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Research Article

STUDIES ON INTEGRATED NUTRIENT MANAGEMENT PRACTICES FOR INCREASING PRODUCTION AND MAINTAINING SOIL FERTILITY IN MAIZE (ZEA MAYS L.)

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A B S T R A C T

Maize is an important crop for food and nutritional security in India. Strong market demand and resilience of maize to abiotic and biotic stresses have increased the area and production of maize in the country over the past decade. However, productivity of maize, has not increased proportionately and significant yield gaps are evident across maize growing areas in the country.

Keeping this in view, a field study was carried out at Experimental farm, Faculty of Agriculture, Annamalai University to find out most efficient and economic combination of different organic and inorganic sources of nutrients to increase the productivity of hybrid maize (Zea mays L.) without deteriorating the soil qualities. Ten different treatments with three replications each were carried out in randomised block design.

INM practice including pressmud based vermicompost @ 5 t ha-1 and with recommended dose of NPK showed its best results with respect to yield parameters like number of grains per cob, 100 seed weight and yield. The difference in available soil nitrogen, phosporus and pottasium due to different organic and inorganic treatments were significantly superior in post harvest soil over control. Among the different organic manures, pressmud based vermicompost @ 5 t ha-1 with RDF recorded higher post harvest soil N, P and K. The least soil available nutrient content was noticed in control treatment plot in post harvest soil.

INTRODUCTION

Maize (Zea mays L.) is one of the most important cereal crop in the world agriculture as food, feed and industrial raw material, it has high genetic yield potential than other cereal crops. Hence it is called as 'miracle crop' and also as 'queen of cereals'. Being a C4 plant, it is very efficient in converting solar energy in to dry matter. Maize crop is a major rainy season cereal crop, which provides the nutritional security due to its high nutritional value and has great demand.

On account of its quick growth habits, maize is a highly exhaustive crop and it is absolutely necessary that essential nutrient elements should be supplied in appropriate proportion to maintain soil fertility and to get higher yield. Hence heavy doses of these fertilizers are applied to maize. Though these practices helps to increase the production of crop; deterioration of natural resources (*viz.* land, water and air) is also the side of such high input intensive cultivation. Over reliance on use of chemical fertilizers has been associated with declines in soil physical and chemical properties and crop yield (Hepperly *et al.,* 2009)

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and significant land problems, such as soil degradation due to over exploitation of land and soil pollution caused by high application rates of fertilizers and pesticide application (Singh, 2000).Organic manures not only supply the plant nutrients but also improve soil health. Moreover, the amount of micronutrients present in organic manures may be sufficient to meet the requirement of crop production. But, it is also the fact that optimum yield level of maize production can't be achieved by using only organic manures because of their low nutrient content. Efficacy of organic sources to meet the nutrient requirement of crop is not as assured as mineral fertilizers. Under such situation, integrated plant nutrient system (IPNS) has assumed a great importance and has vital significance for the maintenance of soil productivity. Hence, joint use of chemical fertilizers along with various organic sources is capable of improving soil quality and higher crop productivity on long- term basis.

Highest productivity of crops in sustainable manner without deteriorating the soil and other natural resources could be achieved only by applying appropriate combination of different organic manures and inorganic fertilizers (Chandrashekara *et al*., 2000). It is important to identify the good type of available organic resources which can be used as fertilizers and their best combination with appropriate proportion of inorganic fertilizers.

However, due to above points the main purpose of this research was tofind out the best combination of organic and inorganic fertilizers for maximum production of maize in sustainable manner without affecting the soil Fertility.

MATERIALS AND METHODS

A field experiment which consists of 10 treatments was conducted at the Experimental Farm, Annamalai University, Tamil Nadu, India during two consecutive seasons in the year 2014. The experimental site was located at 11º24' N latitudes and 79º44' E longitudes with average annual rainfall of 1200 mm. The soil of experimental field was deep with clay loam in texture, neutral pH (7.6), medium in organic carbon (0.55%) and available P_2O_5 (27.0 kg/ha), high in K_2O (278.5kg/ha) and low in available N (210.0 kg/ha).

The treatments includes Absolute Control (T1), Recommended dose of fertilizer(RDF) (T2) , Pressmud compost and FYM @ 12 t ha^{-1} along with RDF (T3& T4) and differential dose of Pressmud based vermicompost , FYM based vermicompost and Crop residue based vermicompost @ 5 t ha^{-1} (T5, T6 & T7) and @ 3 t ha^{-1} (T8, T9 & T10)along with RDF for ascertaining the effect of the different treatments on growth and development of maize. The recommended fertilizer dose was 135:62.5:50 kg N, P_2O_5 and K_2O per ha^{-1}. 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 30 and 60 DAS in two equal splits. Maize hybrid 'NK 6240' was sown in flat bed at a spacing of 60cm x 25cm with seed rate of 15 kg/ha. The experimental research treatments was fixed by randomized block design with three replications.

Regular biometric observations were recorded at specific time intervals by selecting randomly five plants in each treatment. Crop was harvested at 130 days after sowing for both the years and yield observations were recorded from net plots. Randomly five soil samples from each plot were taken and examined for physico- chemical properties and nutrient status of soil after harvest of maize crop. The trend of observations was same for both the years, hence data was subjected to pooled analysis for interpreting the results. Yield attributes and grain yield of the crop were recorded. The available nitrogen was estimated by alkaline permanganate oxidation method as outlined by Subbiah and Asija. (1956). It was expressed in kg ha^{-1}. The content of available P and available K in the solution was estimated by the procedure described by Olsen *et al*., (1954) and Jackson, (1973). It was also expressed in kg ha^{-1}. The data were statistically analyzed and interpreted.

RESULTS AND DISCUSSION

Effect on yield attributing characters and Yield

The yield potential of maize is determined by yield components and the values of yield components are generally in accordance with that of growth parameters. This was well reflected in the present investigation also.

Among the yield parameters, grain numbers cob^{-1} was greatly influenced by pressmud based vermicompost @ 5 t ha^{-1} compared to FYM based vermicompost and crop residue based vermicompost. This might be due to enhanced dry matter production recorded in this treatment which is responsible for determining higher values in components of yield. 100 grain weight was not influenced by different organic sources of vermicompost and other compost as it was mainly governed by the genetic characters of the cultivar (Mehdi Rashtbari *et al*., 2012).

Among the various INM treatments, substantial increase in yield attributes *viz.,* cob length, cob diameter and grain numbers cob^{-1} was realized in pressmud based vermicompost @ 5 t ha^{-1} + RDF applied plots which reflected in grain yields. Significantly increased grain yields was recorded in pressmud based vermicompost @ 5 t ha^{-1} + RDF applied plot over other treatments. The aforesaid increased yields in this treatment might be due to higher nutrient uptake and increased photosynthetic efficiency as evident from optimum LAI values recorded (Aspasia Efthimiadou *et al.,* 2010). The constant release of N from organic manure, particularly from pressmud based vermicompost supplemented with NPK fertilizer might have satisfied the demand of the crop at every phenophase of maize crop. This adequate biomass production and improvement in yield parameters have resulted in higher yield in this plot (Balamurugan and Sudhakar, 2012). FYM based vermicompost and crop residue based vermicompost follows the line in descending order in respect of grain yields.
The control plot (no fertilizer) recorded the least value of grain yields.

Soil chemical properties

Regarding the pH, there was no significant variation found among the treatments and control.

In respect of organic carbon, between organic and inorganics, organic treatments showed higher organic carbon content. Among different organic treatments, Pressmud compost (T3) and FYM (T4) @ 12 t ha^{-1} showed higher organic carbon content followed by vermicompost treatments (T5 to T10). This increase in organic carbon content of soil in the aforesaid treatments might be due to the buildup of humus by application of organic manures in these treatments. This was consistent with the views of Babu Mathew (2001) and Balamurugan (2011). Lowest organic matter content was recorded in T2 (inorganic) and was in par with control treatment which shows inorganic treatment has no effect on organic carbon content (Table).

The difference in available soil nitrogen, phosporus and pottasium due to different organic and inorganic treatments were significantly superior in post harvest soil over control. Vermicompost application irrespective of source of preparation enhanced the available soil N, P and K contents (Table) at the end of the experiments when compared to their initial status and over recommended dose of fertilizer alone and control. Among the different vermicomposts, pressmud based vermicompost @ 5 t ha^{-1} with RDF (T_5) recorded higher post harvest soil N, P and K. This might be due to the tendency of pressmud based vermicompost amended soils to retain more of available N, P and K at the growth cycle, probably due to the presence of more organic matter (Arancon *et al*., 2006). Further increase in microbial population due to addition of pressmud might have regulated soil temperature and continuous availability of soil moisture and humus content in soil. This might have created favourable soil environment for microbes favouring their sustenance, rapid multiplication and its effect on nutrient availability. Similar observations have also been made by Rangaraj *et al.* (2007).

Table 1 Effect of INM practices on growth and yield attributing characters and yield of hybrid maize.

Treatments	Grain number cob^{-1}	100 grain weight (g)	Grain yield (kgha^{-1})	Organic carbon (%)	Available N	Available P	Available K
T_1 -Control (No fertilizer and no organic manure)	133	24.35	2698	0.48	184.1	22.3	271.5
T_2- Recommended dose of fertilizer	188	24.39	3821	0.47	187.8	24	276.3
T_3- T_2 + Pressmud compost @ 12 t ha^{-1}	255	24.47	5199	0.55	197.1	27.9	288.3
T_4-T_2 + FYM @ 12 t ha^{-1}	223	24.42	4538	0.54	193.2	26.4	283.2
T_5- T_2+ Pressmud based vermicompost @ 5 t ha^{-1}	320	24.56	6549	0.52	201.4	29.3	294.8
T_6- T_2+ FYM based vermicompost @ 5 t ha^{-1}	293	24.53	5989	0.52	197.2	28	288.6
T_7- T_2+ Crop residue based vermicompost @ 5 t ha^{-1}	258	24.49	5265	0.51	193.5	26.4	283.6
T_8- T_2 + Pressmud based vermicompost @ 3 t ha^{-1}	280	24.52	5721	0.52	197	27.8	287.8
T_9- T_2+ FYM based vermicompost @ 3 t ha^{-1}	265	24.50	5410	0.51	193.1	26.5	283.1
T_{10}- T_2+ Crop residue based vermicompost @3 t ha^{-1}	231	24.44	4704	0.51	191	25.2	279.6
SEd	6.93	0.04	147.20	0.01	1.6	0.6	1.9
CD (p=0.05)	14.50	NS	307.65	0.02	3.1	1.1	3.8

The least soil available nutrient content was noticed in control treatment plot (T_1) in post harvest soil.

SUMMARY AND CONCLUSION

The results obtained from the field experiments conducted to study the sustainability in yield and changes in soil nutrient availability by maize as influenced by various organic manures, vermicompost and fertilizer were briefly summarized hereunder.

- Maize being an exhaustive crop depletes soil fertility. The study on judicious integrated nutrient management strategy revealed that application of recommended dose of inorganic fertilizer along with pressmud based vermicompost @5 t ha^{-1} to maize not only enhanced productivity of maize over the control and recommended N, P and K respectively, but also improved soil fertility in terms of higher available N, P, K and organic carbon over control..
- INM practice including vermicompost and recommended dose of NPK showed its best results with respect to yield parameters like number of grains per cob and grain yield.
- Organic carbon and post harvest available NPK content was recorded maximum in INM treatment including pressmud compost @ 12 t ha and recommended dose of NPK.

Thus it can be recommended that basal application of pressmud based vermicompost @ 5 t ha^{-1} along with recommended dose of fertilizer could be recommended for growing maize crop to achieve higher production and maintain soil fertility. If the availability of pressmud is limited, FYM based vermicompost can also be recommended to achieve similar maize yields with out detoriating the soil fertility for the farmers in tail end areas of Cauvery delta regions of Tamil Nadu, India.

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