



# Effect of Enriched Organic Compost and Foliar Nutrition on Growth and Yield of Ragi (*Eleusine coracana* L.)

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## Authors' contributions

This work was carried out in collaboration between both authors. Author GRP wrote the manuscript and analysed data and author SR design the concept and contributed data. Both authors read and approved the final manuscript.

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## ABSTRACT

An on-field experiment was conducted at Puliyanthoppu village in Krishnagiri District, Tamil Nadu during (Dec 2019 – April 2020) to examine how enriched organic compost and foliar nutrition influenced the growth performance and production of finger millet under irrigated condition. The experiment was comprised of three main plot plot treatments (enriched FYM compost, enriched poultry manure compost and enriched pressmud compost at 750 kg ha<sup>-1</sup>) and five sub plot treatments (Foliar spray of humic acid, panchagavya, vermiwash, seaweed extract with different concentration), adopting statistical design SPD and it was replicated thrice. From the results of the field experiment, among main pot, enriched poultry manure compost @ 750 kg ha<sup>-1</sup> (M<sub>3</sub>) significantly exhibited greater values of growth and yield such as plant height (103.64cm), LAI (5.71), number of tillers (161.27 m<sup>-2</sup>) and dry matter production (9156 kg ha<sup>-1</sup>), grain yield (3504 kg ha<sup>-1</sup>) and straw yield (6597 kg ha<sup>-1</sup>).. Similar results were obtained under subplot treatments, namely foliar spray of seaweed extract @ 0.3% on 20, 40 and 60 DAT (S<sub>3</sub>) . whereas, the least values of growth and yield

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of ragi were registered under control (water spray). It was determined that there was a substantial interaction impact between the main and subplot treatments. This study illustrates that cultivation of ragi under irrigated condition with combined application of enriched poultry manure @ 750 kg ha<sup>-1</sup> and foliar application of seaweed extract @ 0.3% on 20, 40 and 60 DAT was found to be an economically and agronomically sound practice that would increase productivity and profitability in Krishnagiri district of Tamil Nadu.

**Keywords:** Finger millet; enriched poultry manure; seaweed; growth and yield.

## 1. INTRODUCTION

Millets exhibit the unique characteristics among cereals. India is the world's foremost producer of several millets. Among them, finger millet (*Eleusine coracana* L.) contributes about 85 per cent of total production [1] and it is cultivated in India with an area of 11.9 lakh hectares with a production of 19.8 lakh tonnes and a productivity of 1662 kg ha<sup>-1</sup>. In Tamil Nadu, it is cultivated in an area of 0.78 lakh hectares with a production of 2.56 lakh tonnes and a productivity of 1966 kg ha<sup>-1</sup> [2]. It can able to withstand water stress, warming stress, and nutritional stress [3]. Despite these advantages, farmers still grow millets as rainfed crop with poor management practices which result in yield reduction. In the wake of green revolution, our agriculture is dependent mostly on chemical fertilizers which leads to the degradation of soil fertility. In order to overcome this problem, enhancing the ragi productivity through organic nutrient management has become a mandate.

By incorporating organic materials into the soil, it improves the soil physical properties, such as structure, stability of its aggregates, ability to withhold water, drainage, aeration, and root penetration, as well as its chemical properties, such as its nutrient content, composition, and pH [4]. Organic inputs like poultry manure application increases soil organic matter, total N, as well as P exchangeable cations [5]. FYM have traditionally been used by farmers, as it supplies all macro nutrients (N, P, K, Ca, Mg, S) and micro nutrients (Fe, Mn, Cu, Zn) essential for plant growth [6]. Pressmud is reported to have major plant nutrients and therefore its influence physical, chemical and biological features of soil [7]. Besides, soil application of nutrients is not alone enough to meet the growing crop demand particularly in medium duration crop like ragi.

Ideal strategy to overcome this problem by combined application of nutrients by soil and

foliar means. Foliar feeding is a technique which is sprayed on the leaves of the plant, so that plants can easily absorb nutrients through leaves. The application of seaweed resulted in a wide range of reactions in plants, including rapid development, higher yields, enhanced nutrient uptake, and increased resilience to biotic and abiotic stress [8]. Humic acid-based fertilizer increases crop yields by stimulating the plant enzymes, hormones and improves soil fertility [9]. Vermiwash is a rich source of soluble plant nutrients and contains earthworm secretions and enzymes that can promote crop growth [10]. Panchagavya considered to be a highly effective liquid organic manure blended with five products which has multiple functions and can effectively supplement to chemical fertilizer [11]. It supplies both micro and macro nutrients which enhances the fertilizer use efficiency and reduce the cost of cultivation. Keeping the aforesaid information in view, the present research was designed to develop a sustainable nutrient management strategy in order to achieve maximum productivity in Finger millet under irrigated conditions.

## 2. MATERIALS AND METHODS

The experiment was conducted in the farmers field at Puliyanthoppu village, Krishnagiri District, Tamil Nadu during December 2019 - April 2020 (Marghazipattam). The field site was located at 12°49'N latitude and 78°38'E longitude and at an altitude of 492 meter above MSL. The experimental soil had a low nitrogen, medium phosphorus, and high potassium. The experiment comprised three main plot treatments viz., M<sub>1</sub>- Enriched FYM compost @ 750 kg ha<sup>-1</sup>, M<sub>2</sub>- Enriched pressmud compost @ 750 kg ha<sup>-1</sup>, M<sub>3</sub>- Enriched Poultry manure compost @ 750 kg ha<sup>-1</sup> and five subplot treatments namely, S<sub>1</sub>- Control (Water spray), S<sub>2</sub>- Foliar spray of humic acid @ 0.3%, S<sub>3</sub>-Foliar spray of panchagavya @ 3%, S<sub>4</sub>- Foliar spray of

**Table 1. Nutrient content of enriched organic manure**

<b>Nutrient</b>	<b>Nitrogen (%)</b>	<b>Phosphorous (%)</b>	<b>Potassium (%)</b>
Enriched FYM	1.38	6.17	0.72
Enriched pressmud compost	1.93	7.38	1.89
Enriched poultry manure compost	2.72	7.54	2.03

**Table 2. Experimental details**

<b>Particulars</b>	<b>Description</b>
Parentage	Co11 x PR202
Duration (days)	120-125
Special features	Non-lodging, drought resistance, easy thresh ability, resistance to neck and finger blast
Date of sowing	3.12.2019
Date of transplanting	25.12.2019
Date of harvesting	1.4.2020

vermiwash @ 5%, S<sub>5</sub>-Foliar spray of seaweed extract @ 0.3% (All the foliar sprays were given at 20, 40 and 60 DAT). The experiment with different treatments was tested in the field in a split plot design with three replications. Farm yard manure, pressmud and poultry manure are used and biofertilizers are purchased from department agricultural microbiology, faculty of Agriculture, Annamalai University. Enriched compost prepared with following procedure, Enriched FYM compost was prepared by mixing single super phosphate @ 187.5 kg ha<sup>-1</sup>, biofertilizers 10 kg of *Azospirillum* and 10 kg of *Phosphobacteria* were thoroughly blended with 750 kg of FYM on dry weight basis and formed into heap like structure and it was maintained under shaded condition with 60% moisture. The same procedure followed in preparation of enriched poultry manure compost and enriched pressmud compost [12]. After two months, enriched compost was ready and it was applied to the respective plots as per treatment schedule before transplanting. The nutrient content of above said enriched organic compost are furnished in Table 1. The cultivar used for the study was Co 15 and field experiment details was given in Table 2. Eighteen days old healthy seedling were transplanted @ 2 seedling hill<sup>-1</sup> with a spacing of 30 x 10 cm. The recommended fertilizer schedule (RDF) of ragi viz., 60:30:30 kg of NPK ha<sup>-1</sup> was applied.

## 2.1 Biometric Observation

From each net plot area, five plants were chosen at random and tagged for biometric observation at various growth phases of crop. Plant height, dry matter production, number of productive ear

head m<sup>-2</sup>, number of grains ear head<sup>-1</sup>, grain yield and straw yield was measured and recorded at harvest stage. Leaf area index was estimated at flowering stage and number of tillers m<sup>-2</sup> was recorded at maximum tillering stage. Harvesting of ear heads was done in each plot separately. The grains were cleaned, dried, and their dry weight was recorded at 14 per cent moisture level and straw yield was also recorded. The data on each characters were evaluated throughout the investigation was statistically analysed as suggested by Panse and Sukhatme [13]. To make the statistical inferences, the critical differences were calculated at a 0.05 probability level.

## 3. RESULTS AND DISCUSSION

### 3.1 Effect of Enriched Organic Compost and Foliar Nutrition on Growth Attributes (Table 3)

Among the main plot treatments, application of enriched poultry manure compost (M<sub>3</sub>) @ 750 kg ha<sup>-1</sup> significantly registered the maximum plant height of 103.64 cm, leaf area index of 5.71 (flowering stage), dry matter production of 9156 kg ha<sup>-1</sup> and number of tillers m<sup>-2</sup> of 161.27. These could be attributed to the gradual transformation and mineralization of organic matter, which resulted in a continuous supply of nitrogen (N) by enriched compost during the entire crop growth cycle. Additionally, by dissolving the water-insoluble P compounds by naturally occurring acids released during disintegration of organic matter and thus resulted in increased availability of phosphorus to crop, along with higher native potassium

availability, may be a significant factor for achieving greater plant height, number of tillers  $m^{-2}$ , LAI and DMP by organics. This result agreed with the findings of Sherin and Ahuja [14] whose treatment applications improved plant height, number of tillers  $m^{-2}$ , LAI and DMP. The least plant height of 92.36 cm, number of tillers  $m^{-2}$  of 103.76, leaf area index of 3.83 and dry matter production of 7012  $kg\ ha^{-1}$  recorded under  $M_1$  (enriched FYM compost @ 750  $kg\ ha^{-1}$ ).

In respect of foliar treatments, plots applied with seaweed extract @ 0.3% on 20, 40 and 60 DAT ( $S_5$ ) exhibited an accelerated effect on the growth attributes viz., plant height of 103.52 cm, LAI of 5.68, number of tillers of 163.08  $m^{-2}$  and DMP of 9049  $kg\ ha^{-1}$ . This is mostly because of seaweed extract was applied three times, which accelerated up several kinds of metabolic processes like photosynthesis, energy transfer reactions, cell divisions, and elongation. Additionally, significant quantities of nutrients and growth hormone are included in a balanced manner. These elements might contribute for improved growth characteristics [15]. This treatment was followed by foliar spraying of humic acid @ 0.3% on 20, 40 and 60 DAT ( $S_2$ ). The least plant height of 88.87 cm, leaf area index of 3.29, number of tillers  $m^{-2}$  of 91.24 and dry matter production of 6381  $kg\ ha^{-1}$  were recorded under  $S_1$  (water spray).

### 3.2 Effect of Enriched Organic Compost and Foliar Nutrition on Yield Attributes (Table 4)

Among different yield attributing characters, in main plot treatments,  $M_3$  (enriched poultry manure compost @ 750  $kg\ ha^{-1}$ ) recorded highest values of number of earhead of 95.81  $m^{-2}$  and number of grains ear head $^{-1}$  of 1480. This may be because of application of enriched poultry manure compost and inorganic fertilizer, resulted in increasing the nutrient availability in the soil, which led to enhancement of the yield attributes of ragi. This result is in agreement with the result of Agbede et al. [16] who reported significant application on yield attributes with enriched organic compost and foliar nutrition. The least number of earhead of 72.51  $m^{-2}$ , number of grains ear head $^{-1}$  1092 and test weight 2.99 g were recorded in  $M_1$  (enriched FYM compost @ 750  $kg\ ha^{-1}$ ). Among foliar nutrition treatments, higher number of earhead of 96.27  $m^{-2}$  and number of grains ear head $^{-1}$  of 1472 were obtained with the foliar spraying of seaweed extract @ 0.3% on 20, 40 and 60 DAT ( $S_5$ ). These might be the result of providing both macro and micro nutrients via foliar spray, which promoted the development of more floral buds and prevented shedding by ensuring optimal biophysiological conditions in plants, thereby increasing the yield attributes [17,18]. The lowest yield attributes were registered under water spray ( $S_1$ ).

**Table 3. Effect of enriched organic compost and foliar nutrition on growth attributes of ragi**

Treatments	Plant height (cm)	Leaf area index	Number of tillers $m^{-2}$	Dry matter production ( $kg\ ha^{-1}$ )
<b>Main plots</b>				
$M_1$ - Enriched FYM @ 750 $kg\ ha^{-1}$	92.36	3.83	103.76	7012
$M_2$ - Enriched pressmud compost @ 750 $kg\ ha^{-1}$	97.12	4.77	131.39	7945
$M_3$ - Enriched poultry manure compost @ 750 $kg\ ha^{-1}$	103.64	5.71	161.27	9156
S.Ed.	1.14	0.06	1.91	105
C.D(P=0.05)	3.27	0.19	5.44	299
<b>Sub Plots</b>				
$S_1$ - Control (water spray)	88.87	3.29	91.24	6381
$S_1$ - Foliar spray of humic acid @ 0.3 %	100.16	5.20	138.95	8531
$S_1$ - Foliar spray of panchagavya @ 3 %	97.89	4.79	133.94	8070
$S_1$ - Foliar spray of vermiwash @ 5 %	98.19	4.88	134.15	8155
$S_1$ - Foliar spray of seaweed @ 0.3 %	103.52	5.68	163.08	9049
S.Ed.	0.88	0.04	1.25	73
C.D(P=0.05)	1.83	0.09	2.59	152

**Table 4. Effect of enriched organic compost and foliar nutrition on yield attributes and yield of ragi**

Treatments	Number of productive ear heads m <sup>-2</sup>	Number of grains ear head <sup>-1</sup>	Grain yield (kg ha <sup>-1</sup> )	Straw yield (kg ha <sup>-1</sup> )
<b>Main Plots</b>				
M <sub>1</sub> - Enriched FYM @ 750 kg ha <sup>-1</sup>	72.41	1092	2689	5467
M <sub>2</sub> - Enriched pressmud compost @ 750 kg ha <sup>-1</sup>	82.61	1264	3098	6058
M <sub>3</sub> - Enriched poultry manure compost @ 750 kg ha <sup>-1</sup>	95.81	1480	3504	6597
S.Ed.	1.09	17	73	74
C.D(P=0.05)	3.12	48	158	212
<b>Sub Plots</b>				
S <sub>1</sub> - Control (water spray)	64.73	950	2389	4968
S <sub>1</sub> - Foliar spray of humic acid @ 0.3 %	87.85	1375	3316	6347
S <sub>1</sub> - Foliar spray of panchagavya @ 3 %	84.40	1290	3090	6079
S <sub>1</sub> - Foliar spray of vermiwash @ 5 %	84.95	1307	3139	6134
S <sub>1</sub> - Foliar spray of seaweed @ 0.3 %	96.27	1472	3567	6675
S.Ed.	0.76	12	37	56
C.D(P=0.05)	1.59	24	83	119

### 3.3 Effect of Enriched Organic Compost and foliar Nutrition on Grain Yield and Straw Yield (Table 4)

In respect of yield, enriched poultry manure compost @ 750 kg ha<sup>-1</sup> (M<sub>3</sub>) recorded higher grain and straw yield of 3504 and 6597 kg ha<sup>-1</sup>, respectively. This could be attributed to composted poultry manure that increased the microbial activity, and enhanced uptake of vital plant nutrients, which in turn improved the translocation of photosynthesates from source to sink that lead to increased grain and straw production [19]. The least grain and straw yields of 2689 and 5467 kg ha<sup>-1</sup>, respectively were recorded under the application of enriched FYM compost @ 750 kg ha<sup>-1</sup> (M<sub>1</sub>). Among the various foliar treatments, seaweed extract @ 0.3% on 20, 40 and 60 DAT (S<sub>5</sub>) registered higher grain and straw yield of 3567 and 6675 kg ha<sup>-1</sup>. This might be attributed to higher biomass production at early stages of crop growth through increased utilization of nutrients, leading to higher LAI and photosynthetic rate resulting in higher growth and yield attributes [20]. It was followed by (S<sub>2</sub>). The least grain and straw yields were obtained under water spray (S<sub>1</sub>) of 2389 and 4968 kg ha<sup>-1</sup>, respectively.

### 4. CONCLUSION

The results of this field study, showed that combined application of enriched poultry manure

compost @ 750 kg ha<sup>-1</sup> followed by foliar spray of seaweed extract @ 0.3% on 20, 40 and 60 DAT was found to be best agronomic nutrient management practice for performing higher growth and yield of finger millet under irrigated condition.

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### COMPETING INTERESTS

Authors have declared that no competing interests exist.

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