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EFFECT OF MINERALIZATION OF TEA PRUNINGS ON SOME SOIL CHARACTERISTICS†

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The effect of incorporating tea prunings with soil on some edaphic characteristics was examined. During the first two months of incorporation tea prunings decomposed rapidly and brought about an increase in the availability of N and K and the organic matter content both in the surface (0-3") and sub-surface (3" - 6") soil. Incorporation of prunings reduced leaching of added N and K and the application of fertilizer N tend to reduce K availability in soil.

INTRODUCTION

Tea (*Camellia sinensis L.*) is grown widely in some parts of the world. In Sri Lanka the mature tea plant is pruned once in 2-3 years in the low-country (elevation 1000' above sea level). and once in 4 years in the up-country (Elevation 1000' above sea level). The pruned material is estimated to be about 10-15 tons per acre on a fresh weight basis and contains about 200 lbs of nitrogen, 100 lbs of phosphorus and 150 lbs of potassium. When this amount of pruned material is incorporated into the soil it undergoes mineralization releasing the nutrients contained in them. At a time when fertilizer prices are high such a practice will be of much economic benefit.

The investigation reported in this paper was carried out at the low-country station of the Tea Research Institute of Sri Lanka to study the influence of mineralization of tea prunings on some soil fertility characteristics.

MATERIALS AND METHODS

The experiment consisted of 24 randomized plots, each 12' × 12' in dimension and had 8 effective bushes. The pruned material was left on the ground, lightly mixed with soil in 12 plots. In the remaining 12 plots all the pruned material was removed. Soil samples devoid of large particles of the prunings were taken from each plot at monthly intervals and analysed for organic matter by the method of Walkley and Black. Ammonia nitrogen was estimated by the microdiffusion method after extracting the soil with 2N KCl. Available potassium was extracted with *N* NH_4Cl at pH 7 and estimated by flame photometry.

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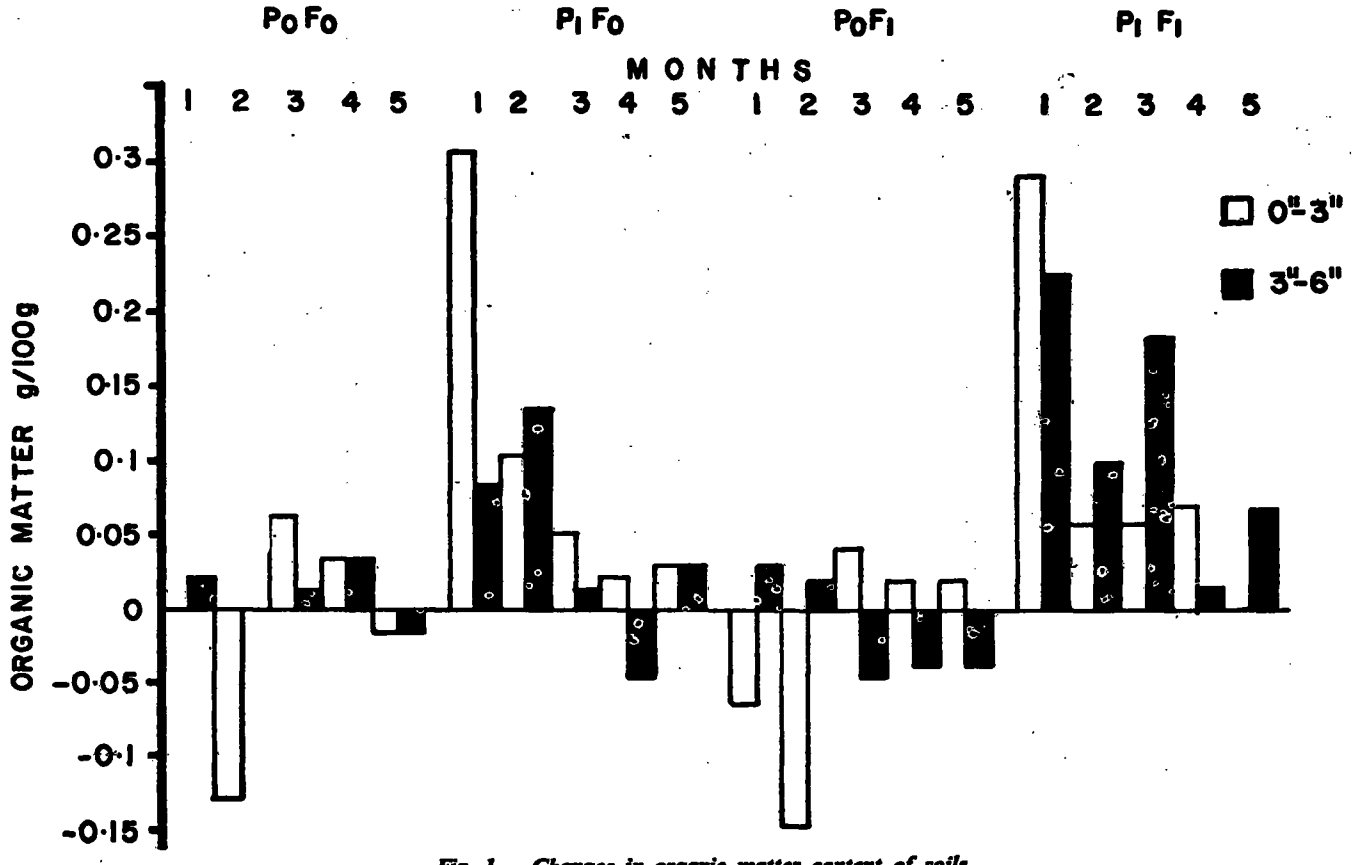

Fig. 1 — Changes in organic matter content of soils.

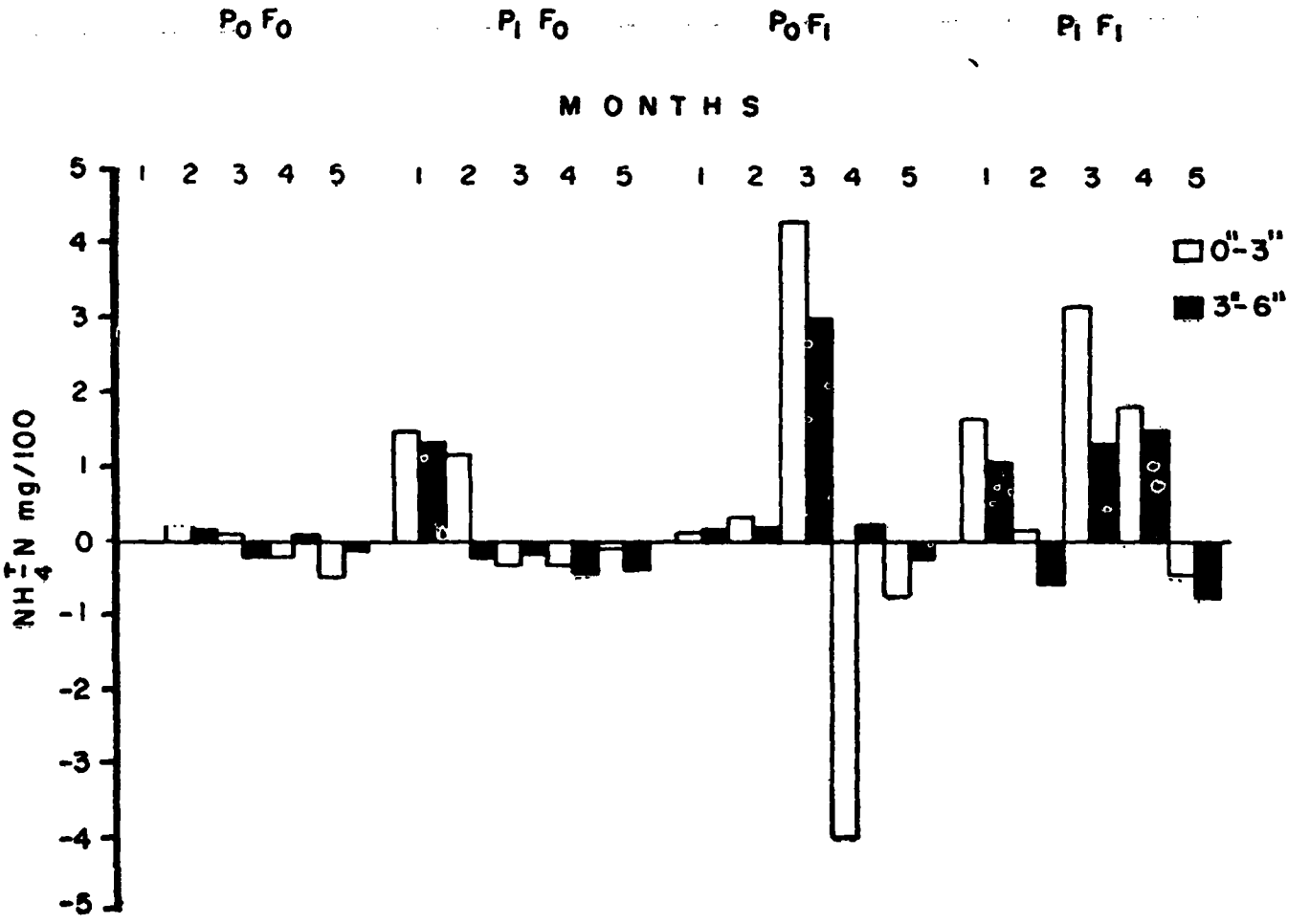

Fig. 2 — Changes in NH_4^+-N content of soili,

After 2 months, half the plots where pruned material was left and half the control plots were fertilized, each with 11 oz of ammonium sulphate, about 3 mg N/100 g soil, 0.75 oz of saphosphosphate and ½ oz of muriate of potash. Soil samples collected from the plots over a further period of 3 months were analysed at monthly intervals.

RESULTS AND DISCUSSION

Organic matter, ammonium-nitrogen and available potassium contents of the control and treated plots are given in Tables 1, 2 and 3 respectively.

Organic matter content

Soil organic matter content has increased in both P_1 treatments in 0-3" and 3"-6" layers (Table 1). As could be expected, the surface soils show a higher organic matter content. At the end of the first month after pruning and retention of the pruned material the soil organic matter content has increased from 2.16% to 2.49%. This amount has continued to rise in the second month but remains almost constant after that (Fig. 1). These results indicate that during the first two months, decomposition of added pruned material is rapid and thereafter it decomposes slowly. Investigations on decomposition of organic matter added to soil indicate a similar pattern of breakdown.

TABLE 1 — *Organic matter content of tea soils incorporated with tea prunings at monthly intervals (g/100 g; average of 6 values)*

Treatment	*Depth in inches*	*Time from incorporation of prunings in months*					
		0	*1*	*2*	*3*	*4*	*5*
P_0F_0	0—3	2.16	2.16	2.04	2.10	2.13	2.12
	3—6	2.01	2.03	2.03	2.04	2.07	2.06
P_1F_0	0—3	2.19	2.49	2.59	2.64	2.66	2.69
	3—6	2.03	2.11	2.24	2.25	2.21	2.24
P_0F_1	0—3	2.28	2.22	2.08	1.12	2.14	2.16
	3—6	2.02	2.05	2.07	2.03	2.00	1.97
P_1F_1	0—3	2.21	2.49	2.54	2.59	2.65	2.65
	3—6	2.00	1.98	2.20	2.17	2.38	2.43

P_0 = Prunings removed — F_0 = Fertilizers not added
P_1 = Prunings retained — F_1 = Fertilizers added after two months

Organic matter content of the sub-surface soils indicate that some organic matter has been transported from the surface soil to the sub-surface soil by biological activity or leaching. Addition of fertilizers to the P_1 treatment has not resulted in any considerable differences in the organic matter of the surface soils but, in the sub-surface soils, this value has increased over the unfertilized soils during the last 2 months. Thus, the addition of fertilizers to P_1 has increased the total organic matter content in the soil (0-6") more than in the corresponding unfertilized soils. This is likely to be due to the increased microbial activity brought about by the addition of fertilizers. Jansson has shown that the incorporation of nitrogen accelerates decomposition of carbonaceous material.

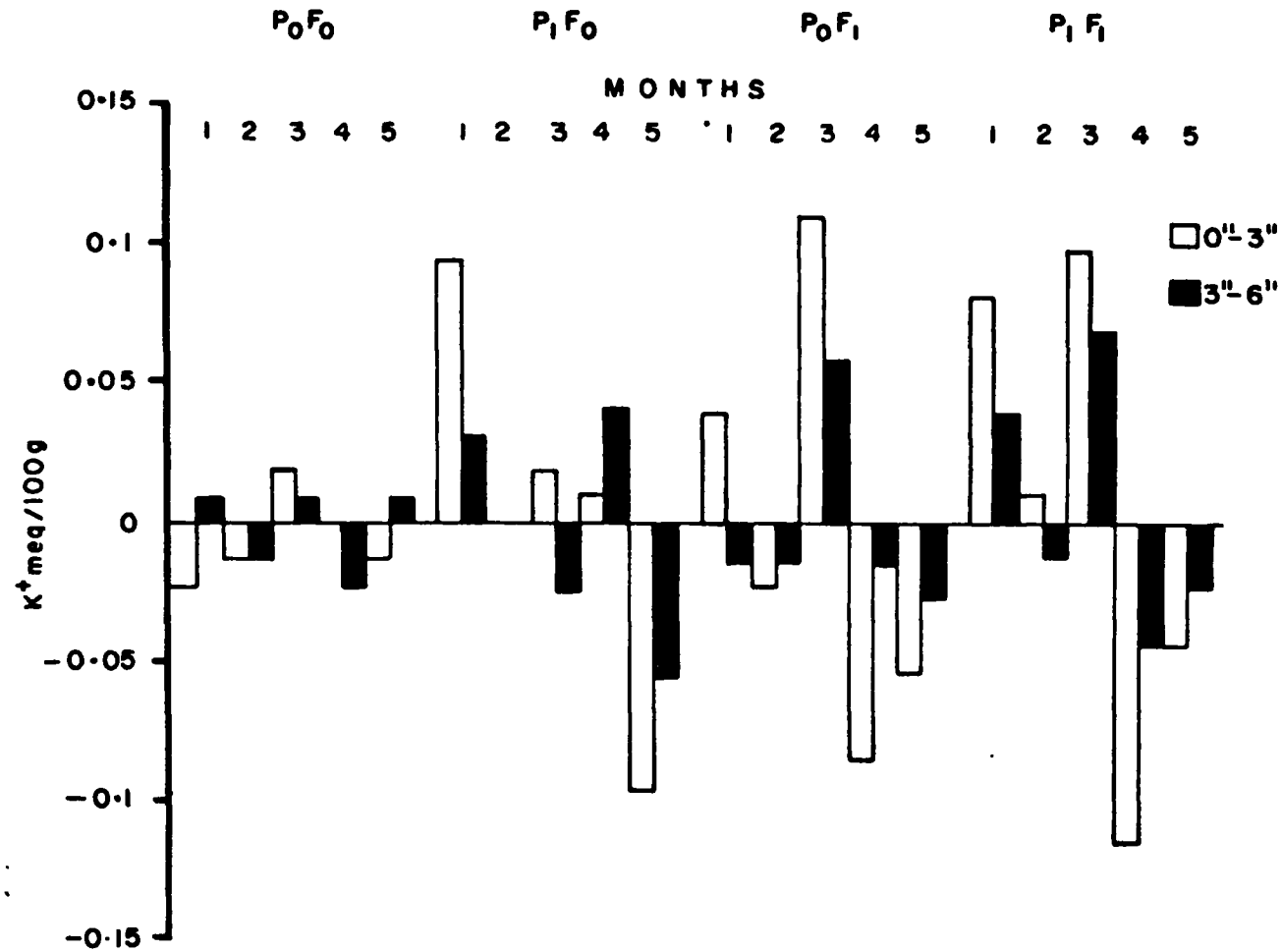

Fig. 3.—Changes in available K† content of soils.

Ammonium-nitrogen

Ammonium-nitrogen content during the first two months of the experiment has risen considerably more in P_1F_0 than in P_0F_0 (Table 2 and Fig. 2).

TABLE 2 — *NH_4-N content of tea soils incorporated with tea prunings at monthly intervals (mg/100 g; average of 6 values)*

Treatment	Depth in inches	Time from incorporation of prunings in months					
		0	1	2	3	4	5
P_0F_0	0—3	1.89	1.94	2.24	2.30	2.24	1.82
	3—6	1.24	1.28	1.43	1.40	1.41	1.40
P_1F_0	0—3	1.98	3.46	3.58	3.34	3.06	2.96
	3—6	1.25	2.60	2.38	2.32	1.96	1.47
P_0F_1	0—3	1.85	1.90	2.14	6.40	2.52	1.68
	3—6	1.28	1.34	1.50	4.48	4.68	4.40
P_1F_1	0—3	1.91	3.49	3.66	6.66	4.96	4.40
	3—6	1.74	2.78	2.10	3.32	3.80	2.96

P_0 = Prunings removed — F_0 = Fertilizers not added
P_1 = Prunings retained — F_1 = Fertilizers added after 2 months

The organic nitrogenous compounds in the added material has started to ammonify from the first month as shown by the high ammonium nitrogen content in P_1F_0 treatments. Nitrogen content continues to be higher in this treatment than in the control (P_0F_0) throughout the experiment indicating that mineralization of nitrogen in the added organic material occurred during this period although it is at a diminishing rate. Studies carried out by Cornfield and Gaur *et al* also indicate a similar pattern of N release. The increase of the NH_4+ -N content due to the incorporation of pruned material had amounted to 1.52 mg/100 g one month after this incorporation and is equivalent to about 15 lbs/acre.

From the third month of the experiment the NH_4+ -N content of the treated soil tends to decrease probably due to leaching and uptake by the growing plants. The increase in NH_4+ -N in the 3 -6" layer of the P_1F_0 treatments within the first month of the experiment suggests leaching of mineralized N. This is likely to be due to a relatively high loss of NH_4+ -N by leaching and uptake compared to the gain of this form of N from added plant material.

Keeping pruned material on the surface, has reduced leaching of added nitrogen as shown in Table 2. Most of the N added after the second month has leached into the 3-6" layer in P_0F_1 but in P_1F_1 where pruned material was left, most of the added N has remained in the top layer. Without added organic matter, N content in the 0-3" region in P_0F_1 had decreased from 6.40 mg/100 g to 1.68 mg/100 g over the last 3 months but the corresponding values for P_1F_1 are 6.66 and 4.40 respectively.

Available potassium

Available K in the 'treated' plots has increased rapidly in the first month (Table 3 and Fig. 3). This rapid rise in K could be attributed to mineralization of the added organic matter and to the solubilisation effect of rain water. It has been shown that nearly two-thirds of K in plant is not strongly bound and is soluble in water. In the subsequent months available K content has increased only slowly probably due to the removal of this element by plants and soil microorganisms.

Fixation of potassium by soil microorganisms has been reported by Hurwitz and and Bachelor and Roberts.

In the last month available K content in 0-3" has decreased considerably probably due to a decrease in the release of K from the added organic matter and due to the losses from soil attributable to leaching and uptake by plants. The available K content in the lower layer has not decreased considerably showing that leaching has taken place from the upper layers.

TABLE 3 — *Available potassium content of tea soils incorporated with tea prunings at monthly intervals (meq/100 g; average of 6 values)*

Treatment	*Depth in inches*	*Time from incorporation of prunings in months*					
		0	*1*	*2*	*3*	*4*	*5*
P_0F_0	0—3	.15	.13	.12	.14	.14	.13
	3—6	.11	.12	.11	.12	.10	.11
P_1F_0	0—3	.14	.23	.23	.25	.26	.17
	3—6	.14	.17	.17	.15	.19	.16
P_0F_1	0—3	.11	.15	.13	.24	.16	.11
	3—6	.11	.10	.09	.15	.14	.12
P_1F_1	0—3	.11	.19	.20	.30	.19	.15
	3—6	.10	.14	.13	.13	.16	.14

P_0 = Prunings removed — F_0 = Fertilizers not added
P_1 = Prunings retained — F_1 = Fertilizers added after 2 months

The effect of addition of K fertilizers has not lasted more than two months probably due to leaching and uptake of this element by plants. The difference between available K content in P_1 and P_0 treatments is greater without added fertilizers than in their presence. This phenomenon may be due to increased chemical and biological fixation of potassium in the presence of fertilizers. Increased fixation of K due to increase of NH_4+-N has been shown by Stanford and Pierre.

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