Impact of Effective Microorganism Inoculated Organic Waste on Maize and Soil Microorganism

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Abstract

Field experiment was conducted to study the impact of effective microorganism (EM) inoculated agricultural organic wastes on maize *(Zea mays)*. The experiment was conducted in randomized block design and replicated thrice with ten treatments *viz.*, T_1- Control,T_2- Recommended dose of fertilizer,T_3- Recommended dose of fertilizer with 12.5t $ha^{-1}$of EM inoculated pressmud compost, T_4- Recommended dose of fertilizer with 11.5 t $ha^{-1}$of EM inoculated pressmud compost, T_5- Recommended dose of fertilizer with 10.5 t $ha^{-1}$of EM inoculated pressmud compost, T_6 – Recommended dose of fertilizer with 12.5 t $ha^{-1}$of pressmud compost, T_7 – Recommended dose of fertilizer with 12.5 t $ha^{-1}$of EM inoculated FYM, T_8- Recommended dose of fertilizer with 11.5t $ha^{-1}$of EM inoculated FYM, T_9- Recommended dose of fertilizer with 10.5 t $ha^{-1}$of EM inoculated FYM, T_{10}- Recommended dose of fertilizer with 12.5 t $ha^{-1}$of FYM.

The maize grain & stover yield and soil microbial population was significantly influenced by recommended dose of fertilizer with 12.5 t $ha^{-1}$of EM inoculated pressmud compost(T_3). The least grain and stover yields was recorded in control treatment(T_1). In general, it can be concluded that application of recommended dose of fertilizer with 12.5 t $ha^{-1}$of EM inoculated pressmud compost to maize crop can be recommended for the farmers for achieving higher growth, yield and soil microbial population. EM inoculation is very use full method to make the availability of organic input for agriculture after the natural calamity periods.

Introduction

Maize is one of the most important cereal crops grown all over the globe 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 tones. 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} (Gangaiyah, 2013). In Tamil Nadu it is cultivated in an area of 0.22 million ha with production of 0.81 million tonnes and the productivity is 4.5 t ha^{-1} and also it occupies fourth position in Indian maize production. Since the crop has very high genetic yield potential, it is called as the 'miracle crop' and also as 'Queen of cereals' (Prasanna Kumar *et al.*, 2007). Maize yields are stagnant in recent years and this situation cannot coup to solve the food problems of ever increasing population. As heavy feeder of nutrients, maize productivity is largely dependent on nutrient management. Therefore, it needs fertile soil to express its full yield potential.

Corn has always had high nutrient demands and already puts a great strain on soil and fertilizer nutrient sources. 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. Organic manures may increase soil fertility and thus the crop production potential possibly by changes in soils physical and chemical properties including nutrient availability. A press mud from sugar mill is another source of organic matter and contains substantial quantities of nutrient for improving physical condition and improvement of soil fertility. 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 seed germination and root growth of the crop plants by improving the water holding capacity and aeration of the soil.

Composting is an organically rich soil amendment produced by the decomposition of waste materials. Effective microorganism(EM) mainly consist of lactic acid bacteria (*Lactobacillus spp*), yeast (*Saccharomyces spp*) and photosynthetic bacteria *(Rhodopseudomeonas spp*) which co-exist for the benefit of whichever environment they are introduced (Higa and Kinjo, 1989). EM plays an important role in composting of organic waste. This microbial solution can convert all waste into very good manures within a short time.

Material and Methods

The experiment was conducted, to study the impact of effective microorganism (EM) inoculated organic waste on yield of maize (*Zea mays*) and soil microorganism. The soil of the experimental fields was clay loam texture with low in available nitrogen, medium in available phosphorus and high in available potassium. The maize hybrid P 3502 (duration 90-105days) was chosen for the study.

The experiment was conducted in randomized block design and replicated thrice with ten treatments *viz.*, T_1- Control,T_2- Recommended dose of fertilizer ,T_3- Recommended dose of fertilizer with 12.5t $ha^{-1}$of EM inoculated pressmud compost, T_4- Recommended dose of fertilizer with 11.5 t $ha^{-1}$of EM inoculated pressmud compost,T_5- Recommended dose of fertilizer with 10.5 t $ha^{-1}$of EM inoculated pressmud compost, T_6 – Recommended dose of fertilizer with 12.5 t $ha^{-1}$of pressmud compost, T_7 – Recommended dose of fertilizer with 12.5 t $ha^{-1}$of EM inoculated FYM,T_8- Recommended dose of fertilizer with 11.5t $ha^{-1}$of EM inoculated FYM, T_9- Recommended dose of fertilizer along with 10.5 t $ha^{-1}$of EM inoculated FYM,T_{10}- Recommended dose of fertilizer with 12.5 t ha^{-1} of FYM. The well decomposed pressmud compost and farm yard manure used in the study.

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 60%. After 30-45 days the compost was ready to matured and apply in field where as conventional method takes around 5 months for its maturity. After maturity the compost was of good quality, with a good texture and pleasant odour.

The ridges and furrows were formed. The recommended seed rate of 15 kg ha^{-1} was sowing with a spacing of 60 cm x 25 cm. The recommended dose fertilize is: 135:62.5:50 kg N, P_2O_5 and K_2O per hectare was followed. Half dose of N and full dose of P_2O_5 and K_2O were applied basally. The remaining N was applied as top dressing at 25 and 45 DAS in two equal splits.

Soil microbial analysis

Soil samples were taken from individual plots at the end of experiments, dried and powdered. Soil water extract of respective treatments was cultured to assess the soil microbial population. For bacterial counts, the soil extract at a concentration of 10^{-5} and 10^{-6} was inoculated in Nutrient Glucose Agar medium and observed on 3rd day.

For assessing the fungal population, the extract was inoculated at a concentration of 10^{-3} and 10^{-4} in Rose Bengal Agar medium and the counts were taken on 4th day. For actinomycetes, the soil water extract was inoculated in Ken knight's Agar medium at a concentration of 10^{-4} and 10^{-5} and count was taken on 11th day.

The population of microorganisms was expressed in ten thousands. Fungi and actinomycetes were identified based on morphology. Bacteria were identified through Hewlett Packard microbial identification system.

Results and Discussion

Grain yield (Table 1)

Application of different composts with chemical fertilizers significantly influenced the maize grain and stover yield. Among the treatment, application of recommended dose of fertilizers along with 12.5 t ha^{-1} of EM inoculated pressmud compost registered higher grain and stover yield of 6542 and 11559 kg ha^{-1} respectively. It was on par with the treatment T_7 - recommended dose of fertilizers with 12.5 t ha^{-1} of EM inoculated FYM. The control (T_1) treatment recorded least grain and stover yield of 2271 and 5875 kg ha^{-1} respectively. EM inoculated pressmud compost have induced quick decomposition and timely release of nutrient rich inorganic matter, N, P, Ca and trace elements which enhance and contribute to increase growth and yield parameters, which has ultimately increased grain and stover yield of maize (Nathiya, 2013)

Soil microbial population(Table 1)

Various compost materials with chemical fertilizer application significantly altered the soil bacterial, fungal and actinomycetes population. Among the various treatments, application of recommended dose of fertilizer along with 12.5 t ha^{-1} of EM inoculated pressmud compost (T_3) recorded significantly higher bacterial, fungal and actinomycetes population of 60.21 CFU g^{-1}, 35.26 CFU g^{-1} and 10.97 CFU g^{-1} respectively. It was followed by the treatment T_7 - recommended dose of fertilizer along with 12.5 t ha^{-1} of EM inoculated FYM recorded the higher soil bacterial, fungal and actinomycetes population. The T_1-control registered less number of soil bacterial, fungal and actinomycetes population of 38.36 CFUg^{-1}, 21.99 CFUg^{-1} and 6.25 CFUg^{-1} respectively. Increase in soil microbial population due to addition of organics might have regulated soil temperature and ensures continuous availability of soil moisture and the humus content of soil. The inoculation of EM in pressmud compost which diversify and increase the number of beneficial microorganism in soil, it also acts as a good substrate for microorganism in soil. This was in line with the findings of Winget and Gold (2007).

Conclusion

In general, it can be concluded that application of recommended dose of fertilizer with 12.5 t $ha^{-1}$of EM inoculated pressmud compost to maize crop can be recommended for the farmers for achieving higher growth, yield and soil microbial population.

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Table.1. Impact of Effective Microorganism inoculated organic waste on Maize grain & stover yield and soil microorganism

TREATMENT	Grain yield (Kg ha^{-1})	Stover yield (Kg ha^{-1})	Bacterial 10^5 CFU g^{-1} of soil	Fungal 10^4 CFU g^{-1} of soil	Actinomycetes 10^4 CFU g^{-1} of soil
T_1-Control	2271	5875	38.36	21.99	6.25
T_2 -Recommended dose of fertilizer	3818	7961	41.27	23.86	7.18
T_3 - Recommended dose of fertilizer + 12.5 t ha^{-1} of EM inoculated pressmud compost	6542	11559	60.21	35.26	10.97
T_4 - Recommended dose of fertilizer + 11.5 t ha^{-1} of EM inoculated pressmud compost	6014	10858	54.29	32.11	9.92
T_5- Recommended dose of fertilizer + 10.5 t ha^{-1} of EM inoculated press mud compost	5007	9739	46.63	27.27	8.45
T_6- Recommended dose of fertilizer + 12.5 t ha^{-1} of pressmud compost	5800	10528	53.22	31.20	9.80
T_7 - Recommended dose of fertilizer + 12.5 t ha^{-1} of EM inoculated FYM	6275	11310	57.23	33.72	10.48
T_8 - Recommended dose of fertilizer + 11.5 t ha^{-1} of EM inoculated FYM	5633	10259	50.33	29.68	9.12
T_9 - Recommended dose of fertilizer + 10.5 t ha^{-1} of EM inoculated FYM	4783	9420	44.14	25.65	7.99
T_{10} - Recommended dose of fertilizer + 12.5 t ha^{-1} of FYM	5390	10012	49.31	28.76	8.97
SE_d	117	220	1.25	0.68	0.19
CD(P=0.05)	246	463	2.56	1.26	0.39