THE INFLUENCE OF LONG TERM ADDITION OF ORGANIC AMENDMENTS ON SOIL CHEMISTRY

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Introduction

With ever increasing demand for food production, the improvement of soil fertility to get higher yields is of prime importance. Due to the negative impacts of chemical fertilizers, the use of organic amendments is increasingly becoming popular among farmers worldwide. Though the benefits cannot be generalized, they play an important role in enhancing the chemical, physical, and biological properties of soil (Yagi *et al.*, 2003). The present study tried to assess the soil improvements due to long term addition of organic amendments and also whether application of organic manure could compensate the use of chemical fertilizers in vegetable cultivation in Sri Lanka. Soil sampling was carried out in a model vegetable plot at the Agricultural Research Station (HORDI) at Gannoruwa, Sri Lanka.

Materials and Methods

Two vegetable sites (Site 1 and Site 2) located at HORDI were used as the experimental sites for this study. Both sites have been cropped twice per year. Site 1 has been maintained as a monocrop plantation under different doses of compost (COM), chemical fertilizer (NPK) and a combination of chemical fertilizer and compost (COM+NPK), over a period of 10 years. A mixed crop of vegetables has been maintained in Site 2 using different organic amendments; compost made by *Tithonia* (T), *Gliricidia* (G), both *Tithonia* and *Gliricidia* (T+G), vermicompost (V) (at a rate of 40 t/ha) and chemical fertilizers, NPK (recommended dosage) over a period of 5 years. From each site soil samples were randomly taken from depths, 0-15 cm and 15-30 cm separately. The soil analyses were carried out at the Institute of Fundamental Studies, Kandy to determine selected soil parameters using standard procedures. The results were analyzed using One-way ANOVA Minitab 14.3 version.

Results and Discussion

In Site 1, the pH, Organic Carbon (C), Cation Exchange Capacity (CEC) and NO^-_3-N levels showed significantly higher values in both COM and NPK+COM treatments compared to NPK, indicating favorable effects from long-term use of organic amendments. The long-term addition of NPK fertilizers could lead to lower the soil pH due to releasing H^+ ion through the nitrification process. Higher pH in COM soils than in COM+NPK chemical fertilizers have a profound effect on making soil acidic but not severe as it was with adding NPK alone.

Renuka (1992) found that organic manure levels considerably raise CEC of soils. Soil Phosphorus (P) content in COM+NPK showed a significantly higher value than COM thereby suggesting that low contribution of soil P from long-term addition of organic amendments (Table 1). However, Maskey *et al.* (2004) observed an enhanced soil P content due to addition of organic manures. The COM+NPK treatment yielded the highest tomato yield (16.5 t/ha) for the season, *Yala*/2008, compared to COM (11.4 t/ha) and NPK (6.5 t/ha) suggesting that addition of organic amendments together with reduced dosage of NPK would be rather beneficial than applying NPK alone.

Table 1. Mean values of some soil parameters in different treatments in Site 1.

Treatment	Soil parameter					
	pH		Organic carbon%	CEC (cmol kg^{-1})	P (µg/g)	NO^-_3-N (µg/g soil)
	0-15 m	15-30 cm	0-15 cm	0-15 cm	0-15 cm	0-15 cm
COM	6.18 a	5.77 x	1.47 a	16.23 a	21.97 a	41.594 a
NPK	5.05 b	4.99 y	1.23 b	13.34 ab	25.53ab	21.062 b
COM+NPK	5.78 c	5.23 z	1.59 a	18.51 a	30.15 b	38.520 a

Different letters indicate significant differences ($P \leq 0.01$). a,b,c for 0-15 cm depth and x,y,z for 15-30 cm.

Table 2. Mean values of some soil parameters in different treatments in site 2.

Parameter	Depth cm	Treatments				
		NPK	T	G	T+G	V
pH	0-15	5.97 b	6.29 a	6.44 a	6.28 a	6.13 ab
	15-30	5.94 x	6.10 xy	6.24 y	6.14 xy	5.98 xy
C	0-15	1.43 b	1.59 a	1.59 a	1.55 ab	1.50 ab
	15-30	1.29 x	1.39 x	1.43 x	1.38 x	1.36 x
CEC	0-15	17.06 a	21.27 a	18.67 a	42.99 b	15.78 a
	15-30	17.23 x	18.55 x	22.48 xy	38.93 y	28.0 xy
P	0-15	28.32 a	23.18 a	25.61 a	26.06 a	19.06 a
	15-30	15.51 x	09.97 x	14.49 x	14.73 x	09.36 x
NO^-_3-N	0-15	23.72 a	32.90 a	36.82 a	30.47 a	27.07 a
	15-30	25.13 x	26.52 x	27.75 x	20.06 x	18.84 x

Different letters indicate significant differences ($P \leq 0.01$). a,b, for 0-15 cm depth and xy for 15-30 cm.

In site 2, only the soil pH and organic C showed consistently higher results in soils treated with organic amendments (except vermicompost) than soils treated with NPK. In both depths, a significantly higher CEC was obtained in soils treated with T+G than all other treatments. Unlike in other treatments, relatively lower values of CEC were obtained for soils of 15-30 cm depth under T and T+G treatments, which may be due to higher clay content compared to top soils. Though the differences are not significant, the soils treated with T and G separately showed higher NO^-_3-N levels compared to NPK and V treated soils.

Conclusions

The results of the present study indicated that long term addition of organic amendments could increase the overall soil status significantly compared to the addition of chemical fertilizers alone. The results also revealed that organic amendments alone will not sustain a vegetable yield on the long run, hence need to apply in combination with NPK. Addition of compost could definitely reduce the use of chemical fertilizers thereby reduce the negative effects of using chemicals. Vermicompost seems to contribute to the improvement of soil properties positively, but not as much as other organic fertilizers used in the study. Overall, the use of organic amendments in combination with reduced dosage of chemical fertilizers could bring many positive effects to the soils and would benefit the farmers.

References

Maskey, S.L., Bhattarai, S. and Karki, K.B. (2004). Long term effect of different sources of organic manures on wheat soyabean rotation. SAARC Journal of Agriculture, 2, 243-256.

Renuka, K.A. (1992). Effect of incorporation of green manure on soil reaction and pH buffering. B.Sc. research report, Department of Soil Science, Faculty of Agriculture, University of Peradeniya, Sri Lanka.

Yagi, R., Ferreira, M.E., Cruz, M.C.P. and Barbosa, J.C. (2003) Organic matter fractions and soil fertility under the influence of liming, vermicompost and cattle manure. Scientia Agricola, 60(3): 549-557.