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IMPACT OF VEGETABLE CULTIVATION ON FERTILITY STATUS OF SOILS IN THE NUWARA ELIYA AREA

K.M.A.KENDARAGAMA
Natural Resources Management Center, Peradeniya

M.A.LATHIFF
Horticulture Crops Research and Development Institute, P.O. Box 11, Peradeniya
and
A.G.CHANDRAPALA
Natural Resources Management Center, Peradeniya

ABSTRACT

Land use significantly influences soil fertility and it's sustainability particularly under intensive farming. A soil fertility survey was conducted in June 2000 to determine the effects of intensive vegetable cultivation in the Nuwara Eliya area on fertility status of soil. Treatments were four land uses in the catena namely forest in the upper slope, tea in the middle slope, vegetable in the middle slope and vegetable in the lower slope. Soil samples were collected from 0 – 15 cm depth and the samples were analyzed for some important fertility characteristics. Results showed that forest, tea, vegetable in the middle slope and vegetable in the lower slope respectively had mean values of (a) 4.26, 4.53, 4.86 and 5.43 of pH, (b) 11.6, 14.0, 67.2 and 66.2 ppm of available phosphorus and (c) 10.1, 10.2, 6.7 and 7.6 % of organic matter. Significant differences were not observed among treatments in electrical conductivity and exchangeable potassium. This study reveals an increase in available phosphorus and a decrease in organic matter in vegetable growing lands in comparison with that of tea and forest. This phosphorus build up may be associated with excessive application of fertilizer phosphorus for vegetables. Continuation of phosphorus accumulation in soil may affect the productivity of vegetable cropland in the Nuwara Eliya area.

KEYWORDS: Land use, Vegetables, Fertility

INTRODUCTION

Land use significantly influences soil fertility and it's sustainability in farmlands. This influence commonly occurs as either depletion or accumulation of soil resources such as plant nutrients, soluble salts and organic matter. It is much more evident under intensive farming systems. For example, a phosphorus (P) build up has been reported in intensively farming areas in the Kalpitiya peninsula (Kendaragama, 1997). Jeevanathan *et al.* (1995) reported very high levels of P in potato and vegetable-growing areas of the up country wet zone. Kendaragama (1995) reported a depletion of available P in soil with the practice of alley cropping on alfisols. Andriesse (1987) reported a rapid depletion of active P, Sulphur and Potassium in soil under shifting cultivation. Such studies point out the need of investigating soil fertility changes in major farming areas taking land use into consideration. Among such farming areas, vegetable growing croplands in Nuwara Eliya area are used for intensive farming with three cropping seasons per year. Thus, the aim of this study was to evaluate the effects of intensive crop cultivation on fertility status of soils of vegetable croplands in the Nuwara Eliya area.

MATERIALS AND METHODS

A field survey was conducted during April to August 2000 in 14 villages of the Nuwara Eliya area. These villages included Pattipola, Meepilimana, Ambewela, Ruwan Eliya, Kalukelle, Seethaeliya, Moonplane, Black pool, Boragas, Bambarakelle, Top pass, Shanthipura, Kalapura and Kandapola. The locations have Red Yellow Podzolic soils of the Nuwara Eliya series (Dasanayake and Hettiarachchi, 1999). Landform of the area varies from undulating to rolling with isolated hillocks. Distinct land uses in a central landscape in above villages namely forest, tea, vegetable in the middle slope and vegetable in the lower slope were selected. A total of 46 composite soil samples were collected from above land uses comprising 14 from forest, 4 from tea, 14 from middle slope vegetable and 14 from lower slope vegetable. The samples were drawn from surface (0-15 cm) depth of the soil and were analyzed for soil reaction (pH), Electrical conductivity (EC), available phosphorus (P), exchangeable potassium (K) and organic matter (OM). pH was determined by using a pH meter and EC was measured by using a conductivity bridge. Available P was determined by the Olsen method (Olsen and Sommers, 1982). Exchangeable K was extracted with ammonium acetate and K in the leachate was determined using a flame photometer. Organic matter content was determined by the Walkly-Black method (Nelson and Sommers, 1982).

RESULTS AND DISCUSSION

Soil pH

pH status of soils in four different land use systems are given in the table 1. Mean pH values of forest, tea, vegetable (middle slope) and vegetable (lower slope) was 4.26,4.53,4.86 and 5.43, respectively. It shows acidic nature of soils under all land uses. Dasanayake and Hettiarachchi (1999) also reported that these soils are acidic in reaction having pH value ranging from 4.0 to 4.8. Among the land uses, pH was higher in vegetable growing soils than the soils of forest and tea. It could be due to lime application in vegetable cultivation as reported by Dissanayake (1999). The Department of Agriculture has recommended the application of 2 t/ha of liming materials but farmers apply almost 650 kg/ha per year (Wijewardana, 1999). Therefore, it needs to advise farmers to apply correct quantities of liming materials for maintaining soil pH at optimum range for vegetable crops.

Table 1. pH status of surface (0-15 cm) soil in different land use systems.

Land use system	*Number of Samples*	*pH (1:1, soil:water)* Mean	*SD**	*Range*
Forest	14	4.26	0.46	3.9 – 5.1
Tea	4	4.53	0.57	4.1 – 5.3
Vegetable (Middle slope)	14	4.86	0.62	4.0 – 6.1
Vegetable (Lower slope)	14	5.43	0.61	4.2 – 6.2
LSD (P = 0.05)		0.37		
CV (%)		10.3		

* SD – Standard deviation

Electrical conductivity

Electrical conductivity status of soils in the different land uses are given in the table 2. A significant difference was not observed in EC among land use systems. Its range was wider in forest soils than the other soils.

Table 2. Electrical conductivity status of surface (0-15 cm) soil in different land use systems.

Land use system	*Number of samples*	*Electrical conductivity (dS/m, 1:5/ soil:water)* Mean	*SD**	*Range*
Forest	14	0.26	0.198	0.05 – 0.84
Tea	4	0.27	0.152	0.08 – 0.45
Vegetable (Middle slope)	14	0.21	0.093	0.10 – 0.38
Vegetable (Lower slope)	14	0.21	0.090	0.10 – 0.43
LSD (P = 0.05)		0.18		
CV (%)		51.3		

*SD – Standard deviation

Available Phosphorus

Available P status of soils in the selected land use systems is given in the table 3. Mean available P content was 11.6,14, 67.2 and 61.4 ppm in forest, tea, vegetable (middle slope) and vegetable (lower slope) respectively. It shows an accumulation of P in vegetable growing soils. This P buildup may be associated with excessive fertilizer application for vegetables as reported by Dissanayake (1999). Such a P built up has been reported in intensively vegetable growing areas of up country wet zone (Jeevanathan *et al.*, 1995 and Dissanayake, 1999). Continuation of P accumulation in soil may affect the productivity of valuable vegetable cropland in the Nuwara Eliya area. It shows the need of practicing soil test based P fertilizer application in this area. Another reason for this P build up is application of fertilizer mixtures rather than straight fertilizers by farmers in this area (Dissanayake, 1999). It emphases the need of educating farmers in the use of straight fertilizers and making straight fertilizers available in this area.

Table 3. Available phosphorus status of surface (0-15 cm) soil in different land use systems.

Land use system	*Number of samples*	*Available Phosphorus (ppm)*		
		Mean	*SD**	*Range*
Forest	14	11.6	6.13	4.3 – 25.7
Tea	4	14.0	9.06	3.2 – 24.8
Vegetable (Middle slope)	14	67.2	48.67	20.5 – 194.5
Vegetable (Lower slope)	14	66.2	43.01	8.9 – 129.5
LSD (P = 0.05)		23.4		
CV (%)		79.4		

* SD – Standard deviation

Exchangeable Potassium

Exchangeable K status of soils in the four land use systems is given in the table 4. A significant difference was not observed in exchangeable K in soil among land use systems. However, exchangeable potassium status are better in all land use systems including the forest for which fertilizer K has not been added. The reason for better K status of forest soils could be the supply of K to the soil from leaf litter. Ponnamperuma (1958) and Wijewardena (1999) also reported application of K fertilizers does not have a major effect on the crop yield due to presence of reasonable quantities of exchangeable K in soils in this area. It shows the possibility of practicing soil test based K fertilizer recommendations for crops grown in this area.

Table 4. Exchangeable potassium status of surface (0-15 cm) soil in different land use systems.

Land use system	*Number of samples*	*Exchangeable Potassium (ppm)*		
		Mean	*SD**	*Range*
Forest	14	206.7	180.0	41.4 – 682.5
Tea	4	314.7	245.6	92.8 – 585.0
Vegetable (Middle slope)	14	311.1	130.9	85.8 – 495.3
Vegetable (Lower slope)	14	313.9	196.2	82.7 – 880.8
LSD (P = 0.05)		116.8		
CV (%)		53.3		

* SD – Standard deviation

Organic Matter

Organic matter status of soils in different land uses is given in the table 5. Mean OM content was 10.1, 10.2, 6.7 and 7.6 % in forest, tea vegetable (middle slope) and vegetable (lower slope), respectively. It shows that O.M content is lower in vegetable growing areas than that of forest and tea. Eventhough farmers practice heavy application of organic manure for vegetables (Dissanayake, 1999), the reduction of OM level in vegetable growing soils could possibly be due to frequent exposure of the soil while preparing the land for crop planting as three cropping seasons are practiced in a year. Frequent application of liming materials for their vegetable fields could also be another reason for this reduction in organic matter in the soil.

Table 5. Organic matter status of surface (0-15 cm) soil in different land use systems.

Land use system	*Number of samples*	*Organic matter (%)*		
		Mean	*SD**	*Range*
Forest	14	10.1	5.35	1.4 – 24.6
Tea	4	10.2	1.46	8.2 – 11.7
Vegetable (Middle slope)	14	6.7	2.18	4.1 – 9.8
Vegetable (Lower slope)	14	7.6	2.51	3.2 – 22.0
LSD (P = 0.05)		2.6		
CV (%)		39.3		

* SD – Standard deviation

CONCLUSION

Vegetable cropland in the Nuwara Eliya area is associated with forest and tea lands in the catena. In comparison with forest and tea lands, vegetable growing area has lower levels of soil organic matter possibly due to frequent exposure of soil in land preparation for seasonal vegetable crops. In contrast, available soil phosphorus content is higher in vegetable cropland in comparison with that of forest and tea lands. This phosphorus build up may be associated with excessive application of fertilizer phosphorus for vegetables. Continuation of phosphorus accumulation in soil may affect the productivity of vegetable cropland in the Nuwara Eliya area.

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