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EFFECT OF INTER-PLANTING DADAPS (*ERYTHRINA LITHOSPERMA*) IN TEA (*CAMELLIA SINENSIS*) ON SOIL PHYSICAL PROPERTIES OF AN ULTISOL

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Some soil physical properties were measured in a 25–year–old field experiment planted with tea and interplanted with and without dadap (*Erythrina lithosperma*) in an ultisol in order to quantify the extent of soil improvement due to dadaps. Soil under tea interplanted with dadaps had higher percentage organic matter, total pore space, air pore space, water retention capacity, saturated and unsaturated hydraulic conductivity whereas soils under tea without dadaps had higher percentage dispersion and bulk density.

INTRODUCTION

It is generally accepted that a good stand of shade and green manure trees is often associated with good tea management. Some of the benefits associated with the above are (*a*) modification of micro-climate, such as light, air temperature and relative humidity around the tea favourable for better plant growth (Barua, 1960; Hadfield, 1968; Ripley, 1967); (*b*) a supply to the soil with bulky organic matter in the form of leaf fall and loppings (Dutta, 1960; Goodchild and Foster-Barham, 1958) thus supplementing heavy and rapid losses which take place under tropical conditions; (*c*) make available nitrogen and mineral nutrients in a cheap and relatively-easily available form; (*d*) maintenance of soil structure and its microbial population both closely connected with its fertility, and (e) buffering of soil temperature fluctuations which presumably has beneficial effect on the growth of tea (Manivel and Hussain, 1982).

In Sri Lanka, dadap is widely inter-planted with tea in ultisols in most of the tea growing areas as a medium shade as well as a green manure crop. It was reported that plots which received no nitrogen for years other than that obtained from dadap loppings have throughout maintained their yield and healthy appearance (Holland, 1931). Considerable evidence is available to show that soil physical properties are improved by increasing the organic matter content of the soil (Jamison, 1953; Unger, 1975). This study was undertaken to obtain quantitative data on the extent of improvement to soil properties by dadaps interplanted in tea which is lacking.

MATERIALS AND METHODS

Experimental site

This investigation was carried out in a mature tea field situated in an ultisol. In the above field there is an ongoing experiment with dadap (*Erythrina lithosperma*) inter-planted with Clone TRI 2025. The experimental section is situated in field No. 7 of St. Coombs Estate, Talawakele (1382 m AMSL).

The dadap was planted at a spacing of 6 m x 6 m whereas tea was planted at a spacing of 1.2 m x 0.6 m in 1961. The dadap was lopped twice annually just before monsoonal rains and the loppings put back in the soil as a mulch.

Soil physical properties studied and techniques employed.

Water retention characteristic was determined with undisturbed core samples (diameter 5. 4 cm and height 6.0 cm) taken at random at 0-30 cm depth. Six samples were taken from each plot. Water retention under lower suction (less than 10 k Pa) was determined with hanging water column and higher suction (greater than 10 k Pa and lower than 1500k Pa) was determined with pressure plate apparatus (Vomocil, 1965). Before determining water retention these samples were saturated and saturated water contents were noted. Bulk density was determined according to the core method (Blake, 1965) using the samples taken for water retention. Additional core samples were also taken to determine the saturated hydraulic conductivity in the laboratory using constant head method (Klute, 1965). The unsaturated conductivity of the soil was calculated by the procedure of Campbell(1974). Textural analysis (Gee and Bauda, 1979) and percentage dispersion (USDA hand book No. 60) were also determined. Organic carbon was determined by the method of Walkley and Black (1934).

RESULTS AND DISCUSSION

The measured physical properties are presented in Table I. A striking difference was found in the organic carbon content. The soil under treatment B (tea interplanted with dadap) had significantly higher organic carbon content than treatment A. Although decomposition of organic matter is rapid under tropical conditions, even under shade (Cunningham, 1963) organic matter continually accumulates in the form of leaf fall and loppings from dadap.

It has been reported that dadap adds 4-6 m tonnes/ha/annum as dry matter to the soil (Holland, 1931). In the case of treatment A, only leaf fall from tea and foliage from prunings once in 4-5 years are left to replenish scil organic matter which together with accelerated decomposition leads to reduced organic matter content.

Percentage dispersion gives the measure of ability of the soil structure to withstand the disruptive forces of erosive rain in the tropics. Lower percentage dispersion of treatment B (tea interplanted with dadaps) is due to its higher organic matter content. It was reported that organic matter serves as a substrate for biological activity. Polar substances resulting from decomposition of organic matter were most effective in aggregating cultivated soils (Kroth and Page, 1946). Microbial gums and filamentous fungi are known to thrive well under increased organic matter content and this probably contributed to increased percentage in treatment B. Higher percentage aggregation results in better crumb structure with the inter crumb spaces. Thus as expected lower bulk density and higher total pore space is found in treatment B than in A. Also, the thick layer of mulch found in treatment B, prevents direct impact of rain drops on the soil surface preventing breakdown of soil structure and reducing compaction resulting from labour treading while harvesting tea once in 4-7 days and performing cultural operations. Both saturated water content and total pore space determination in soil under treatment B gave similar results and were higher than in soil under treatment A.

Table 1 gives the textured distribution under the two treatments. The soil under tea interplanted with dadaps (Treatment B) had more clay when compared to treatment A. This is due to greater degree of soil exposure to erosive rain in treatment A, for a period of 4-6 months once in four years when most of the tea canopy is removed by pruning (Sandanam and Anandacumaraswamy, 1982). Particle size distribution could change in favour of sand due to downward eluviation and erosion which favours the removal of finer particles from the top soil (Aina, 1979).

Water retention of the soil under the two treatments are given in Table 1. Using the above values, available water capacity and air porosity were calculated assuming moisture content at 10 k Pa suction as field capacity. The soil under treatment B had higher water retention capacity than that of A. This is due to improved soil structure by mulching and higher organic matter content. In addition, increased clay content of the soil under treatment B also increases its water holding capacity. Mulching influenced the water holding capacity and water release characteristics of the soil favourably (Lal, 1974). Increasing the organic matter content of the fine textured soils results in improved structure, which decreases crusting and surface sealing and permits greater infiltration (Jamison, 1953). It was reported that soil moisture level at 0-45 cm depth in tea interplanted with dadaps was higher than in soil under unshaded tea during dry periods (Venkataramani, 1961). This is partly due to higher water retention capacity of the soil under tea interplanted with dadaps. Another probable reason is that the direct impact of rain on the soil is broken to some extent by dadap foliage and this coupled with the effect of loppings and leaf fall on the surface help in maintaining the porous nature of the soil surface thus favouring greater infiltration in addition to higher water retention.

Higher air porosity of treatment B over that of A, shows that it has more pores that are larger to allow rapid infiltration of rain water followed by early drainage so that oxygen is not limiting for plant growth (Carry and Hayden, 1973). This was further endorsed by higher saturated hydraulic conductivity (Table 1) of soil under treatment B. The unsaturated conductivity (Table 2) which is an important soil characteristic was also higher for treatment B under various suctions calculated. This again reflects the improved soil structure of treatment B, where extensive groups of small pores capable of conducting significant amounts of water are found.

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TABLE 1 — *Physical Properties of soil (Mean With Standard Error)*

Treatments	Soil Texture (%) *sand*	*silt*	*clay*	*% Organic Carbon*	*Bulk density gm - cm* $^{-3}$	*% Volumetric Saturated water content*	*Saturated Hydraulic Conductivity (cm/h)*
A	26.82±1.21	18.40±1.08	54.38±1.30	3.31±0.28	0.85±0.08	66.25±8.45	1.30±0.96
B	19.00±1.06	21.80±2.59	59.20±2.36	4.62±0.36	0.78±0.10	70.12±4.65	1.98±1.37

Treatments	*% Volumetric Water content at 10k Pa*	*1500k Pa*	*% Total Pore space*	*Total available water cm/30 cm*	*Percentage Dispersion*
A	42.46±4.35	21.48±2.60	67.92	5.93±1.73	79.8±2.2
B	43.24±3.61	19.72±2.26	70.56	6.56±1.17	74.2±1.4

TABLE 2 — *Unsaturated Hydraulic conductivity*

Treatments	Unsaturated Hydraulic Conductivity (cm/h) at *10 K Pa*	*30k Pa*	*100k Pa*	*1500k Pa*
A	3.53×10^{-2}	1.36×10^{-3}	5.54×10^{-4}	1.05×10^{-7}
B	4.17×10^{-2}	4.14×10^{-3}	1.59×10^{-3}	1.09×10^{-7}

Treatment A : Soil under tea without Dadaps

Treatment B : Soil under tea interplanted with Dadaps

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