sugar industry is the second largest agro-processing industries in India next to textiles. At present among the few agro industries sugarcane industries have successfully contributed to the rural economy. They contribute a significant amount of solid and liquid by-products as waste. The various by-products of sugarcane industry are sugarcane tops, pressmud, bagasse, molasses and effluent. Biocompost is the final product obtained by mixing sugar cane pressmud and distillery spentwash in the ratio of 1:2.5 along with consortium of efficient microbial decomposers, *viz.*, *Phanerocheate chrysosporium, Trichurus spiralis, Pacelomyces fusisporus, Trichoderma* spp., etc., and subjected for composting by wind-row method. Handling and management of these by-products is a huge task, because it requires lot of space for storage and disposal. There is a scope to utilize these by-products in crop production as organic nutrient source.

Use of biocompost for agricultural crop production can solve the problem for disposal of wastes, problem of lack of organic matter and also reduces the cost of chemical fertilizers. On the other hand, a judicious combination of organic and inorganic sources of nutrients might be helpful to obtain a good economic return with good soil health for the subsequent crops. Compost enrichment is the technique to improve the nutrient content of the compost. In the previous experiments studied, phosphorus content in biocompost is slightly low compared to nitrogen and potassium. Hence, an attempt has been made to enrich the biocompost with phosphorus and evaluated its effect on growth, yield and yield parameters of finger millet along with varied levels of P fertilizer.

Material and Methods

The experiment was carried out at Maddur, located in Mandya, Karnataka, India, which falls under Southern Dry Zone of Karnataka (Agro Climatic Zone No. 6) and is situated at 12° 36' North latitude 77° 4' East longitude and at an altitude of 662 meters above the mean sea level. The chemical properties of the initial soil sample were as follows: the pH was 7.71, electrical conductivity was 0.31 dS m^{-1}, available soil nitrogen, phosphorus and potassium content was 388.16, 98.60 and 287.70 kg ha^{-1}, respectively. The test crop selected was finger millet, variety GPU 28. The experiment was carried out following randomized complete block design (RCBD) with nine treatments and three replications. The treatment details are: T_1: Absolute Control, T_2: 100 per cent RDF + FYM @ 10 t ha^{-1} (POP), T_3: 100 per cent RDF + Biocompost @ 10 t ha^{-1}, T_4: 100 per cent NPK + RP-PSB enriched

biocompost @ 10 t ha^{-1}, T_5: 100 per cent NPK + SSP enriched biocompost @ 10 t ha^{-1}, T_6: 100 per cent NK, 75 per cent P + RP-PSB enriched biocompost @ 10 t ha^{-1}, T_7: 100 per cent NK, 75 per cent P + SSP enriched biocompost @ 10 t ha^{-1}, T_8: 100 per cent NK, 50 per cent P + RP-PSB enriched biocompost @ 10 t ha^{-1} and T_9 : 100 per cent NK, 50 per cent P + SSP enriched biocompost @ 10 t ha^{-1}.

Phosphorus enrichment of biocompost : Rock phosphate-PSB enriched biocompost was prepared by mixing 100 kg of biocompost with 5.5 kg of rock phosphate which is equivalent to one per cent P_2O_5 and PSB culture at 25:1 ratio. The PSB (Phosphate solubilising bacteria) used in the study was *Bacillus megatherium.* SSP enriched biocompost was prepared by mixing 100 kg of biocompost with 6.25 kg of SSP fertilizer which is equivalent to one per cent P_2O_5.

Application of manures and fertilizers : FYM and enriched biocompost was applied fifteen days before transplanting of finger millet. Entire dose of P and K was applied as per the treatments and N was applied in two split doses. Composition of FYM and enriched biocompost is presented in Table 1.

Growth parameters like plant height and number of tillers per plant and yield observations like number of fingers per ear head, test weight, grain yield and straw yield were recorded as per the standard procedures.

Nutrient use efficiency : Nutrient use efficiency like agronomic nutrient use efficiency was calculated using the formula :

$$\text{ANUE} = \frac{\text{Grain yield (kg ha}^{-1})}{\text{Nutrient applied (kg ha}^{-1})}$$

Results and Discussion

Plant Growth

Significantly higher plant height (118.2 cm) and number of tillers per plant (3.85) was recorded with application of 100 per cent NPK + RP-PSB enriched biocompost @ 10 t ha^{-1}. However it was on par with the treatments T_5, T_3, T_2 and T_6. The increase in the plant height and number of tillers per plant in enriched biocompost treated plots is mainly due to increased availability of nutrients from enriched biocompost and mineralization. Research findings of Nehra and Hooda (2002) and Abbasi *et al*. (2014) revealed that increase in plant growth by application of organic manures might be due to enhanced sugar translocation and turgor pressure in plant cell in enriched biocompost treated plots that leads to cell enlargement and multiplication.

Table 1

Chemical composition of FYM, biocompost and enriched biocompost

Parameter	FYM	Bio compost	SSP enriched biocompost	RP-PSB Enriched biocompost
pH (1:10)	7.32	7.28	7.33	7.34
EC (dS m^{-1})	2.35	3.02	2.90	2.86
Organic carbon (%)	25.80	49.09	50.80	52.1
Total Nitrogen (%)	0.60	2.21	2.24	2.27
Total Phosphorus (%)	0.31	1.22	1.82	1.87
Total Potassium (%)	0.57	1.84	1.85	1.85
Total Calcium (%)	0.78	0.86	0.91	0.85
Total Magnesium (%)	0.21	0.26	0.29	0.24
Sulphur (mg kg^{-1})	25.60	34.04	45.20	39.50
Sodium (%)	0.23	0.28	0.28	0.28
Iron (mg kg^{-1})	973.0	1238.0	1126.0	1174.6
Manganese (mg kg^{-1})	456.0	482.8	434.8	457.6
Zinc (mg kg^{-1})	164.0	141.2	139.4	126.5
Copper (mg kg^{-1})	66.80	72.30	59.30	68.30
Ni (mg kg^{-1})	0.13	0.19	0.18	0.18

Yield and Yield Parameters

Significant variations were observed in grain and straw yield of finger millet between the treatments. Significantly higher grain yield (3752 kg ha^{-1}) and straw yield (6386 kg ha^{-1}) was obtained with 100 per cent NPK + RP-PSB enriched biocompost @ 10 t ha^{-1} (T_4). The positive effect of increase in grain and straw yield of finger millet by the application of phosphorus

TABLE 2

Effect of application of phosphorus enriched biocompost on yield and yield attributes of finger millet

Treatments	Plant height (cm)	No. of tillers per plant	No. of fingers per ear head	Test weight (gm)	Grain yield (kg ha^{-1})	Straw yield (kg ha^{-1})	B:C ratio
T_1	76.90	1.86	6.49	2.99	2376	4263	1.94
T_2	112.6	3.21	8.70	3.32	3587	6040	2.31
T_3	113.4	3.79	9.01	3.41	3675	6190	2.39
T_4	118.2	3.85	9.17	3.45	3752	6386	2.27
T_5	117.0	3.81	9.12	3.44	3690	6258	2.46
T_6	112.0	2.92	8.42	3.26	3540	6014	2.14
T_7	103.1	2.56	8.35	3.20	3405	5959	2.28
T_8	99.80	2.40	8.30	3.12	3222	5778	1.95
T_9	98.00	2.13	8.12	3.00	2921	5754	1.98
S.Em.±	3.37	0.09	0.27	0.10	106.6	186.6	-
CD @5%	10.11	0.28	0.81	0.31	319.7	559.3	-

enriched biocompost might be due to increased nutrient content of enriched biocompost and balanced supply of plant nutrients through organic sources and inorganic fertilizers (Rangaraj *et al*., 2007 and Selvamurugan *et al*., 2013). However, application of 100 per cent NPK + SSP enriched biocompost at 10 t ha^{-1} (T_5) has highest B:C ratio (2.46) compared to application of 100 per cent NPK + RP-PSB enriched biocompost @ 10 t ha^{-1} (2.27), because of lesser cost requirement of SSP enriched biocompost compared to RP-PSB enriched biocompost. Hence application of 100 per cent NPK + SSP enriched biocompost at 10 t ha^{-1} is beneficial in obtaining higher income per rupee invested.

Significantly higher number of fingers (9.17) per ear head was recorded with 100 per cent NPK + RP-PSB enriched biocompost @ 10 t ha^{-1} (T_4). Combined application of organic matter and chemical fertilizers increased the number of fingers per ear head in finger millet (Gangadhar Nanda, 2015).

The test weight varied significantly among the different treatments. Significantly higher test weight (3.45 gm) was recorded with the application of 100 per cent NPK + RP-PSB enriched biocompost @ 10 t ha^{-1}, however it was on par with the treatments T_2, T_3, T_5, T_6 and T_7. Kalaivanan and Hattab (2016) reported that the increase in 1000 seed weight might be due to rapid mineralization of nutrients from organic sources with adequate supply of inorganic nutrients leading to increased nutrition of crop that resulted in translocation of photosynthates to seeds, which ultimately recorded more test weight of seeds.

Nutrient Use Efficiency

The plants are considered to be efficient in nutrient utilization if they use the applied nutrients efficiently to produce the maximum quantity of biomass. The

TABLE 3

Agronomic nutrient use efficiency (Grain yield in kg per kg nutrient applied) of N, P_2O_5 and K_2O

Treatments	Nutrient use efficiency (kg kg^{-1})		
	N	P_2O_5	K_2O
T_1	-	-	-
T_2	35.87	71.74	71.74
T_3	36.75	73.50	73.50
T_4	37.52	75.04	75.04
T_5	36.90	73.80	73.80
T_6	35.40	94.40	70.80
T_7	34.05	90.80	68.10
T_8	32.22	128.9	64.44
T_9	29.21	116.8	58.42

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efficiency of applied fertilizer nutrient is expressed by agronomic nutrient use efficiency (ANUE). Treatment T_4 shows higher agronomic nutrient use efficiency in case of N and K_2O. Whereas in case of P_2O_5, treatments T_8 and T_9 with lower P_2O_5 fertilizer application shows higher agronomic nutrient use efficiency. Omar Hattab *et al*. (1998) found that the supply of nutrients and agronomic efficiency varied according to the nature of decomposition of the materials and their mineralization.

Application of phosphorus enriched biocompost had positive impact on crop growth and yield of finger millet. Among all the treatments imposed, application of 100 per cent NPK + RP-PSB enriched biocompost @ 10 t ha^{-1} recorded highest growth and yield of finger millet compared to T_2: 100 per cent RDF +FYM @ 10 t ha^{-1} (POP). However, application of 100 per cent NPK + SSP enriched biocompost at 10 t ha^{-1} was beneficial in obtaining higher income per rupee invested. Biocompost may be utilised as an alternate to FYM wherever it is available as the yield of T_4 is on par with T_2, T_3, T_5 and T_6. Hence to reduce the cost of cultivation and ease of application, 100 per cent NPK along with biocompost @ 10 t ha^{-1} may also be practiced wherever possible to obtain better yield and profit.

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