Effect of enriched organic compost and foliar nutrition on growth and yield of Ragi

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 and five sub plot treatments, adopting statistical design, SPD and it was replicated thrice. From the results of the field experiment, among enriched compost, enriched poultry manure compost @ 750 kg ha^{-1} significantly exhibited greater values of growth and yield. Similar results were obtained under subplot treatments, namely foliar spray of seaweed extract @ 0.3 % on 20, 40 and 60 DAT and the least values of growth and yield 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 illustrate that cultivation of ragi under irrigated condition with combined application of enriched poultry manure @ 750 kg ha^{-1} 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 Tamil nadu.

Keywords: Finger millet, enriched poultry manure, seaweed, growth and yield

Introduction

Millets exhibits 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 [17] 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^{-1}. 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^{-1}[3]. It can able to withstand water stress, warming stress, and nutritional stress [8]. Despite these advantages, farmers still grow~~grew~~ millets as rainfed crop with poor management practices which result results 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 became 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 [15]. Organic inputs like poultry manure application increases soil organic matter, total N, as well as P exchangeable cations [1]. FYM have traditionally been used by farmers, as it supplies all macro nutritents (N, P, K, Ca, Mg, S) and micro nutrients (Fe, Mn, Cu, Zn) essential for plant growth [11]. Pressmud is reported to have major plant nutrients and therefore its influence physical, chemical and biological features of soil [14]. 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 [9]. Humic acid-based fertilizer increases crop yields by stimulating the plant enzymes, hormones and improves soil fertility [12]. Vermiwash is a rich source of soluble plant nutrients and contains earthworm secretions and enzymes that can promote crop growth [5]. 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 [19]. 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.

Materials and Methods

The experiment was conducted in the farmers` field at Puliyanthoppu village, Krishnagiri District, Tamilnadu 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 in potassium. The experiment comprised of three main plot treatments *viz*., M_1- Enriched FYM compost @ 750 kg ha^{-1}, M_2- Enriched pressmud compost @ 750 kg ha^{-1}, M_3- Enriched Poultry manure compost @ 750 kg ha^{-1} and five subplot treatments namely, S_1- Control

(Water spray), S_2- Foliar spray of humic acid @ 0.3 %, S_3-Foliar spray of panchagavya @ 3 %, S_4- Foliar spray of vermiwash @ 5 %, S_5-Foliar spray of seaweed extract @ 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. Enriched compost prepared with following procedure, Enriched FYM compost was prepared by mixing single super phosphate @ 187.5 kg ha^{-1}, biofertilizers10 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. After two months, enriched compost was~~ill be~~ ready and it was applied to the respective plots as per treatment schedule before transplanting. The cultivar used for the study was Co 15. Eighteen days old healthy seedling were transplanted @ 2 seedling $hill^{-1}$ with a spacing of 30 x 10 cm. The recommended fertilizer schedule (RDF) of ragi *viz.*, 60:30:30 kg of NPK ha^{-1} was applied. From each net plot area, five plants were chosen at random and tagged for biometric observation at various growth phases of crop. 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 [16]. To make the statistical inferences, the critical differences were calculated at a 0.05 probability level.

Result and Discussion

Effect of enriched organic compost and foliar nutrition on growth attributes (Table~~.~~ 1)

Among the main plot treatments, application of enriched poultry manure compost (M_3) @ 750 kg ha^{-1} 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^{-1} and number of tillers m^{-2} 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 [18] whose treatment applications improved plant height,

number of tillers m^{-2}, LAI and DMP[18]. 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 [4]. 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).

Effect of enriched organic compost and foliar nutrition on yield attributes (Table 2)

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 ear head 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*. [2] who reported significant application on yield attributes with enriched organic compost and foliar nutrition. The least number of ear head 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 ear head 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~~may~~ be the result of providing both macro and micro nutrients via foliar spray, which promoted~~s~~ the development of more floral buds and prevented~~s~~ shedding by ensuring optimal biophysiological conditions in plants, thereby increasing the yield attributes [10,7]. The lowest yield attributes were registered under water spray (S_1).

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Effect of enriched organic compost and foliar nutrition on grain yield and straw yield. (Table~~.~~ 2)

In respect of yield, enriched poultry manure compost @ 750 kg ha^{-1} (M_3) recorded higher grain and straw yield of 3504 and 6597 kg ha^{-1}, respectively. This could be attributed to composted poultry manure that increase~~d~~s the microbial activity, and enhanced uptake of vital plant nutrients, which in turn improve~~d~~s the translocation of photosynthaetes from source to sink that lea~~d~~s to increase~~d~~s the grain and straw production [13]. The least grain and straw yields of 2689 and 5467 kg ha^{-1}, respectively were~~as~~ recorded under the application of enriched FYM compost @ 750 kg ha^{-1} (M_1). Among the various foliar treatments, seaweed extract @ 0.3 % on 20, 40 and 60 DAT (S_5) registered higher grain and straw yield of 3567 and 6675 kg ha^{-1}. 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~~, which inturn maximum grain and straw yields~~ [6]. It was followed by (S_2). The least grain and straw yields were~~as~~ obtained under water spray (S_1) of 2389 and 4968 kg ha^{-1}, respectively.

Conclusion

~~From the~~ The results of this field study showed~~, concluded~~ that combined application of enriched poultry manure compost @ 750 kg ha^{-1} 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.

Ethical approval

This study does not involve experiments on animals or human subjects

Data availability

All data generated and analysed are included within this research

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Table. 1: 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})
MAIN PLOTS				
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
SUB PLOTS				
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. 2:. Effect of enriched organic compost and foliar nutrition on yield attributes and yield of ragi.

TREATMENTS	Number of productive ear heads m^{-2}	Number of grains ear $head^{-1}$	Grain yield (kg ha^{-1})	Straw yield (kg ha^{-1})
MAIN PLOTS				
M_1- Enriched FYM @ 750 kg ha^{-1}	72.41	1092	2689	5467
M_2- Enriched pressmud compost @ 750 kg ha^{-1}	82.61	1264	3098	6058
M_3- Enriched poultry manure compost @ 750 kg ha^{-1}	95.81	1480	3504	6597
S.Ed.	1.09	17	73	74
C.D(P=0.05)	3.12	48	158	212
SUB PLOTS				
S_1- Control (water spray)	64.73	950	2389	4968
S_1- Foliar spray of humic acid @ 0.3 %	87.85	1375	3316	6347
S_1- Foliar spray of panchagavya @ 3 %	84.40	1290	3090	6079
S_1- Foliar spray of vermiwash @ 5 %	84.95	1307	3139	6134
S_1- 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