A STUDY ON RE-UTILIZATION OF BLACK POLYTHENE PLANTING BAGS AS MULCH MATERIAL IN RUBBER SEEDLING NURSERY

Radha Lakshmanan and K.I. Punnoose

Introduction

Mulch is a protective surface covering generally practised for supressing weed growth, for conservation of soil and moisture and for providing physiological benefits to the plant through microclimate modification. The effectiveness of mulches in reducing the diurnal and seasonal variations in soil temperature is maximum at the soil surface than at the lower depths particularly in dry soils.

Plant mulches are the most widely used source of mulch material. Lack of availability of this source of mulch has led to the use of alternate materials of which plastic mulches are the most available (Othieno, 1982; Gutal et al, 1992; Radha et al., 1995). Plant mulches have high solar reflectivity and immobilize air within the mulch layer. Since still air has a low thermal conductivity, heat received from the sun during the day is slowly transmitted from the surface of the mulch to the surface of the soil. Similarly heat loss from soil by way of back-radiation at night is reduced by the mulch layer resulting in little diurnal variation in soil temperature.

Black plastic absorbs much radiation but transmits little. The mulch is heated greatly but transmits little energy downward by conduction because of the intermediate layer of still air. Transclucent plastic transmits much of the incident radiation through in the visible range but permits little of the long wave radiation out because of vapour condensation on the underside. Maximum temperatures are reduced considerably especially on hot and clear days, while minimum temperatures are increased by the presence of plastic. The effect of the plastic mulches diminish as the crop develops and shades more of the surface. Alteration and modification of the soil thermal regime with mulching is thus possible (Waggoner et al., 1960).

Maurya and Lal, 1981 from investigations on effect of different mulches on yield of maize growing in a tropical Alfisol observed the amplitude of diurnal fluctuation in soil temperature at 5 cm depth to be 7°c for straw mulch, 12°c for black polythene and 15°c for transparent polythene mulches. The maximum soil temperature with black polythene was 3-4°c lower than that with transparent polythene. Maize yield was similar in the grass and polythene mulched areas. Gurnah and Mutea, 1982 from studies on effect of different mulches on arabica coffee found that grass mulches lowered soil temperature while black and clear polythene greatly increased soil temperature. Gutal *et al.*, 1992 from a 3 year study on different types of mulches on tomato growth

and yield observed that 25μ black LDPE film had a significant effect in increasing yield by 55 percent, reducing weed growth intensity by 90 percent and conserving 28 percent soil moisture compared to the control.

Budded stumps of rubber raised in polybags upto 2-3 whorls or upto 6-7 whorls is an important source of planting material in rubber as it enables selection of uniform planting material for field planting besides reducing the long gestation period in *Hevea*. The black polythene bags are cut lengthwise and at the lower portion to remove the plant along with the soil core for field planting after which the bags are discarded. A study was therefore initiated at Central Nursery, Karikattoor to test the possibility of using the black polythene cut bags as mulch material in seedling nursery.

Materials and Methods

Mulching was carried out in the seedling nursery during November after the first round of fertilizer application, 8 weeks after planting. The discarded polythene bags (LDPE - 400 guage) were cut lengthwise to cover the area in between the rows of seedling and a layer of soil 5 cm thickness placed over the mulches to prevent drifting away by wind. The split sheets were so arranged as to avoid gaps between the sheets. A few holes were punched into the polythene to enable rain water infiltration. The efficacy of black polythene sheets as mulch material was compared with that of plant mulch of 5 cm thickness. The growth of the plants, the extent of weed growth with polythene mulching, soil temperature changes, changes in soil water content and nutrient uptake by plants were monitored. Soil thermometers were installed at 5 cm, 10 cm and 20 cm soil depth to record soil temperature. Soil temperature fluctuations were computed as the difference in soil temperature recorded at 0800 IST and 1430 IST. The weather data during the period of study is presented in Table 1.

RESULTS AND DISCUSSION

Plant growth characteristics and leaf nutrient status:

Application of mulches significantly increased plant diameter at 4 and 6 months after mulching (Table 2). Polythene mulches compared favourably with plant mulches. The effect of mulches on other plant growth attributes at 8 months after planting is presented in Table 3. Polythene mulch showed a significant superiority over that of plant mulch with respect to plant height. The number of leaf whorls per plant and

Table 1: Weather data during the study period

Month	Rainfall (mm)	Temperature (°c) Maximum	Minimum	Mean evaporation (mm)	Relative humidity (%) 0800 IST	1430 IST
1993 November	258.8	30.0	23.3	3.0	95	73
December	77.2	31.8	22.8	3.2	93	62
1994 January	35.6	32.9	21.6	3.9	88	54
February	97.2	32.8	23.6	4.2	93	58
March	60.1	33.0	23.5	4.9	91	56
April	262.0	32.7	23.8	4.5	92	66
May	252.3	32.1	24.6	4.1	92	69

Table 2. Effect of mulches on plant growth

Treatment	Plant diameter (cm)			
	Months after mulching			
	Pretreatment	2	4	6
Plant Mulch	0.46	0.61	0.96	1.14
Polythene mulch	0.44	0.58	0.99	1.13
No mulch	0.44	0.57	0.91	0.99
SEm*	0.0001	0.02	0.02	0.03
CD 0.05	NS	NS	0.05	0.09

average number of leaves per whorl did not show any significant difference between the mulched and unmulched plots. The mean length of internode was significantly superior in the black polythene mulch plots while the values in the plant mulched plots though higher was statistically on par with that of the unmulched plots. Similar was the case with respect to leaf weight (wet and dry), total shoot dry weight and shoot:root ratio. The root growth attributes like root dry weight, depth of tap root penetration and the number of surface roots at the collar region were on par for the mulched and unmulched plots. Rooting density was statistically superior in the polythene mulched plots followed by that in the plant mulched plots and least in the unmulched plots. A significant increase in percentage of buddable seedlings was observed with mulching though this did not vary with the type of mulch used. Budding success was not affected by mulching. There was no significant difference in N, P, K, Ca and Mg content of the leaves due to effect of mulching (Table 3).

Weed growth

The beneficial effect of polythene mulch on reduction of weed growth is evident from the data in Table 4. The weed dry matter g m^{-2} at one month after mulching was significantly lower in the polythene mulched plots

Table 3. Mean growth characteristics at 6 months after mulching

Growth attributed	Polythene mulch	Plant mulch	No mulch	SEm*	CD 0.05
Height cm	219.0	182.7	160.30	4.46	17.50
Dlameter in cm	1.1	1.1	0.99	0.03	0.09
No. of whorls/plant	3.6	3.6	4.30	0.30	NS
Mean No. of leaves/whorl	10.6	7.8	8.40	1.10	NS
Mean internodal length cm	23.9	18.9	13.30	1.70	6.70
Leaf wet welght (g)	149.6	78.5	70.30	8.10	31.80
Leaf dry weight (g)	55.9	26.5	23.70	2.89	11.30
Shoot dry weight (g)	297.2	128.9	103.80	23.70	93.10
Root dry weight (g)	93.1	55.2	47.20	9.66	NS
Shoot:Root ratio	3.2	2.34	2.25	0.17	0.68
Depth of taproot (cm)	65.7	61.3	59.70	4.59	NS
No of surface roots (collar)	18.0	10.7	9.30	3.77	NS
Root density gcm-3 (0-15 cm)	$6x10^{-4}$	$2.77x10^{-4}$	$1.4x10^{-4}$	$3.2x10^{-5}$	$1.24x10^{-4}$
Buddable seedlings (%)	80.60	81.10	59.70	3.54	12.03
Budding Success (%)	84.40	84.90	89.40	7.95	NS
Nitrogen (%)	3.65	3.43	3.59	0.079	NS
Posphorous (%)	0.25	0.25	0.24	0.006	NS
Potassium (%)	0.81	1.09	0.93	0.176	NS
Calcium (%)	1.14	1.19	0.95	0.176	NS
Magnesium (%)	0.17	0.16	0.16	0.010	NS

Table 4. Effect on weed growth-weed dry weight gm^{-2}

Treatment	Months after mulching			
	1	2	5	6
Polythene mulch	6.74	94.35	5.37	47.50
Plant mulch	12.34	94.35	8.60	95.00
No mulch	12.36	129.45	13.33	142.20
SEm	0.33	7.74	1.27	10.79
CD 0.05	1.30	30.39	4.98	42.36

while weed growth in the plant mulched plots was comparable to the unmulched control plots. At two months after mulching weed control was significantly superior in the mulched treatments, the weed control efficiency being of the order of 66% and 27% of the control (unmulched) in the polythene and plant mulch treatments respectively. The weed growth recorded at 6 months after mulching indicated a weed control efficiency of 66% (polythene mulch) and 33% (plant mulch) over the unmulched control plots.

Soil moisture

Since irrigation was given uniformly to all the plots once in a week no severe moisture deficit was noticed in any of the treatments (Table 5). Frequent rains received during the season also contributed to the soil water content thereby reducing the soil moisture deficit.

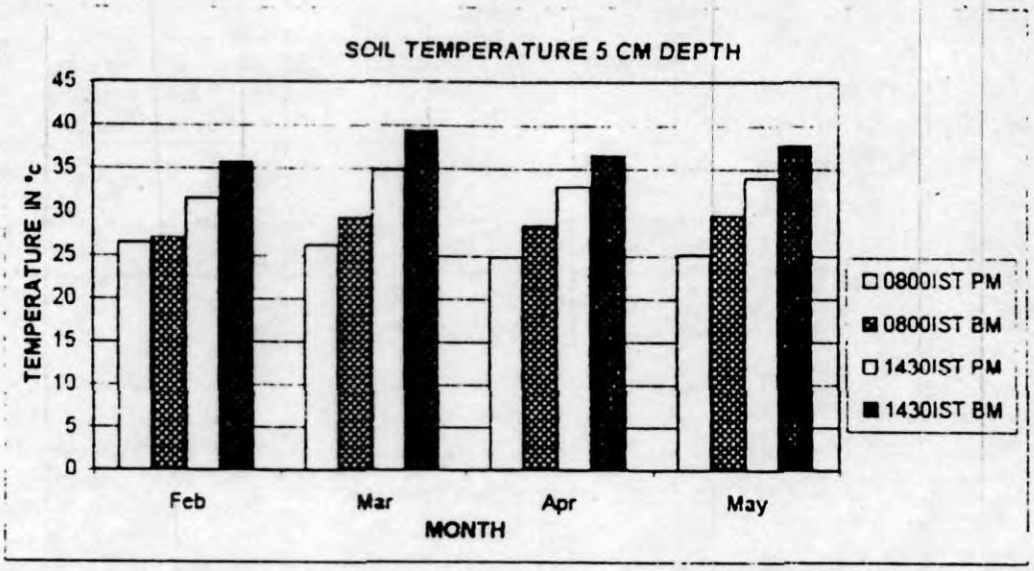
Soil temperature

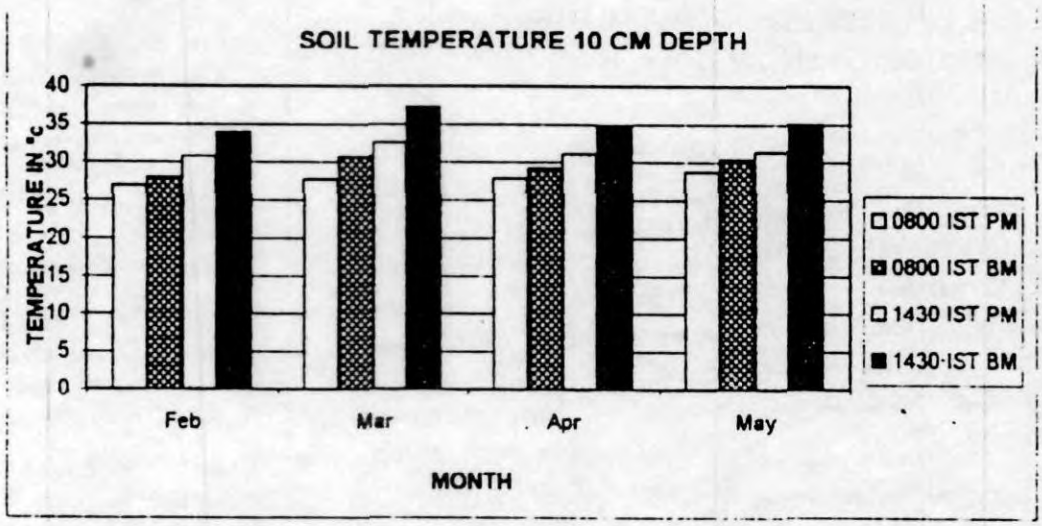
Temperature at 0800 IST and 1430 IST (Fig.1) was higher under black polythene than under plant mulch at 5 cm soil depth. The increase in soil temperature under polythene mulch over that of plant mulch was 0.5°, 3.3°c, 3.6°c and 4.5°c in February, March, April and May at 0800 IST and that at 1430 IST was 4.2°c, 4.5°c, 3.7°c and 3.7°c respectively. The mean fluctuation in soil temperature (difference in temperature observed at 0800 IST and 1430 IST) at this depth was 8.8°C, 9.9°c, 8.1°C and 8.1°c for the months of February, March, April and May under polythene mulch while that under plant mulch was 5.1°c, 8.7°c, 8.0°c and 8.9°c respectively. Surface soil temperature fluctuations under plant mulch was relatively less in the month of February thereafter the fluctuation was similar to that under polythene mulch which could be attributed to the decomposition of the plant mulch.

At 10 cm soil depth the increase in soil temperature with black polythene mulch ranged from 1.2°c to 2.9°c at 0800 IST and from 3.2°c to 4.6°c at 1430 IST over that of plant mulch. The mean fluctuation of soil

Table 5. Soil Moisture Content

Treatment	Soil Moisture (%)							
	0-15 cm				15-30 cm			
	Feb	Mar	May	June	Feb	Mar	May	June
Polythene mulch	18.80	12.90	17.20	19.80	20.70	13.70	16.40	20.20
Plant mulch	22.20	11.30	18.40	20.30	23.30	14.30	19.30	21.50
No mulch	18.40	9.40	18.60	18.60	20.40	13.20	20.10	21.20
SEm	0.57	0.86	0.27	0.64	0.40	0.53	0.56	0.99
CD (0.05)	2.26	NS	1.06	NS	1.58	NS	2.20	NS





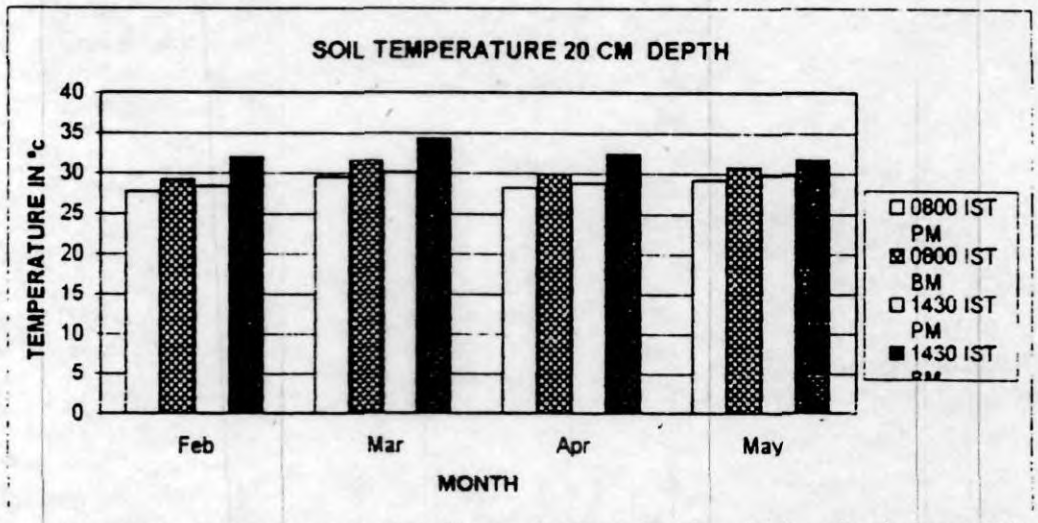


Fig. 1. Soil temperature variation at 5, 10 & 20 cms. depth under plant (PM) and polythene (BM) mulch

temperature was to the extent of 5.9°c,6.6°c, 5.7°c and 4.7°c for the months of February, March, April and May in the polythene treatments while that under plant mulch was 3.9°c, 4.9°c, 3.2°c and 2.6°c respectively.

At 20 cm soil depth, temperature changes with type of mulch was relatively less. Polythene mulch increased soil temperature to the extent of 1.5°c to 2°c at 0800 IST and 2°c to 4°c at 1430 IST over that of the plant mulch. The mean fluctuation of soil temperature was to the extent of 2.8°c, 2.7°c, 2.4°c and 1°c during the months of February, March, April and May under black polythene while that under plant mulch was 0.6°c, 0.6°c, 0.7°c and 0.5°c respectively.

An increase in soil temperature with black polythene mulch was evident.

Cost analysis

Mulching with polythene sheets (black polythene) showed a cost saving of 62 per cent over that of plant mulches (Table 6). A added beneficial effect of mulching with polythene was the reduction in weed growth observed which contributes to reducing the cost of weed control. Reduction in labour utilisation for weed control operation to the extent of 60 percent was reported with black polythene mulching (Radha *et al.*, 1995).

Table 6 - Economics of mulching

Treatments	Quantity kg/ha.	Cost of material	Labour cost for spreading mulches Rs.	Total cost Rs.
Plant mulch	625 bundles of 35 kg each	10937.50	1625.00	12562.00
Polythene mulch	750 Kg.	1500.00	3250.00	4750.00

* Labour task for plant mulching-25 workers/ha.
*Labour task for polythene mulching-200m²/worker/day

Conclusion

The study thus indicates the possibility of re-utilising the discarded polythene bags (black) as much material in seedling nursery. Though soil temperature fluctuations were greater under black polythene mulch compared to that of plant mulch this did not have any adverse effect on growth of plants. Plant growth was comparable in the polythene and plant mulched plots. Weed control effciency was higher in the black polythene mulched plots.

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