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THE EFFECT OF POST PRUNE OPERATIONS ON SOIL PHYSICAL PROPERTIES AND YIELD OF TEA

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An experiment was conducted to study the effects of post prune cultivations such as growing Guatemala and *Eragrostis* grasses, planted in between pruned tea rows for a period of six months, on the extent of improvement of soil physical properties in the mid-country intermediate zone. This was compared with tillage by forking done both at the end and in the middle of the pruning cycle. In the treated plots the soil physical properties had improved in terms of organic carbon content,total pore space and water retention characteristics compared to the control while the mean cycle yield too was higher. Among the two grass varieties used in this study, the highest yield was obtained in plots interplanted to *Eragrostis.* This effect could be attributed to favourable soil physical properties.

INTRODUCTION

Continuous cultivation of any crop causes deterioration in soil physical and hydraulic properties(Aina, 1979). The deterioration may be minimum in a vigorously growing clonal tea which almost completely covers the ground when established. However, in a mature clonal tea field, there is surface soil compaction resulting from continuous treading by workers for harvesting and other cultural operations. It could also result from the beating action of rain drops when the soil is exposed immediately after pruning (Holland and Jochim, 1933;De Silva and Seevaratnam, 1968;Hudson,1971;Manipura,1972). This results in lower infiltration and higher run-off and lower water and air holding capacity of the surface soil. Though forking is recommended to alleviate soil compaction, the effect is temporary (Portsmourth, 1956; Tolhurst,1959;Kandiah,1975). Under up-country conditions, forking has not resulted in any significant yield increase(Manipura,1973). It is hence of importance that an alternative method is developed to alleviate soil compaction. Previous work has shown that growing grasses improves the soil physical properties (Low,1955;Sandanam *et.al.,* 1982 b). Though studies on the effect of growing grasses on soil physical properties after uprooting old seedling tea fields have been conducted, no work has been done to investigate these aspects in soils exposed after pruning. This study was undertaken to evaluate the effect of growing grasses in a pruned tea field on soil physical properties and the yield of tea in contrast to the conventional cultural operation of forking of tea rows.

MATERIALS AND METHODS

The study was undertaken in clone TRI 2025 in Field No.5 of St.James Estate, Hali-ela situated in the mid-country intermediate zone (Uva) in 1987. Four blocks with five plots in each block were marked out in late July. The field was pruned in September and dolomite applied at the rate of 1 $t.ha^{-1}$. The following treatments were assigned at random to the plots in each block.

T1 - Control (No soil reconditioning)

T2 - Growing Guatemala grass (*Tripsacum laxum*) in inter-row

T3 - Growing weeping love grass (*Eragrostis curvula)* in inter-row

T4 - Forking at the end of the cycle (*every row*)

T5 - Forking in middle of the current pruning cycle(*every other row*) and end of the pruning cycle (*every other row*)

Soon after pruning, in all plots prunings except foliage were taken out of the field. Guatemala and *Eragrostis* grasses were planted in between the tea rows at a spacing of 20 cm within the row in plots assigned to treatments T2 & T3 respectively. At the same time, in plots assigned to treatments T4 and T5, forking was done with a garden fork by forcing the fork into the ground at a nearly vertical angle up to a depth of 40 -45 cm the handle being pushed forward so as to open a pocket behind the tines. Ground litter was incorporated in the pocket before withdrawing the fork. The operation was repeated at intervals of 24 - 30 cm along the contour. The grasses were allowed to grow till the tea canopy regenerated. Guatemala and Erogrostis grasses were lopped over a period of six months at 30 cm height from the ground level and the loppings used to thatch the same plots after recording their weights. Once the tea canopy regenerated, the grasses were cut at ground level. Weekly harvesting of all plots were done for two months for covariance analysis before imposition of treatments. Weekly yield records commenced in early March 1988 and total yields were corrected using covariance analysis.

Physical Properties

Measurements of physical properties of soil were made in May 1988, using undisturbed core samples (diameter 5.4cm and height 6.0 cm) collected at 0 - 15 cm depth from the plots for estimation of water retention (one replicate only). Water retention up to 10 kPa was measured using the hanging water column (Klute,1986) and up to 1500 kPa by the pressure plate apparatus(Soil Moisture Equipment Co., USA). For the water retention data, Campbell's water retention model was fitted (Campbell, 1985). The air entry potential (Φ_e) and Campbell's 'b' value which indicate the porosity index, were estimated. Bulk density was determined on undisturbed core samples collected at 0 - 15 cm depth from all plots, according to the method of *Blake et.al* (1986). Soil samples were also collected at 0-15 cm depth from each plot at five points for organic carbon determination. These samples were bulked and subsamples taken were and analysed by the method of Walkley and Black (1934) after sieving through a 2mm sieve.

RESULTS AND DISCUSSION

The fresh weight of the grass loppings at time of tea canopy regeneration (May 1988) is presented in Table 1.

TABLE 1 – *Weight of grass loppings*

Treatments	*Weight* (t ha-1)
T2 Guatemala grass	32.7
T3 *Eragrostis* grass	0.7

The percentage of organic carbon as well as the bulk density of the soil in 0 – 15 cm depth are presented in Table 2.

TABLE 2 – *Organic carbon and bulk density of soils in 0-15 cm depth*

Treatments	*Organic carbon (%)*	*Bulk density* (Mg m^{-3})
T1 - Control	1.01	1.12
T2 - Guatemala grass	1.13	1.06
T3 - *Eragrostis* grass	1.19	1.04
T4 - Forking (End-cycle)	1.15	1.06
T5 - Forking (Mid and end-cycle)	1.13	1.08
L.S.D. (P=0.05)	NS	0.05

There was no significant difference in organic carbon content of the treated plots compared to the control (Treatment 1). This may be due to exclusion of surface litter and root residues by sieving through a 2mm sieve before analysis (Tolhurst, 1959). In addition, a six months period may not be adequate for decomposition of residues and improvement in organic carbon status. Also the coefficent of variation for organic carbon was a high value of 28.8% which could result in the treatment means being not significant. It was reported that Gautemala grass roots add about 8 m.t of dry matter to 0 - 15 cm of the soil in an 18 month period (Sandanam *et.al,* 1982a). It was estimated that leaves from prunings contribute about 1.8 m.t/ha[1] (Visser,1960). Theoretically to increase the organic carbon from 1.0 to 1.1%, about 1500 kg of C has to be incorporated into the 0-15 cm depth. However, due to natural mineralization and microbial respiration the amount necessary may be very much higher than 1500 kg.

All treatments had low bulk density compared to the control. The low bulk density in T2 and T3 is the result of root proliferation of Guatemala and *Eragrostis* grasses. It was reported that grasses have an extensive feeder root system which ramifies in the soil leading to loosening of the soil with simultaneous improvement in the organic carbon content (Tolhurst, 1959;Sandanam *et.al.*,1976;1982a). This results in better soil aggregation which reduces soil compaction (Martin,1944) . In treatments T4 and T5 the low bulk density is attributable to loosening of the soil by forking and incorporation of leaf litter into the pockets. The high bulk density in the control treatment may be due to lack of soil cultivation. It was reported that treading by workers engaged in cultural operations and impact of rain drops increase the compaction of surface soil and bulk density (Bulfin and Gleason, 1967). There was no difference in the bulk density of treatment T5 and control. This is possibly due to soil consolidation by the end of six months.

Th1e total water holding capacity of the soil in the 0 - 15 cm depth, the air entry potential ($Ö_e$) and Campbell's 'b' value are presented in Table 3.

TABLE 3 – *Total water holding capacity (TWC),air entry potential (Φ_e) and water retention parameters of the soil in 0 -15 cm depth*

Treatments	*TWC SE** *(mm)*	$Ö_e$	*Cambell's 'b' value*
T1 – Control	41.6 +3.5	1.94	8.49
T2 – Guatemala grass	52.5 +2.9	0.46	8.85
T3 – *Eragrostis* grass	49.5 +3.1	0.54	9.40
T4 – Forking (End cycle)	46.8 +3.8	0.24	9.97
T5 – Forking (Mid-and end- cycle)	46.4 +3.4	0.83	8.79

* mean of five measurements

All the treated plots showed an increase in water holding capacity of the soil compared to the control (T1) with the highest being found under *Guatemala* followed by *Eragrostis.* Air entry potential was lower under grasses and forking treatments which indicates that water can enter the soil at lower suctions. The Campbell's 'b' value was also higher under the treated plots. This is due to the presence of different size pores which facilitate conduction and retention of water and air. The water retention characteristics of the soil under different treatments are presented in Fig.1. The mean cycle yield is presented in Table 4.

TABLE 4 – *Mean cycle yield of tea*

Treatments	*Made tea (kg ha-¹)*
T1 – Control	3705
T2 – Guatemala grass	4405
T3 – Eragrostis grass	4939
T4 – Forking (End-cycle)	4449
T5 – Forking (Mid and end cycle)	4421
L.S.D. (P=0.05)	366

All treatments gave significantly higher yield than the control presumably due to the improved fertility status in terms of water retention and bulk density of the soil. The highest yield was obtained in the plots interplanted with *Eragrostis.* Under up-country conditions *Eragrostis* gave a higher yield compared to treatments reconditioned with *Guatemala,* (Anandacumarasamy and Amarasekara, 1986). A linear regression of bulk density vs yield gave a high correlation ($R^2 = 0.80$) suggesting their direct proportionality. A linear regression of 'b' value vs yield gave a low correlation (R^2=0.52) suggesting the lack of a causal relationship.

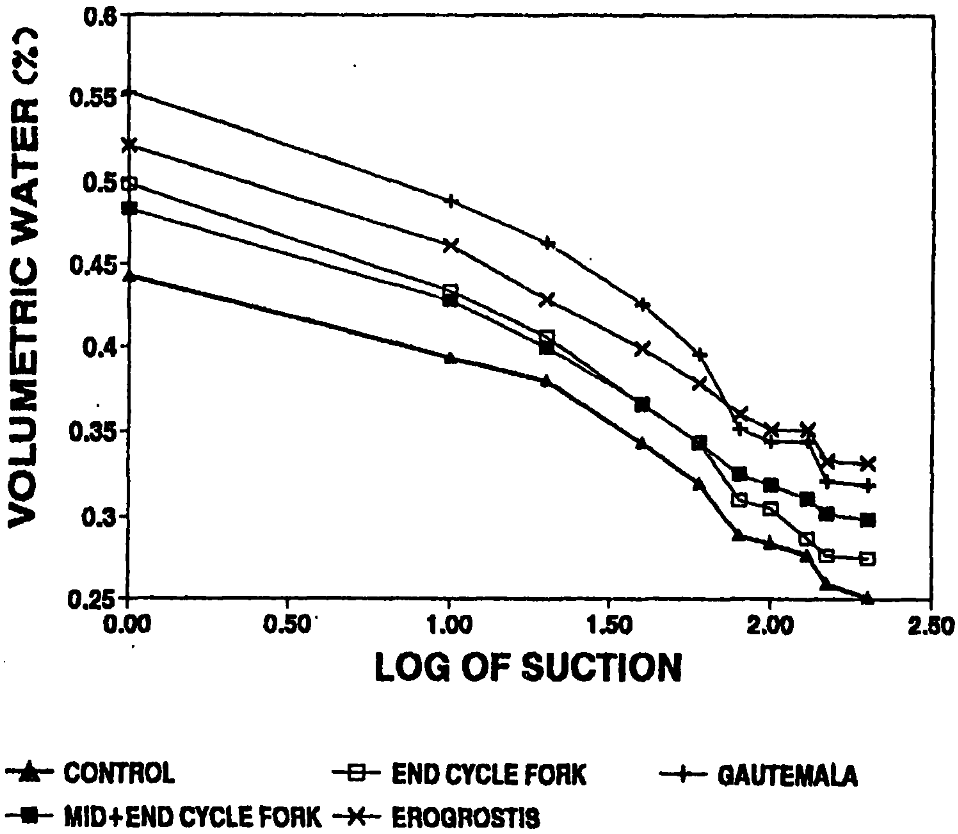

Fig. 1 – *Water retention curve in different treatments.*

CONCLUSION

This preliminary study clearly show the beneficial effect of post - prune operations in old tea fields in terms of improved soil physical and hydraulic properties and tea yield. The effect of such treatments may be more pronounced and long lasting in soils where the surface soil is compacted with low organic carbon.

The economic benefit of this exercise is reported by Herath *et al* (1996). The economic analysis suggests that all the treatments except the control are profitable for the growers.

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