

EFFECT OF DIFFERENT MULCHING MATERIALS ON SOME SOIL PROPERTIES, EARTHWORM POPULATIONS AND GROWTH OF MID-GROWN YOUNG TEA

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Mulching is an important cultural practice for soil-moisture conservation in tea lands. However, this practice is restricted owing to the unavailability of currently recommended materials such as Mana grass (*Cymbopogon confertiflorous*) and Guatemala grass (*Tripsacum laxum*) in adequate quantities. Hence an investigation was carried out to study the feasibility of using coir dust, paddy husk, sawdust and refuse tea as alternative mulching materials. The results indicate that there is an improvement in soil moisture retention, and an increase in soil N, K and organic carbon, when all the materials tested are used. There was a yield increase of 25-50% owing to mulching during the first year, but over the next three years yields gradually declined. Refuse tea, sawdust, coir dust and paddy husk could therefore be used in mid-country tea soils as alternative mulching materials when grass loppings are not available.

Key Words: soil moisture, mulching, young tea plants

INTRODUCTION

New clearings under young tea remain exposed to the vagaries of weather, until such time as the tea forms a canopy and provides an adequate soil cover. As a consequence, new clearings are vulnerable to erosion, soil-moisture evaporation, and effects brought on by the proliferation of weeds. In order to minimise these adverse effects, it is necessary to provide ground cover with dead or live mulches.

Live mulches, or cover crops, may compete with tea, particularly for moisture during dry periods, resulting in retardation in growth and even death of the young tea plants (Manipura, 1972). The practice of mulching in tea plantations is commonly known as thatching. The materials generally used for thatching are loppings of Mana and Guatemala grasses. It has been reported that mulching results in enhanced plant growth, increased soil fertility and improved soil and soil-moisture conservation (Manipura *et al.*, 1969), and that it suppresses weeds (Othieno and Ahn, 1980) and increases yields (Sandanam and Rajasingham, 1982).

Loppings of grass are generally applied in the field soon after young tea is planted. This is generally done at the tail-end of the monsoon, and well before the

onset of the drought. The quantity of grass loppings required for thatching is about 30-40 mt ha⁻¹ (fresh weight). This quantity could be obtained from a hectare of a well-tended grass clearing in a single lopping. For this purpose, the maintenance of a separate area under a grass species, to serve as a "thatch bank", is advocated in order to provide the required mulching materials (Sivapalan, 1987).

The information available on the use of possible re-cyclable natural materials, such as sawdust, coir dust, paddy husk and refuse tea as mulching materials, *vis-à-vis* grasses, in the mid-country, is scanty. A field study was therefore conducted to evaluate the influence of these materials on soil-nutrient status, earthworm populations, and the growth and yield of tea.

MATERIALS AND METHODS

The study was carried out at Galphele Estate, Panwila (710 m amsl). The soils at Galphele Estate belong to the Red Yellow Podsollic group, categorized as Ultisols according to USDA soil taxonomy (Mapa *et al.*, 1999).

The soils at the study blocks were sandy, deep and well-drained, and the slope of the land varied from 15 to 20%. Five types of mulching materials, viz. Mana grass, sawdust, coir dust, paddy husk and refuse tea, were tested against a control where no mulching material was used. The treatments were randomised in four blocks of the clone TRI 2025. The plot size was 16 m² and each plot had 20 plants. Fresh Mana loppings were applied at the rate of 37.5 mt ha⁻¹. All the other materials were applied as layers, about 5 cm in thickness. The materials were uniformly spread over the soil surface about 15 cm from the collar of the plant. Mulching was done three times during the first year.

Details of the mulching materials, applied on a dry matter basis, are given in Table 1.

Table 1. Total C and N, the C/N ratio, and the rates of thatching materials used

Material	Total C (%)	Total N (%)	C/N ratio	Dry weight (mt ha ⁻¹)
Refuse tea	34.44	3.15	10.93	44.8
Mana grass	40.32	1.40	28.80	13.9
Coir dust	34.80	0.84	41.43	16.2
Sawdust	40.86	0.28	145.93	37.0
Paddy husk	29.70	0.77	38.57	29.6

The amounts of the different materials used, in order to maintain a mulch layer 5 cm thick, varied according to the moisture content and the nature of the material. For example, with granular materials like sawdust, refuse tea and paddy husk, the amount needed for a 5 cm-thick layer was much higher than with mana grass loppings and coir dust. Mulching was repeated every fourth month.

The assessments were made, both during dry- and wet-weather periods, as described below. The soil-moisture content was estimated gravimetrically, at depths of 0-15 cm, during the dry season (February to April) in the second year following the first application of mulching materials.

Soil sampling was done to a depth of 15 cm using an auger. Five samples from each lot were bulked to obtain a composite sample. The soil-nutrient analysis was done during the first and second years following the first mulching treatment. The Walkley and Black (1934) method was used for determining organic C content, the Kjeldahl method for N, and the ammonium chloride extraction method for K.

Growth assessments were made a year after application of the mulching materials. Tipping weights, number of plucking points at the commencement of plucking, and the yield of tea at every harvest, were recorded. An assessment of earthworm populations was made before, and at regular intervals after, application of the mulching materials, by counting the earthworms emerging at the surface of an area, 30 cm x 30 cm, when 0.55% formaldehyde solution is applied.

RESULTS AND DISCUSSION

Effect of mulching on soil moisture

All the plots where mulching had been carried out showed a significantly higher soil-moisture content, during the dry weather of 1995 and 1996, than did the control treatment (Table 2). High soil-moisture contents were observed in plots mulched with Mana grass, paddy husk and coir dust in both 1995 and 1996. The reason for the higher soil-moisture content in mulched plots could be due to reduced evaporation and increased soil permeability, resulting from the mulching (Russel, 1973). Reduced transpiration from the tea plants, brought about by low soil temperature under mulch, would have also contributed in conserving soil moisture (Steward, 1959; Wijeratna *et al.*, 1994).

Table 2. Effect of different mulching materials on the soil-moisture content

Treatments	Moisture content (%), 1995	Moisture content (%),1996
Sawdust	17.1 a	9.8 a
Coir dust	17.3 a	10.0 a
Paddy husk	18.8 a	10.0 a
Refuse tea	16.5 a	9.5 a
Mana grass	18.2 a	10.3 a
Control	13.0 b	6.2 b
LSD (P=0.05)	2.8	1.5
CV (%)	11.1	10.9

Means followed by common letters are not significantly different at the 5% level.

Effect of mulching on nutrients, soil carbon and pH

The effect of the mulching treatments on N, K, organic carbon content and pH are given in Table 3.

Table 3. Effect of mulching on soil N, K, organic carbon content and pH

Treatments	Nitrogen (%)	Potassium (%)	Organic C (%)	Soil pH (in water)
Sawdust	0.077 b	44.05 cb	1.7 cb	4.41 a
Coir dust	0.074 b	42.55 c	1.5 cd	4.44 a
Paddy husk	0.070 b	39.05 c	1.5 cd	4.50 a
Refuse tea	0.118 a	106.35 a	2.3 a	4.33 ab
Mana grass	0.113 ab	61.10 b	1.9 b	4.39 a
Control	0.057 b	28.70 c	1.3 d	4.05 b
LSD (P=0.05)	0.03 b	17.82	0.332	0.31
CV (%)	29.7	22.0	12.7	4.7

Means followed by common letters are not significantly different at the 5% level.

Mulching increased the soil organic-carbon content in all the treatments above that in the control (Table 3). Refuse tea and Mana grass mulch had a significantly higher organic carbon content when compared with that in the control. A low organic-carbon content, in plots mulched with paddy husk, sawdust and coir dust, may be due to the slow rate of decomposition of these materials in which the C/N ratio is high (Wickremasinghe, 1984; Wijeratna *et al.*, 1994).

There was a significant increase in soil-N concentration in plots mulched with refuse tea and Mana grass. The contribution to soil-N content by other materials, viz. paddy husk, sawdust and coir dust, varies from 22 to 35% above the control.

The increase in soil K was significant in plots mulched with refuse tea when compared with other materials, and the contribution to soil K from Mana was significant when compared with sawdust, coir dust and paddy husk.

The increase in soil pH above the control treatment, brought on by the different types of mulching materials, is favourable for the cultivation of tea.

Effect of mulching on the growth of young tea

The measurements of plant height, collar thickness (or girth), and the dry weights of shoots at the 1st and 2nd tippings, are given in Table 4.

Table 4. Effect of different mulching materials on the growth of young tea

Treatments	Plant height (cm)	Girth (cm)	Dry wt. of 1st tippings (kg plot ⁻¹)	Dry wt. of 2 nd tippings (kg plot ⁻¹)
Sawdust	56.6 a	1.85 a	0.078 bc	0.460 ab
Coir dust	58.3 a	1.84 a	0.074 bc	0.420 bc
Paddy husk	58.9 a	1.84 a	0.085 ab	0.550 a
Refuse tea	58.4 a	1.99 a	0.084 ab	0.490 ab
Mana grass	58.1 a	1.99 a	0.110 a	0.585 a
Control	55.7 a	1.53 b	0.053 c	0.310 c
LSD (P=0.05)	NS	0.27	0.027	0.128
CV (%)	7.2	9.8	22.5	18.1

Means followed by common letters are not significantly different at the 5% level.

Although the observed differences in plant heights are not significantly different, all the mulched plots showed an increase in plant height. There was a significant increase in plant girth in all the mulch treatments compared to the control treatment. Except for the paddy-husk treatment, there was a significantly higher dry weight of tipplings in the Mana treatment compared to all the other mulch treatments, confirming the superiority of Mana grass as a mulch (Wijeratna *et al.*, 1994).

Effect of mulching on earthworm populations

Pre-sampling was done in July 1993, and some assessments of earthworm populations were done at regular intervals. The earthworm-population assessments are given in Table 5.

Table 5. Effect of different mulching materials on earthworm populations
Mean numbers of earthworms per m²

Treatment	July 1993	Sep 1993	Oct 1993	Dec 1993	Mar 1994	Sep 1994	Oct 1994	Dec 1994
Sawdust	2	39	24	38	38	43	42	45
Coir dust	2	16	15	8	8	16	13	16
Paddy husk	3	4	12	25	26	24	20	27
Refuse tea	3	1	4	14	14	15	9	12
Mana grass	2	17	3	53	53	44	44	51
Control	3	1	1	4	3	5	4	4
SE	0.6	3.2	2.2	4.4	4.3	3.8	3.9	4.3

The results indicate an increase in earthworm populations in all the mulching treatments compared to the control. The highest earthworm populations was observed in plots mulched with Mana grass, followed by sawdust, while the populations were lowest with refuse tea and coir dust. As reported by Ashok Kumar (1994), this may be due to the preference of worms for materials with a high C content.

Effect of mulching on tea yields

Tea was brought into plucking two years after planting. The number of plucking points per bush at the commencement of plucking, and the yield recorded during the first cycle of plucking, are given in Table 6.

Table 6. Effect of different mulching materials on tea yields

Treatments	No. of plucking points per bush	1 st year yield (made tea) kg ha ⁻¹	2 nd year yield (made tea) kg ha ⁻¹	3 rd year yield (made tea) kg ha ⁻¹	4 th year yield (made tea) kg ha ⁻¹
Sawdust	48.7 b	929 bcd	2050 ab	2770 ab	941 a
Coir dust	47.5 b	973 bc	2013 b	2772 ab	828 a
Paddy husk	43.7 b	879 cd	1998 b	2776 ab	843 a
Refuse tea	73.7 a	1237 a	2278 a	3069 a	898 a
Mana grass	72.5 a	1125 ab	2239 ab	3031 a	909 a
Control	23.7 c	743 d	1994 b	2571 b	696 a
LSD (P=0.05)	12.4	226	263	376	NS
CV (%)	15.9	15.3	8.4	8.8	19.2

Means followed by common letters are not significantly different at the 5% level.

Mulching resulted in a significantly higher number of plucking points at the commencement of plucking in the 1st year. The number of plucking points, observed in plots treated with refuse tea and Mana grass, was significantly higher than with the other treatments. The higher number of plucking points resulted in higher yields during the first year.

There was a 51% yield increase in the mana treatments, and a 66% yield increase in the refuse-tea treatments, over the control, during the first year. The increases were lower in the 2nd and 3rd years: 14% and 19% for refuse tea, and 11% and 19% for Mana, respectively.

There was no significant yield increase in all the mulched plots during the 4th year, compared to the control. There were overall low yields during the 4th year owing to the severe drought conditions during this period.

Our results are in line with other studies carried out by Wijeratna *et al.* (1994). They also showed the beneficial effects of mulching on the growth and yield of tea

CONCLUSION

The beneficial effects of mulching on growth of young tea and on soil fertility, and on moisture retention, receive reconfirmation from this investigation. In addition, the beneficial effects of soil fertility on earthworm populations are demonstrated.

Both Mana grass and refuse tea were found to be superior to the other mulching materials tested.

Although mulching with Mana grass is superior to the other mulching materials, sawdust, coir dust, paddy husk and refuse tea may be used in new clearings, to minimize the adverse effects of drought, when grass loppings are not available. Materials with a high C/N ratio, viz. paddy husk, coir dust and sawdust, should be amended by adding urea.

When thick layers of materials with high C/N ratios, such as paddy husk, are used, seepage of water is impeded until the materials are well decomposed, and hence partially-decomposed paddy husk should be used to overcome this problem.

It was observed that when materials such as coir dust and sawdust are used, there is a tendency for them to slide down steep slopes. Therefore, these materials need to be restricted to flat or gently-sloping lands.

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