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Influence of Integrated use of Organic and Inorganic Sources of Nutrients on Biological Properties of Soil in Sweet Corn

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ABSTRACT: Soil being the source of various nutrients, supports various life forms. As world population and food production demands rise, intense cropping systems and indiscriminate use of chemical fertilizers creates the imbalance in soil eco system. Healthy soil is the foundation for profitable, productive, and environmentally sound agricultural systems. By understanding how the soil processes that support plant growth and regulate environmental quality and keeping this in view a field experiment entitled "Sustaining soil health and productivity of sweet corn through nutrient management" was carried out under field conditions during *kharif* season of 2017 at Agricultural College Farm, Bapatla. The biological properties of soil in respect of dehydrogenase activity and microbial population of bacteria, fungi and actinomycetes were significantly influenced by integration of organic and inorganic sources of nutrients over sole application of inorganic sources of nutrients. The biological properties of soil *viz.*, dehydrogenase activity and microbial populations were recorded in T_{10} which received integration of 25 per cent RDF, liquid N, P and K LBF each @ 1.5 L ha^{-1} and cow based liquid organic manures (beejamrutham and jeevamrutham) and it was on par with the integrated treatments receiving (T_7, T_8 & T_9) cow based liquid organic manures along with inorganic fertilizers.

Keywords: Microbial population, Liquid biofertilizers, Dehydrogenase activity, Sweet corn soil health.

INTRODUCTION

Sweet corn is a special type of corn becoming popular in India and is being cultivated in maize growing areas. The urban people have great interest in consuming green ears and it is found that sweet corn is more delicious when it is steam boiled and consumed. Due to its extra sweetness and short duration, sweet corn is gaining popularity and already awareness has been created among the farming community. As the product is freshly consumed, the quality of corn is considered to be the most important.

Sweet corn is an exhaustive crop and it is harvested at milky stage requires more nutrients for optimum production. So integrated nutrient management involving particularly FYM, liquid N, P and K biofertlizers and cow based liquid formulations *viz.,* Beejamrutham and Jeevamrutham not only acts as a source of multiple nutrients, helps in improving the microbial population there by they will have ability to improve soil characteristics (Ashmeet Kaur, 2020). In this context, it is worthy to study the nutrient management options in conjunction with inorganic fertilizers play an important role in sustaining productivity of sweet corn.

MATERIALS AND METHODS

A field experiment entitled "Sustaining soil health and productivity of sweet corn through nutrient management" was conducted at Agricultural College Farm, Bapatla using sweet corn hybrid maize Mahy-301 as a test crop. The experiment comprising of 10 treatments *viz*., T_1: Absolute Control, T_2: 100% RDF, T_3: FYM @ 5 t ha^{-1} + LBF @ 1.5 L ha^{-1}, T_4: Beejamrutham + Jeevamrutham, T_5: 50% RDF + FYM @ 5 t ha^{-1}, T_6: 50% RDF + LBF @ 1.5 L ha^{-1}, T_7: 50 % RDF + T_4, T_8: 25% RDF + T_4, T_9: 25% RDF + FYM @ 5 t ha^{-1} + T_4, T_{10}: 25% RDF +LBF @ 1.5 L ha^{-1} + T_4 laid out in randomized complete block design with three replications. The initial Dehydrogenase activity was 20.12 µg TPF g^{-1} day^{-1} and microbial population *viz.,* bacteria, fungi and actinomycetes was 17×10^5, 6×10^3 and 38×10^4 respectively.

Dehydrogenase enzyme activity in the soil sample was determined by following the procedure as described by Klein *et al.* (1971). Enumeration of microbial population *viz.,* bacteria, fungi and actinomycetes were estimated as per the procedures outlined by Paroda (2007).

RESULTS AND DISCUSSION

Bacteria. The bacterial population in soil at tasseling and at harvest (Table 1) was markedly influenced by the treatments. It was observed that higher count of bacterial population was observed at harvest when compared to tasseling in treatments which received seed treatment with beejamrutham followed by fortnight interval application of liquid jeevamrutham while in other treatments was at tasseling. The treatment T_2 which received inorganic fertilizers recorded significantly lesser population than the treatments (T_3 and T_4) received organic sources of nutrients at both the stages of crop growth.

The maximum colony forming units were observed in the treatment T_{10} (25% RDF + LBF @ 1.5L ha^{-1} + beejamrutham + jeevamrutham) while the minimum were observed in absolute control (T_1). According to Sreenivasa *et al*. (2010); Latkovic *et al.* (2020); Neelima and Sreenivasa (2011) maximum number of beneficial microorganisms observed in treatments received liquid formulations was mainly due to their constituents such as cow dung, cow urine, legume flour and jaggery containing both macro and essential micro nutrients, many vitamins, essential amino acids, growth promoting substances like indole acetic acid (IAA), gibberllic acid (GA) and beneficial microorganisms.

Among the treatments, the treatments (T_5 to T_{10}) which received integration of inorganic and organic sources of nutrients showed superiority over the sole application of inorganic sources of nutrients. Applied organic sources of nutrients *viz.,* FYM and liquid jeevamrutham served as a source of nutrients and also as a substrate for decomposition and mineralization of nutrients there by creating favourable conditions for proliferation of microbes. Integration of FYM, liquid N, P and K biofertilizers and inorganic fertilizers might have exerted stimulating influence on the preponderance of bacteria which was earlier reported by Selvi *et al*., (2005); Gunjal and Chitodkar (2017).

Fungi. The results revealed that fungal population was higher at tasseling and subsequently decreased with advancement of crop growth in all the treatments and the decrease was releatively low in treatments which received seed treatment with beejamrutham followed by liquid jeevamrutham application at fortnight interval.

The highest fungal population was observed in treatment T_{10} (25% RDF + LBF @1.5L ha^{-1} + beejamrutham + jeevamrutham) whereas the lowest fungal population was observed in absolute control. Increase in microbial population with the application of organic manure might be due to stimulated growth and activities of soil microorganisms, nutrient cycling and availability and assisting in root growth. Similarly Krishnan (2014) reported enormous amount of microbial load in Jeevamrutham treated soils.

Among the integrated treatments T_5 to T_{10}, the treatments which received seed treatment with beejamrutham followed by application of liquid jeevarutham (T_7 to T_{10}) for every fortnight interval showed higher beneficial microorganisms than the treatments which received FYM and liquid biofertilizers (T_5 and T_6). This might be due to during the formulation of jeevamrutham and beejamrutham a handful of soil was collected from the field was used. This would serve as a initial inoculum of bacteria, fungi and actinomycetes. The results are in confirmity with Papen *et al.* (2002); Sreenivasa *et al*. (2010) who have also reported the presence of naturally occurring beneficial microorganisms predominantly bacteria, yeast, actinomycetes and certain fungi in organic liquid manures

Actinomycetes. The maximum number of colony forming units (Table 1) with respect to actinomycetes were recorded in treatment T_{10} (25% RDF + LBF @1.5L ha^{-1} + beejamrutham + jeevamrutham) whereas the minimum number of colony forming units were observed in absolute control. Somasundaram *et al*. (2003) reported that liquid organic sources of nutrients not only enhance the microbes in the environment but also act as catalysts with a synergistic effect to promote all the useful microbes of the environment by secreting proteins, organic acids and antioxidants in the presence of organic matter and convert them into energy thereby improving actinomycetes population in soil.

Compared to the treatment which received only RDF (T_2), the other treatments which received either organic sources of nutrients alone or combination of both recorded higher number of actinomycetes population at both the stages of crop growth.

Dehydrogenase Activity. Dehydrogenase activity in soil is an index of microbial population and it was (Table 1) significantly influenced by the imposed treatments. All the treatments had shown significant improvement in enzyme activity at tasseling and at harvest of the crop over the initial.

At both the stages of crop growth significantly highest dehydrogenase activity was observed in the treatment T_{10} which received combination of organic source of nutrients *viz.,* liquid N, P and K biofertilizers, seed treatment with beejamrutham followed by liquid jeevamrutham application at fortnight interval along with inorganic source of nutrients (25% RDF). The highest activity might be due to enhanced microbial activity. Singaram and Kamalakumari (1995) supported that, increase in dehydrogenase activity on microbial consortium addition could be probably due to the increase in the microbial activity.

Among the different treatments, the treatments which received integrated source of nutrients recorded higher values of dehydrogenase activity than the treatment received inorganic source of nutrients only. Supplementation of balanced nutrition to crop was responsible for better proliferation of root (rhizosphere) and resulted maximum activity of enzymes. These findings are corroborate with the findings of Sireesha *et al.* (2017) who reported maximum activity of dehydrogenase in the rhizosphere of maize – onion cropping system on integration of 50 per cent RDF with 50 per cent N through FYM. Similar results were also reported by Pawar *et al.* (2013).

The unmanured and unfertilized control treatment T_1 registered the lowest activity than all other treatments indicating the beneficial effect of fertilizers and manures on enzymatic activity in soil.

Table 1: Biological properties of soil as influenced by integrated nutrient management in sweet corn.

Treatments	Bacterial population ($\times 10^5$)		Fungal population ($\times 10^3$)		Actinomycetes ($\times 10^4$ CFU g^{-1} soil)		Dehydrogenase activity (µg TPF g^{-1} soil day^{-1})	
	Tasseling	Harvest	Tasseling	Harvest	Tasseling	Harvest	Tasseling	Harvest
T_1 : Absolute Control	19.00	17.33	39.33	37.67	26.33	24.00	8.67	8.00
T_2 : 100 % RDF	21.67	20.33	40.00	38.00	27.84	25.33	13.67	12.33
T_3: FYM @ 5t ha^{-1} + LBF @ 1.5L ha^{-1}	28 .33	29.00	46.33	49.33	39.33	39.67	23.00	24.00
T_4 : Beejamrutham + Jeevamrutham	25.00	33.33	48.67	54.00	38.36	39.00	25.00	23.67
T_5 : 50% RDF + FYM @ 5t ha^{-1}	25.33	23.33	44.00	42.30	30.68	28.33	17.33	16.33
T_6 : 50% RDF + LBF @ 1.5L ha^{-1}	25.33	23.67	45.00	43.22	36.98	34.67	18.67	18.00
T_7 : 50 % RDF+ T_4	27.00	32.00	49.00	55.33	39.67	39.67	24.33	27.33
T_8 : 25% RDF + T_4	26.33	31.67	48.96	56.00	38.61	39.67	24.00	25.67
T_9 : 25% RDF + FYM @ 5t ha^{-1} + T_4	27.33	34.00	49.00	59.00	39.28	40.33	25.33	28.00
T_{10} : 25% RDF +LBF @ 1.5L ha^{-1} + T_4	29.00	36.67	51.33	60.33	45.54	47.33	26.33	29.67
SEm±	1.25	1.41	1.41	1.52	1.98	2.12	0.94	1.10
CD @ 0.05	3.70	4.17	4.19	4.52	5.87	6.30	2.80	3.27
CV (%)	8.48	8.65	5.29	5.32	9.50	9.79	7.91	8.95

CONCLUSION

Application of organic sources of nutrients like farm yard manure, liquid biofertilizers and cow based liquid organic sources of nutrients *viz.,* beejamrutham and jeevamrutham not only supplied adequate amount of macro and micronutrients but also might have played a major role in improving biological properties of soil which might have resulted in the improvement of crop growth and finally enhancing the yield and yield attributes of sweet corn.

FUTURE SCOPE

The study of biological properties with integrated use of organic and inorganic sources of nutrients will help in better understanding of population of microbes in soil which will help in improving the soil health. Further studies on soil biological properties will help in identification of microbes and microbial diversity which needs special consideration as microbial diversity plays an important role in maintaining microbial ecological multi functionality.

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