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EFFECT OF SOIL RECONDITIONING ON GROWTH AND YIELD OF TEA

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Effect of soil reconditioning on establishment, growth and yield from pruning on tea was investigated in this study. It was observed that soil reconditioning improved the growth and yield of tea compared to no soil reconditioning.

INTRODUCTION

Beneficial effects of soil reconditioning with grasses such as Guatemala (*Tripsacum laxum*) and Mana (*Cymbopogen confertiflorus*) after uprooting and prior to replanting tea has been demonstrated by various workers (Tolhurst, 1955, Sandanam, Jayasooriya and Somaratne 1976; Sandanam and Ananthacumaraswamy 1982, Sandanam *et al.*, 1982*a*). The effect on improvement in soil physical conditions resulting from reconditioning, though relatively of short duration under tropical conditions (Haworth, 1953 ; Pereira, Chenery and Mills, 1954) provides favourable soil environment for better establishment and growth of the newly planted tea. Though most of the work reported earlier quantified improvements in soil physical properties, this was not always reflected in improved growth. The present study was undertaken to find out whether soil reconditioning prior to replanting tea helps in better establishment, growth and yield of tea.

MATERIALS AND METHODS

The investigation was carried at two sites situated in different agroecological regions. Site I was at St Coombs Estate, Talawakele (Lat. $6^0.55^8$ N ; Long. $80^0.40'$ E ; 1,382 m AMSL) and site II was at Galphele Estate, Kandy (Lat. $7^0.21^{0}$', Long. 80^043 E ; 840 m AMSL). At both sites graminacious species were used for soil reconditioning. The experimental plots were 14.4 m × 6.6 m indimensions. There were six treatments replicated five times. The rehabilitation grasses were allowed to remain for 18 months.

Site I—St Coombs Estate, Talawakele

T_1 — Old seed tea (control)
T_2 — Reconditioning with Guatemala grass (*Tripsacum laxum*)
T_3 — Reconditioning with Mana grass (*Cymbopogen confertiflorus*)
T_4 — Reconditioning with Guinea grass (*Panicum maximum*)
T_5 — Reconditioning with Guinea grass (*Panicum maximum*) and loppings removed for fodder
T_6 — Reconditioning with weeping love grass (*Eragrostis curvula*)

Site II—Galphele Estate, Kandy

T_1	—	Old seed tea (control)
T_2	—	Reconditioning with Guatemala grass (*Tripsacum laxum*)
T_3	—	Reconditioning with Mana grass (*Cymbopogen confertiflorus*)
T_4	—	Reconditioning with Guinea grass (*Panicum maximum*)
T_5	—	Reconditioning with Guinea grass (*Panicum maximum*) and loppings removed for fodder
T_6	—	Reconditioning with sugar cane (*Saccharum officinarum*)

Guatemala, Mana, Guinea and Eragrostis were lopped every three months and loppings thatched in the plot itself. In the case of sugar cane there were only loppings and trash retained in the plots.

In T_5 (at both sites) loppings were removed for fodder out of the plots.

After reconditioning for 18 months, tea was planted in July 1981 at a spacing of 1.2 m × 0.6 m with one-year-old tea plants of clone TRI 2025, a moderately drought resistant and high yielding clone. At both sites, at the end of first year of planting casualties were infilled with new tea plants of the same age. However, mortality rate was assessed only at St Coombs Estate. The experimental plots at St Coombs and Galphele Estates were brought into plucking after a cut across and tipping, in February and October 1981, respectively. The tipping weights were recorded only at St Coombs Estate. Thereafter, weekly plucking rounds were maintained up to March, 1983 at Galphele Estate after which the experiment was terminated due to heavy casualties resulting from the drought of 1983 while at St Coombs Estate yield records were maintained up to April 1985.

In May 1985, the plots at St Coombs Estate were pruned and the pruning weights, girth of the main stem at ground level and the area covered by the frame were recorded. The number of casualties at the end of the first and sixth year after planting was also recorded. In early August 1985 the plots were tipped and brought into plucking for the second cycle. The tipping weights were recorded.

RESULTS AND DISCUSSION

Table 1 presents the mortality rate under different treatments at St Coombs Estate. The mortality rate of newly planted tea was higher in the unreconditioned plots than the rest of the plots both at the end of first year after planting and at the end of six years. This is probably due to a favourable air-water relationship present in the reconditioned soil. It was shown that physical properties of soil reconditioned with grass were remarkably improved (Martin, 1944 ; Pereira, Chenery and Mills, 1954 ; Sandanam *et al.*, 1982*b*). The roots of the young newly planted tea prefer well aerated moist soil, that will permit easy physical penetration to ensure that the roots can keep in contact with water reserves throughout their development. Further, higher infiltration rates and higher available water capacities of the reconditioned soil besides thatching during the first year favours the young tea plant to withstand the drought better than those in the unreconditioned plots. It is interesting to note that the plots reconditioned with Guinea grass where loppings were removed for fodder, had the same low rate of mortality as in other reconditioned plots where loppings were retained for thatching. This clearly demonstrates that an improvement is brought about in the soil environment by growing grasses alone. However, the effect of thatching alone, without reconditioning with grasses were not tested in these trials. Other studies have shown that the beneficial effects from grass mulches were marginal (Othieno and Ahn, 1980) in higher altitude areas.

TABLE 1—*Percentage Mortality rate*–(*St Coombs Estate*)

Treatment		*End of 1st year*	*End of 1st cycle (6 years)*
1. No soil reconditioning	..	68·4	8·7
2. Soil reconditioning with Guatemala grass	..	12·5	2·4
3. Soil reconditioning with Mana grass	..	18·4	3·3
4. Soil reconditioning with Guinea grass	..	13·8	2·2
5. Soil reconditioning with Guinea grass and removed for fodder	..	17·0	2·0
6. Soil reconditioning with Eragrostis	..	15·1	3·3
LSD (P = 0.05)	..	17·0	4·0

It was shown for other crops that when a plant is uprooted a toxic effect is noticeable on young plants of the same species if they are planted immediately afterwards (Elliotte, McCalla and Waiss, 1978). This may be another reason for the higher rate of mortality in the unreconditioned soil. Even though casualties were replaced until the end of the first year, the mortality rate at the end of six years was also higher in the unreconditioned plots (Table I). However, the mortality rate was comparatively lower at the end of six years than at the end of first year. This may be partially due to infilling using comparatively larger plants (same age as original plants) which had a relatively well developed root system.

The tipping weights taken before the first plucking (Table 2) gives an indication of early growth. The plants in all the reconditioned plots had significantly higher tipping weights. This is due to better establishment and growth in the reconditioned soil. However, this trend was not seen at the beginning of the second cycle where only T_2 showed higher tipping weights.

TABLE 2—*Tipping weights* (*fresh*) (*kg ha*$^{-1}$) – (*St Coombs Estate*)

Treatments		*1st cycle*	*2nd cycle*
1. No soil reconditioning	..	232	1504
2. Soil reconditioning with Guatemala grass and loppings thatched	..	1885	1921
3. Soil reconditioning with Mana grass and loppings thatched	..	1499	1791
4. Soil reconditioning with Guinea grass and loppings thatched	..	1631	1721
5. Soil reconditioning with Guinea grass and loppings removed for fodder	..	1499	1617
6. Soil reconditioning with Eragrostis and loppings thatched	..	2050	1752
LSD (P = 0.05)	..	409	337

Annual and total cycle yield under various treatments at St Coombs Estate are presented in Table 3 and yield for 18 months at Galphele Estate in Table 4. During the first 3 years the reconditioned plots gave higher yields but not in the 4th year. The total yield for the 4 years in the reconditioned plots were significantly higher than the non-reconditioned plots. This is perhaps due to the momentum imparted by vigorous early growth of the plants in the reconditioned soil being carried through the cycle. Similar pattern of yield response was observed at Galphele Estate for 18 months. It is recognized that any set back incurred at the early stages of a perennial plants life will almost stunt plant growth many more years after (Tolhurst, 1955). This may be one of the reasons for the lower yield obtained in the unreconditioned plots. At the 4th year of plucking plants in all the treatments had lower growth rate and thus yields were not significantly different.

TABLE 3—*Yield made tea (kg ha*$^{-1}$*)*–*(St Coombs Estate)*

	1st year	*2nd year*	*3rd year*	*4th year*	*Total*
1. No soil reconditioning ..	655	1266	1873	2770	6564
2. Soil reconditioning with Guatemala grass	1385	2212	2242	2876	8713
3. Soil reconditioning with Mana grass	1171	1946	2110	2855	8082
4. Soil reconditioning with Guinea grass	1146	2019	2185	2918	8268
5. Soil reconditioning with Guinea grass and loppings removed for fodder ..	1107	1749	2106	2762	7724
6. Soil reconditioning with Eragrostis ..	1326	2077	2308	2863	8574
LSD (P = 0.05) ..	174	194	204	106	700

TABLE 4—*Yield made tea (kg ha*$^{-1}$*)*–*(Galphele Estate, October* 1981 – *March* 1983)

Treatments	
1. No soil reconditioning ..	707
2. Soil reconditioning with Guatemala grass ..	1100
3. Soil reconditioning with Mana grass ..	1085
4. Soil reconditioning with Guinea grass ..	1198
5. Soil reconditioning with Guinea grass and loppings removed for fodder ..	1106
6. Soil reconditioning with sugar cane ...	1110
LSD (P = 0.05) ..	286

The pruning weights (both fresh and dry) were not significant between any treatments (Table 5). It is to be noted that when pruning is done only portion of the above ground parts consisting mostly of leaves and tertiary branches are removed which form only part of the dry matter produced by the bush. However, it has been shown that most of the dry matter produced is stored in the woody frame (primary and secondary branches (Magambo and Cannell, 1981). Consequently if the entire above ground portion was pruned it is possible that differences between treatments may have been obtained. Differences, were however noted in bush girth at ground level and the area covered by the frames which is indicative of better growth rate of bushes in the reconditioned soil as seen earlier.

TABLE 5—*Pruning weight, bush girth and area covered by pruned frame.*

		Pruning weight ($mt.ha^{-1}$) Fresh	Dry	Bush girth (cm) at ground level	Area (cm^2) covered by pruned frame
1.	No soil reconditioning	36·6	15·9	17·5	1559
2.	Soil reconditioning with Guatemala grass	42.7	17·7	20·4	2705
3.	Soil reconditioning with Mana grass	37·1	16·0	20·0	2924
4.	Soil reconditioning with Guinea grass	38·3	16·1	19·4	2344
5.	Soil reconditioning with Guinea grass and loppings removed for fodder	38·4	16·1	18·7	2006
6.	Soil reconditioning with Eragrostia	38·9	16·7	18·9	2274
	LSD (P = 0.05)	NS	NS	1·5	557

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REFERENCES

ELLIOTTE, L. F., MCCALLA, T. M. and WAISS (JR). A. (1978). Phytotoxicity associated with residue management in crop residue management. Ed. W. R. Oscuwald and Matthias Stelly ASP Special Publication **31**, 131-146.

HAWORTH, F. (1953). Observations on the root system of Guatemala grass on an upland tea soil in Ceylon. *Trop. Agric.* (Trinidad) **30**, 116-121.

MAGAMBO, M. J. A. and CANNELl, M. G. R. (1981). Dry matter production and partition in relation to yield of tea. *Expt. Agric.* **17**, 33-38.

MARTIN, W. S. (1944). Grass covers in their relation to soil structure. *Emp. J. Exp. Agric.* **12**, 21-32.

OTHIENO, C. O. and AHN, P. M. (1980). Effects of mulches on soil temperature and growth of tea plants in Kenya. *Exp. Agric.* **16**, 287-294.

PEREIRA, H. C. CHENERY, E. M. and MILLS, W. R. (1954). The transient effect of grasses on the structure of tropical soils. *Emp. J. Exp. Agri.* **22**, 148-160.

SANDANAM, S., JAYASOORIYA, S. G. and SOMARATNE A. (1970). Effect of soil reconditioning on organic matter and nutrient status of tea soils and on yield of replanted tea. *J. Plant.Crops.* **4**, (2), 60-67.

SANDANAM, S. and ANANTHACUMARASWAMY, A. (1982). Effect of soil management on some physical properties of a red yellow podzolic tea soil. *Tea* Q. **51**, 75-85.

SANDANAM, S., SOMARATNE, A., AMARASEKERA, A. R., YATAWATTE, S. T., SAMARAJEEWA, S. and ANANTHACUMARASWAMY, A. (1982). An assessment of the suitability of five graminaceous species for soil reconditioning before replanting tea. 1. Effect of species on enrichment of organic matter status by top and root residues. *Tea* Q. **51**, 99- 107.

SANDANAM, S., SOMARATNE, A., AMARASEKERA, A. R., YATAWATTE, S. T., SAMARAJEEWA, S. and ANANTHACUMARASWAMY, A. (1982). An assessment of the suitability of five graminaceous species for soil reconditioning before replanting tea. 2. Effect of species on some soil physical and chemical properties. *Tea.* Q. **51**, 108-117.

TOLHURST, J. A. H. (1955). Ideas on the experimental replanting of tea. *Tea.* Q. **27**, 60-66.