

STUDY OF VARIOUS EM INOCULATED COMPOSTS ON PRODUCTIVITY AND SOIL FERTILITY ENHANCEMENT IN MAIZE

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ABSTRACT

Field experiment was conducted at the Experimental farm, Annamalai University, to study the effect of EM (effective microorganism) inoculated composts on yield and their influence on various nitrogen efficiencies indices in maize. There are ten treatments which includes – Without fertilizer and organic manure (Control), Recommended dose of fertilizer (RDF), RDF with three levels (12.5, 11.5 and 10.5 t ha⁻¹) of EM inoculated pressmud compost, RDF with three levels (12.5, 11.5 and 10.5 t ha⁻¹) of EM inoculated Farm Yard Manure (FYM), RDF with pressmud compost (12.5 t ha⁻¹) and RDF with FYM (12.5 t ha⁻¹). The experiment was conducted in randomized block design and replicated thrice with ten treatments.

The yield components of maize viz., cob length and number of grains cob⁻¹ were favourably influenced by RDF with 12.5 t ha⁻¹ of EM inoculated pressmud compost. It recorded maximum cob length, number of grains cob⁻¹, grain yield and stover yield. Similarly, Nitrogen use efficiency (NUE), Agronomic efficiency (AE), Apparent N recovery (ANR) and Internal efficiency (IE) were also found higher in this treatment. Hence application of RDF along with 12.5 t ha⁻¹ of EM inoculated pressmud compost to maize crop can be recommended for the farmers for getting higher yields and better nitrogen utilization in coastal regions of Tamil Nadu.

Key words: EM, Compost, Press mud, FYM, NUE.

INTRODUCTION

Maize is one of the most important cereal crop grown all over the world and has relatively higher production potential, wider adaptability and multifarious uses (Bhat *et al.*, 2013). It is a rich source of carbohydrates and has higher percentage of proteins than other cereals. At present in world, maize is grown over an area of 168 million hectares with a production of 945.8 million tonnes. In India, maize occupies an area of 8.55 million hectares with a production of 21.73 million tonnes and the productivity is 2.54 t ha⁻¹. It is extensively used for the preparation of by-products like starch, oil, corn flakes, wax, alcohol and tanning material for leather industry.

As heavy feeder of nutrients, maize productivity is largely dependent on nutrient management. The average maize yield is about 1.98 t ha⁻¹ but a yield potential of over 6 t ha⁻¹ is possible. This could be achieved through the adoption of productivity improving technologies such as increased use of hybrid maize and application of fertilizer by small-scale maize producers who make up 70% of the country's maize production (Poverty and Hunger, 2006). Use of inorganic fertilizers for increasing cereal crop production is inevitable in the present circumstances where cereal crop needs and livelihood issues of the people have sustained national priority. But this had declined the soil fertility in the long term. Press mud from sugar mill is another source of organic matter which contains substantial quantities of nutrient for improving physical condition and fertility of the soil.

Farm yard manure (FYM) are the physical composition of cattle litter and other miscellaneous farm wastes. FYM is slow acting and low analysing fertilizer, promotes growth of the crop plants by improving the water holding capacity and aeration of the soil. The modern concept of environmental management is based on recycling of waste. Effective microorganism consists of mixed culture of beneficial and naturally occurring microorganism that can be applied as inoculants. The most outstanding characteristic of EM is that it includes both aerobic and anaerobic species co-existing symbiotically in most beneficially productive manner. EM mainly consist of lactic acid bacteria (*Lactobacillus spp*), yeast (*Saccharomyces spp*) and photosynthetic bacteria (*Rhodospseudomonas spp*). EM solution can convert all waste into very good manures within a short time.

MATERIALS AND METHODS

Field experiment was conducted at the Experimental Farm, Department of Agronomy, Annamalai University, Tamil Nadu, to study the influence of effective microorganism (EM) inoculated organic wastes on yield of maize and various nitrogen efficiency indices in maize. The soil of the experimental site was clay loam in texture with low in available nitrogen, medium in available phosphorus and high in available potassium. The maize hybrid P 3502 (Hybrid) was chosen with a duration of 90-105 days for the study.

The experiment was laid out in Randomized Block Design with ten treatments viz., T₁ - No fertilizer and no organic manure (Control), T₂ - Recommended dose of fertilizer, T₃ - Recommended dose of fertilizer + 12.5 t ha⁻¹ of EM inoculated pressmud compost, T₄ - Recommended dose of fertilizer + 11.5 t ha⁻¹ of EM inoculated pressmud compost, T₅ - Recommended dose of fertilizer + 10.5 t ha⁻¹ of EM inoculated pressmud compost, T₆ - Recommended dose of fertilizer + 12.5 t ha⁻¹ of pressmud compost, T₇ - Recommended dose of fertilizer + 12.5 t ha⁻¹ of EM inoculated Farm Yard Manure (FYM), T₈ - Recommended dose of fertilizer + 11.5 t ha⁻¹ of EM inoculated FYM, T₉ - Recommended dose of fertilizer + 10.5 t ha⁻¹ of EM inoculated FYM, T₁₀ - Recommended dose of fertilizer + 12.5 t ha⁻¹ of FYM. The treatments were replicated thrice.

The Activated Effective Microorganism (AEM) was prepared by using Maple EM mother liquid stock solution. The AEM was prepared with following procedure. Take 1 kg of jaggery solution in a plastic bucket. Mix with 18-20 liter chlorine free water and also with 1 liter EM stock solution. Mix the solution thoroughly

and close the bucket with cover. Stir the solution 2-3 minutes regularly up to 1 week. This solution will be yellowish brown liquid having pleasant odour and a sweet sour test. It has acidic nature with white bubbles.

Organic waste raw material like press mud, farm yard manure were used for making EM compost. The organic waste raw material was inoculated with AEM solution @ 5 lit/tonne of raw material and heaped. Sprinkle water daily to maintain the moisture content of 60%. After 30-45 days the compost was ready to be matured and applied in field as per the treatment schedule. The 4-5 month old pressmud compost and farm yard manure were incorporated in the experimental plots as per the treatment schedule

The recommended dose fertilizer was 135:62.5:50 kg N, P₂O₅ and K₂O per ha⁻¹. Half dose of N and full dose of P₂O₅ and K₂O were applied basally. The remaining N was applied as top dressing at 25 and 45 DAS in two equal splits. The recommended seed rate of 15 kg ha⁻¹ was dibbled at one seed per hole to a depth of 4 cm with a spacing of 60 cm x 25 cm.

ASSESSING NITROGEN EFFICIENCY

Nitrogen use efficiency (NUE).

In this approach, nitrogen use efficiency was calculated in terms of seed yield kg⁻¹ of nitrogen fertilizer applied. It was computed using the formula as given below:

$$\text{NUE} = \frac{\text{Seed yield (kg ha}^{-1}\text{)}}{\text{Amount of nitrogen applied (kg ha}^{-1}\text{)}}$$

Agronomic Efficiency (AE)

In this approach, agronomic efficiency was calculated in terms of seed yield obtain from fertilized plot and unfertilized plot to kg⁻¹ of nitrogen applied. It was computed using the formula as given below:

$$\text{AE} = \frac{(\text{Grain yield in fertilized plot (kg ha}^{-1}\text{)}) - (\text{Grain yield in unfertilized plot (kg ha}^{-1}\text{)})}{\text{Amount of nitrogen applied (kg ha}^{-1}\text{)}}$$

Apparent N recovery (ANR) (%)

Apparent N recovery efficiency is defined as the quantity of nitrogen absorbed per unit of nitrogen applied. It was computed as per the formula suggested by Pillai and Vamadevan (1978).

$$\text{ANR} = \frac{Y_t - Y_0}{N_t} \times 100$$

Y_t = Uptake of N in particular treatment (kg ha⁻¹)

Y₀ = Uptake of N in unfertilized plot (kg ha⁻¹)

N_t = Quantity of N applied for the treatment (kg ha⁻¹)

Internal efficiency (IE)

Internal efficiency was calculated kg grain kg⁻¹ N uptake. It was computed using the formula as given below:

$$IE = \frac{\text{Grain yield(kg ha}^{-1}\text{)}}{\text{Total N uptake(kg ha}^{-1}\text{)}}$$

RESULTS AND DISCUSSION

Yield Parameters

The cob length, cob diameter and number of grains cob⁻¹ were recorded at the time of harvest of the maize crop (Table.1). The cob length, cob diameter and number of grains cob⁻¹ were significantly influenced by various composts along with chemical fertilizer. Among the treatments, application of RDF along with 12.5 t ha⁻¹ of EM inoculated pressmud composts (T₃) recorded significantly higher cob length of 18.90 cm. The next higher cob length was recorded by treatment T₇ - Recommended dose of fertilizer along with 12.5 t ha⁻¹ of EM inoculated FYM of 18.04 cm. The lowest cob length registered in treatment T₁ (control) 13.72 cm. Application of recommended dose of fertilizer with 12.5 t ha⁻¹ of EM inoculated pressmud composts (T₃) recorded significantly higher cob diameter of 4.71 cm. Least cob diameter was registered in treatment T₁ (control) and registered 3.21 cm.

The higher number of grains cob⁻¹ recorded in treatment with Recommended dose of fertilizer along with 12.5 t ha⁻¹ of EM inoculated pressmud composts recorded significantly higher number of grains (412). This was on par with the treatment, T₇ with RDF with 12.5 t ha⁻¹ of EM inoculated FYM. The minimum number of grains were registered in T₁ (control) of 270. The steady supply of nutrients through mineralization of EM inoculated pressmud compost might have contributed for higher cob length, cob diameter and number of grains cob⁻¹. This treatment could have supplied some micronutrients besides major nutrient by pressmud compost which leads to higher nutrient uptake by increasing nutrient availability that might have helped to achieve higher values in the study. These findings was in line with the reports of Santhosh Kumar (2012)

Corn Yield

Application of different composts with chemical fertilizers significantly influenced the maize corn yield (table.1). Among the treatments, application of Recommended dose of fertilizer along with 12.5 t ha⁻¹ of EM inoculated pressmud compost registered higher corn yield of 6482 kg ha⁻¹. It was on par with the treatment T₇ - Recommended dose of fertilizer along with 12.5 t ha⁻¹ of EM inoculated FYM. EM suppress pathogenic species while facilitating the decomposition of organic materials and synthesizing nutrients essential for plant growth and yield. Also higher corn yield might be attributed to rapid mineralization of N and sustained supply of nutrients from pressmud compost, which might have met the nutrient requirement of crop over a long period and specifically at the critical stages of crop growth. Similar report was indicated by Devi (2011). The control (T₁) treatment recorded least corn yield of 2456 kg ha⁻¹ at harvest. The least corn yield recorded under absolute control might be due to lack of adequate supply of nutrients (nitrogen,

phosphorus and potassium) to the crop which in turn affected the growth of the crop ultimately reflecting on yield (Sudhakar *et al.*, 2011)

Stover Yield

The stover yield was significantly influenced by different composts with chemical fertilizer application (table.1). Among the treatments, treatment T₃- Recommended dose of fertilizer along with 12.5 t ha⁻¹ of EM inoculated pressmud compost registered highest stover yield of 11,314 kg ha⁻¹. The next best is T₇-Recommended dose of fertilizer along with 12.5t ha⁻¹ of EM inoculated FYM registered higher stover yield. The treatment which registered the least stover yield was T₁-control of 6444 kg ha⁻¹. Under these conditions of abundant nutrient availability, the maize crop would utilize the nutrients at maximum extent which is turn resulted in appreciable improvement of growth attributes *viz.*, plant height and number of leaves per plant. It ultimately contributes to increase in stover yields.

Nitrogen Efficiency Indices

The computed data recorded on nitrogen use efficiency, agronomic efficiency, apparent N recovery and internal efficiency of applied nitrogen were presented in table.2. Applications of different composts with chemical fertilizers influenced the nitrogen use efficiency, agronomic efficiency, apparent N recovery and internal efficiency in the experiment.

The higher nitrogen use efficiency of 48.41, agronomic efficiency of 29.82, apparent N recovery of 47.99 and internal efficiency of 48.45 was recorded from the treatment T₃- Recommended dose of fertilizer along with 12.5 t ha⁻¹ of EM inoculated pressmud compost. It was followed by treatment T₇- Recommended dose of fertilizer along with 12.5 t ha⁻¹ of EM inoculated FYM. The treatment T₂- Recommended dose of fertilizer recorded least nitrogen use efficiency of 29.70, agronomic efficiency of 11.51 and apparent N recovery of 18.96 in this experiment. Inorganic fertilizer was added in conjunction with organic manures, the nutrient absorption increased and as a result the yield of crop was also improved consequently improving the agronomic efficiencies. This might be due to more amount of available nitrogen in pressmud and proper utilization of nitrogen by the maize plant. This was in agreement with the findings of Mondal *et al.* (2005)

CONCLUSION

Recommended dose of fertilizer along with organic source of nutrients such as pressmud, FYM and EM inoculated compost performed well in increasing the maize yield than no organic manures. Especially application of recommended dose of fertilizer along with EM inoculated pressmud @ 12.5 t ha⁻¹ was found to be the most efficient in increasing the grain and stover yield and nitrogen efficiency indices in maize.

Table.1.Effect of EM inoculated composts on yield parameters and yield of maize

TREATMENT	Cob length(cm)	Cob diameter(cm)	No. of Grains Cob ⁻¹	corn Yield (kg ha ⁻¹)	Stover yield (kg ha ⁻¹)
T ₁	13.72	3.21	270	2456	6444
T ₂	14.68	3.54	288	4010	8260
T ₃	18.90	4.71	412	6482	11314
T ₄	17.20	4.44	380	5938	10747
T ₅	15.87	4.04	325	4865	9585
T ₆	16.86	4.36	371	5710	10568
T ₇	18.04	4.59	397	6212	10992
T ₈	16.54	4.30	352	5542	10322
T ₉	15.52	3.93	306	4675	9330
T ₁₀	16.29	4.17	344	5410	10117
SE _d	0.37	0.09	7	126	230
CD (p=0.05)	0.78	0.19	16	264	483

Table.2.Effect of EM inoculated composts on various nitrogen efficiency indices in maize

TREATMENT	Nitrogen use efficiency	Agronomic efficiency	Apparent N recovery	Internal efficiency
T1	-	-	-	35.58
T2	29.70	11.51	18.96	42.38
T3	48.41	29.82	47.99	48.45
T4	43.99	25.79	40.99	47.75
T5	36.04	17.84	40.99	44.87
T6	42.30	24.10	39.07	46.90
T7	46.01	27.82	44.98	47.88
T8	41.05	22.86	37.19	46.49
T9	34.63	18.61	30.84	44.72
T10	40.07	23.10	38.01	46.21

Statistically not analysed

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