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Soil available Nutrient Status as Influenced by Various Organics and Inorganic Fertilizers in Maize – Maize Cropping system

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ABSTRACT

A field experiment was conducted to evaluate the soil available nutrient status with the application of organic and inorganic source of nutrients during *kharif* and *rabi* seasons of 2008 and 2009 at the irrigated upland farm of Tamil Nadu Agricultural University, Coimbatore. The experiment was laid out in randomized block design with three replications and ten treatments. The results revealed that significant increase in soil available nitrogen, phosphorous and micro nutrients at the end of two years of cropping sequence was recorded with 100 per cent RDF supplied through poultry manure, while, higher soil available potassium was observed with the application of 100 per cent RDF through vermicompost.

Key words : Inorganics, Maize, Organis, Soil fertility.

Maize (*Zea mays L.*) is one of the most important cereal crops grown all over the globe as poor man's food and also as cattle and poultry feed. With the intention of achieving evergreen revolution, intensive research in maize has been started anticipating its importance for food and feed. Maize is an exhaustive crop and responds well to applied fertilizers. Though the continuous use of fertilizers had significantly improved the crop productivity, heavy fertilizer application on the same plot every year in continuous maize system will drain the soil fertility rapidly and result in a plethora of problems *viz*., decline in crop productivity, deficiency of several micro nutrients, environmental pollution etc. The success of future agriculture depends upon sustainability of production systems. This has necessiated research on use of organic manures. It helps farmers to reduce inputs of commercial fertilizers, there by increasing profit margin. However, the use of organic manure alone, cannot sustain the cropping system due to unavailability of required quantities and their relatively low nutrient content (Palm *et al,* 1997).

Thus, it has been realized that application of chemical fertilizers in conjunction with organic manures and bio fertilizers will sustain and maintain the productivity of soil. Therefore, it is necessary to compare various organic as well as biological sources of nutrients with chemical fertilizers in order to find out the most effective combination.

MATERIAL AND METHODS

Field experiments were conducted during *kharif* and *rabi* seasons of 2008 and 2009 at the irrigated upland farm of Tamil Nadu Agricultural University, Coimbatore, Tamil Nadu. The soil of the experimental field was sandy clay loam in texture, alkaline in reaction (pH 8.5), Low in organic carbon (0.39%) and available nitrogen (242.6 kg ha^{-1}), medium in available phosphorus (13.5 kg ha^{-1}) higher in available potassium (552 kg ha^{-1}), Low in Zn (0.76 ppm), Cu (1.98 ppm) Mn (2.44 ppm) available Fe(2.72 ppm). The experiment was laid out in randomized block design, replicated thrice and the same layout was maintained during both the years of study. The experiment consisted of ten treatments comprising four treatments of different organic manures and their combinations *viz*.,100 per cent RDF through FYM, vermicompost and poultry manure and all the manures at 1/3, 1/3, 1/3 proportion. Four treatments were integrated i.e., 50 per cent RDF through organic manures and 50 per cent RDF through inorganic fertilizers. The remaining two treatments were 100 per cent RDF through inorganic fertilizers and control (without organics and inorganics).

Based on the equal N basis, required quantities of organic manures were incorporated in to the soil ten days before sowing (Table 1). The applied manures also satisfied the P and K

requirements of maize. Seed treatment was done with biofertilizers viz., *azospirillum* and *pseudomonas* to all the treatments except the treatment with 100 per cent RDF through inorganic fertilizers and control. All the organic and integrated treatments were sprayed with *panchagavya* at regular intervals. The recommended dose of fertilizer for maize is 150-75-75 kg N,P_2O_5,K_2O ha^{-1}. Fertilizer dose was calculated as per the treatment using Urea, Super Phosphate and Muriate of Potash. The treatments were imposed on test cultivar of maize CoH (M) 5. The data recorded on various parameters during the course of investigation and the summed up data were statistically analysed following the analysis of variance for randomized block design as suggested by Panse and Sukhatme (1978).

RESULTS AND DISCUSSION

Soil available nutrient status

Soil available nitrogen

Post harvest soil available nitrogen status was significantly influenced by varied nutrient management practices with unaltered trend during both the years of study, but differed in magnitude.

The highest status of soil available nitrogen (240.5 and 248.8 kg ha^{-1}) during *kharif* and *rabi* seasons of 2008, was recorded with the application of 100 per cent poultry manure (T_5) which was comparable with 100 per cent RDF through vermicompost (T_4) and showed statistical superiority over 100 per cent RDF through 1/3 FYM + 1/3 VC + 1/3 PM (T_6) and 100 per cent RDF through FYM (T_3) (Table 2.). *Kharif* and *rabi* 2009 seasons, application of 100 per cent poultry manure (T_5) registered significantly higher soil available nitrogen (253.1 and 262.3 kg ha^{-1}) which was on par with 100 per cent RDF through vermicompost (T_4). Supply of recommended dose of nitrogen through fertilizer recorded significantly lesser status of soil available nitrogen than with any of the organic sources.The lowest status of post harvest soil available nitrogen was recorded with unmanured plot (T_1) (Table 3).

The improvement in soil available N with the application of 100 per cent RDF through poultry manure over 100 per cent RDF through inorganics is 8.65 per cent and 15.5 per cent during 2008 and 2009, respectively. This is due to lower amount of residual nutrient made available in inorganic fertilizer applied field. Inorganic fertilizers cause immediate release of nutrients, which will be utilized by the crop or may be lost into the environment through leaching or denitrification process (Singh *et al*., 2006).

Soil available phosphorus

The soil available P status was also influenced owing to the addition of organic manures and inorganic fertilizers. The highest status of post harvest soil available P (13.4 and 13.8 kg ha^{-1}) was recorded with the application of 100 per cent poultry manure (T_5) followed by 100 per cent RDF through vermicompost (T_4) and these two treatments were statistically on par. The next best treatment was 100 per cent RDF through 1/3 FYM + 1/3 VC + 1/3 PM (T_6) during *kharif* and *rabi* seasons of 2008. During 2009 *kharif* and *rabi* seasons, the trend was un alterd the 100 per cent poultry manure (T_5) treatment was found to be extremely superior and recorded highest soil available P (14.1 and 15.2 kg ha^{-1}) which was comparable with 100 per cent RDF through vermicompost (T_4).When all the treatments are considered, the unmanured one

Table 1. Nitrogen content of organic manures on dry weight basis.

S.No.	Organic manures	Nitogen (%)		Quantity on fresh weight basis (t ha^{-1}) added to supply recommended Nitrogen for maize(150 kg ha^{-1})	
		2008	2009	2008	2009
1.	FYM	0.60	0.50	25.00	30.00
2.	Vermicompost	1.74	1.81	8.62	8.28
3.	Poultry manure	2.74	2.27	5.47	6.60

Table 2. Effect of various organics and inorganic fertilizers on soil available nutrient status (kg ha^{-1}) of maize -2008.

Treatments	*Kharif*			*Rabi*		
	N	P	K	N	P	K
T_1 – Control (No manure)	218.0	11.1	534.7	202.6	10.9	527.5
T_2 – 100% RDF	229.0	13.1	542.0	227.0	12.5	536.0
T_3 – 100% RDF through FYM	232.0	12.6	553.6	242.6	13.1	556.8
T_4 – 100% RDF through Vermicompost (VC)	233.1	13.2	562.3	245.7	13.6	574.5
T_5 – 100% RDF through Poultry manure (PM)	240.5	13.4	557.1	248.5	13.8	568.9
T_6 – 100% RDF through 1/3 FYM+1/3VC+ 1/3 PM	232.6	12.6	550.5	243.2	13.3	555.2
T_7 – 50% RDF + 50% through FYM	221.5	12.4	545.7	224.8	12.6	549.7
T_8 – 50% RDF + 50% through VC	223.3	12.8	552.9	226.9	13.0	562.3
T_9 – 50% RDF + 50% through PM	230.8	12.9	549.1.	229.3	13.2	557.0
T_{10} – 50% RDF + 50% through 1/3 FYM+1/3VC+ 1/3 PM	231.2	12.7	546.2	226.4	12.9	553.6
SEd	3.7	0.1	5.1	4.3	0.2	5.0
CD(P=0.05)	7.8	0.3	10.7	8.9	0.4	10.4

Table 3. Effect of i various organics and inorganic fertilizers on soil available nutrient status (kg ha^{-1}) of maize -2009.

Treatments	*Kharif*			*Rabi*		
	N	P	K	N	P	K
T_1 – Control (No manure)	181.6	10.6	518.6	175.6	10.2	507.0
T_2 – 100% RDF	225.7	12.4	531.2	221.4	12.2	526.0
T_3 – 100% RDF through FYM	245.3	13.4	563.7	250.9	13.8	570.0
T_4 – 100% RDF through Vermicompost (VC)	249.5	13.8	579.4	258.6	14.6	585.2
T_5 – 100% RDF through Poultry manure (PM)	253.1	14.1	571.0	262.3	15.2	578.1
T_6 – 100% RDF through 1/3 FYM+1/3VC+ 1/3 PM	246.0	13.7	568.3	249.6	14.1	575.8
T_7 – 50% RDF + 50% through FYM	232.6	13.0	557.6	245.1	13.7	566.7
T_8 – 50% RDF + 50% through VC	235.8	13.1	566.8	248.6	14.2	573.5
T_9 – 50% RDF + 50% through PM	241.4	13.6	564.5	250.2	14.9	570.0
T_{10} – 50% RDF + 50% through 1/3 FYM+1/3VC+ 1/3 PM	233.3	13.2	562.2	243.6	14.0	568.4
SEd	3.7	0.2	5.2	4.0	0.3	5.5
CD(P=0.05)	7.7	0.4	10.9	8.5	0.6	11.5

registered the lower soil available P indicating its poor nutrient status. Application of 100 per cent RDF through poultry manure resulted in higher soil available P at all the growth stages of maize during both the years of study. During 2008, it is 9.4 per cent and during 2009 it is 19.7 per cent higher than control treatment. This is due to the mineralization of organic manure. In this process a number of organic acids, especially the hydroxyl ions (product of microbial metabolism) are produced, which released P through chelation or by removal of metal ions from the insoluble metal phosphates (Mohandas and Appavu, 2000).

Soil available potassium

Post harvest soil available potassium status was significantly influenced by varied nutrient management practices. Application of 100 per cent RDF through vermicompost (T_4) surpassed all other treatments and recorded higher values of 562.3 and 574.5 kg ha^{-1} during *kharif* and *rabi* seasons of 2008, respectively which was statistically on par

Table 4. Effect of various organics and inorganic fertilizers on the availability of micronutrients (ppm).

Treatments	*Kharif* 2008				*Rabi 2008*			
	Zn	Cu	Mn	Fe	Zn	Cu	Mn	Fe
T_1 – Control (No manure)	0.58	0.85	0.34	2.20	0.41	0.73	0.32	1.82
T_2 – 100% RDF	0.65	1.25	0.42	2.42	0.57	0.94	0.38	2.25
T_3 – 100% RDF through FYM	0.69	1.62	0.64	3.10	0.71	1.64	0.69	3.13
T_4 – 100% RDF through Vermicompost (VC)	0.73	1.67	0.75	3.48	0.75	1.68	0.81	3.50
T_5 – 100% RDF through Poultry manure (PM)	0.75	1.68	0.78	3.50	0.77	1.70	0.83	3.52
T_6 – 100% RDF through 1/3 FYM+1/3VC+ 1/3 PM	0.72	1.66	0.59	3.13	0.73	1.67	0.65	3.20
T_7 – 50% RDF + 50% through FYM	0.64	1.41	0.51	2.43	0.68	1.42	0.53	2.46
T_8 – 50% RDF + 50% through VC	0.68	1.45	0.48	2.61	0.70	1.47	0.51	2.63
T_9 – 50% RDF + 50% through PM	0.72	1.51	0.51	2.50	0.74	1.54	0.56	2.54
T_{10} – 50% RDF + 50% through 1/3 FYM+1/3VC+ 1/3 PM	0.71	1.43	0.58	2.53	0.72	1.45	0.61	2.57
SEd	0.06	0.05	0.02	0.22	0.06	0.04	0.03	0.22
CD(P=0.05)	0.13	0.10	0.04	0.46	0.13	0.09	0.06	0.46

Table 5. Effect of various organics and inorganic fertilizers on the availability of micronutrients (ppm).

Treatments	*Kharif* 2009				*Rabi 2009*			
	Zn	Cu	Mn	Fe	Zn	Cu	Mn	Fe
T_1 – Control (No manure)	0.36	0.65	0.28	1.74	0.31	0.58	0.26	1.66
T_2 – 100% RDF	0.51	0.87	0.36	2.23	0.47	0.71	0.34	2.18
T_3 – 100% RDF through FYM	0.76	1.67	0.72	3.15	0.80	1.68	0.73	3.18
T_4 – 100% RDF through Vermicompost (VC)	0.78	1.70	0.84	3.52	0.82	1.72	0.86	3.54
T_5 – 100% RDF through Poultry manure (PM)	0.80	1.72	0.86	3.53	0.84	1.74	0.87	3.55
T_6 – 100% RDF through 1/3 FYM+1/3VC+ 1/3 PM	0.76	1.69	0.67	3.23	0.80	1.70	0.69	3.25
T_7 – 50% RDF + 50% through FYM	0.70	1.44	0.55	2.48	0.73	1.46	0.57	2.51
T_8 – 50% RDF + 50% through VC	0.72	1.48	0.54	2.66	0.74	1.50	0.55	2.68
T_9 – 50% RDF + 50% through PM	0.76	1.55	0.58	2.57	0.78	1.56	0.60	2.59
T_{10} – 50% RDF + 50% through 1/3 FYM+1/3VC+ 1/3 PM	0.75	1.47	0.62	2.59	0.77	1.49	0.63	2.61
SEd	0.07	0.05	0.03	0.23	0.06	0.05	0.03	0.22
CD(P=0.05)	0.14	0.10	0.06	0.48	0.13	0.10	0.06	0.46

from that of the 100 per cent poultry manure (T_5) and significantly superior to all other integrated treatments.During 2009 also, 100 per cent RDF through vermicompost (T_4) proved better than all other integrated and organic manure treatments in recording higher soil available potassium (579.4 and 585.2 kg ha^{-1} during *kharif* and *rabi* seasons respectively) but it was on par with 100 percent poultry manure (T_5). The increase in soil available K is ascribed to the reduction in K fixation and release of K due to interaction of organic matter (Agbede *et al*., 2008). The lowest status of post harvest soil available potassium was recorded with unmanured plot (T_1).

Soil available micronutrients

Post harvest analysis for the soil available micronutrient status at the end of *kharif*, 2008 showed a decreasing trend for Zn, Cu and Mn and slightly increasing trend for Fe. However, soil micronutrient status had decreased from its initial level estimated at the time of begining of the experimentation.

Post harvest analysis at the end of the first year showed that the available Zn content was slightly higher (0.77ppm) with the application of 100 per cent poultry manure than other treatments(Table 4.) It was followed by 100 per cent vermicompost application. At the end of the

two year cropping cycle, the soil available Zn content was 0.84 ppm was recorded with the application of 100 per cent poultry manure application which was higher than the initial value (0.76 ppm), however it was lesser than the critical value (1.2 ppm).

Higher status of soil available Cu content, during *kharif* and *rabi* seasons of 2008, (1.68 and 1.70 ppm) were recorded with the application of 100 per cent poultry manure (T5). But the values were lower than the initial values (1.98 ppm). During *kharif* and *rabi* seasons of 2009, the soil available Cu content were 1.72 and 1.74 ppm, which were recorded with the application of 100 per cent poultry manure, but could not reach its initial values(Table 5.)

The soil available Mn content was reduced markedly from the initial level (2.44 ppm) invariably in all the treatments. At the end of first year cropping cycle, it was 0.83 ppm and at the end of two year cropping cycle it was slightly increased to 0.87 ppm which was recorded with the application of 100 per cent poultry manure (T_5) however, failed to reach its initial soil available value.

Application of 100 per cent poultry manure recorded the highest soil available Fe content (3.50 and 3.52 ppm) during *kharif* and *rabi* seasons of 2008. During *kharif* and *rabi* seasons of 2009, the values were slightly increased and registered 3.53 and 3.55 ppm, respectively. These values were higher than the initial value (2.72 ppm), but lower than the critical value (3.7 ppm).

The lowest available micronutrients (Zn, Cu, Mn and Fe) status was observed under 100 per cent RDF (T_2) and control (T_1) treatments at the end of both the years. The status of soil available micronutrients showed a decreasing trend after the first season and increasing trend from the end of first year to second year. The available micronutrient status was improved with the application of 100 per cent RDF through poultry manure application, which contains appreciable quantities of micronutrients. Application of inorganics alone showed very less soil available micronutrient status. It is due to the fact that chemical fertilizers drain the micronutrients as the same was obvious through the findings of Gupta *et al*. (2000).

CONCLUSION

Application of 100 per cent RDF through poultry manure enriched the soil available nitrogen, phosphorous and micronutrients where as, higher potassium availability was recorded with 100 per cent RDF through vermicompost in continuous maize-maize cropping system under irrigated upland condition of western zone of Tamil Nadu.

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