Effectiveness of coir geotextiles in soil moisture conservation

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Abstract –
Among the diversified use of coir geotextiles, its use as a protective covering to improve crop productivity and to reduce weed problem assumes to be much significant. An experiment has been conducted at Kumbazha, in Pathanamthitta district, Kerala, India to evaluate the different types of coir geotextiles and polythene as soil mulch. The treatments include different mulching materials like natural needled felt, black needled felt, rubberized coir, black polythene and transparent polythene along with a control plot (no mulch). The experiment was laid out in Completely Randomized Design with six replications. The test crops used were bhindi (var. Salkeerthi) and pineapple (var. Mauritius). The study reveals that with bhindi crop growth parameters like plant height, leaf number and lateral spread were increased by mulching with rubberized coir and transparent polythene. These two mulches caused early flowering and increased fruit yield. Coir materials as mulch recorded a yield increase ranging from 67 to 196%. Observations also reveal that weeds were not grown in plots mulched with black polythene, transparent polythene and rubberized coir. Rubberized coir as mulch enhanced the fruit yield in the case of pineapple, which is followed by natural needled felt and transparent polythene. Black polythene resisted weed growth up to 7MAP, whereas rubberized coir and transparent polythene suppressed weeds up to 8MAP. Though the weeds were grown in other treatments the weeds count was significantly lower than that of control plot. Mulching with transparent polythene enhanced the soil temperature whereas rubberized coir lowered soil temperature. More over all mulched treatments had a favourable influence in increasing soil moisture. Observing the biodegradability and eco-friendly nature of coir it could be inferred that rubberized coir can serve as good mulch for bhindi and pineapple with minimum weed problem.

Index Terms - Mulching, Coir, growth, Kerala, India

I. INTRODUCTION

In a predominantly agricultural country like India, heavy rainfall enables luxuriant growth of weeds which may later compete with crops for light nutrients and moisture. One among the most important factors that interferes with the production potential of soil is the cropping system that leaves the soil surface exposed periodically. This encourages weed growth thereby reducing crop yield. Though the introduction of herbicides revolutionalized the world of agriculture, the residual effects of these herbicides on the succeeding crop or the possible interactions of their residues with other pesticides / cultural practices pose problems in crop production. Technologies should therefore be evolved in an eco-friendly way, not merely aiming at short-term gains. This paper analyses and discusses the use of different types of coir geotextiles and polythene sheets as mulch and to assess their effect on weed management.

II. MATERIALS AND METHODS

The experiment was laid out at the farm area in Kumbazha, Kerala, which is located at 9°51'20" & 9°51'44" North latitude and 76°13'54" East longitude. The soil of the experimental site is forest alluvium falling under the textural class forest loam. The different mulching materials constituted the treatments as detailed below.

T_1 - Control (crop alone with no mulch)
T_2 - Mulching with natural needled felt
T_3 - Mulching with black needled felt
T_4 - Mulching with rubberized coir
T_5 - Mulching with black polythene
T_6 - Mulching with transparent polythene

The test crops used were bhindi (var. *Salkeerthi*) and pineapple (var. *Mauritius*). The experiment was laid out in plots of 2.2 x 10 m in CRD with six replications.

The experimental area was leveled and the mulching materials were spread and fixed intact using J-clips. Holes were punched on the mulch materials at the required spacing for planting pineapple and bhindi. Initial

soil samples were taken for analysis. The application of fertilizers was done as per the recommendations of erala Agricultural University (2002). The required plant protection was also followed. Harvesting of bhindi was started after six weeks after planting.

Observations were taken fortnightly on growth characters yield attributes and yield. Weed observations like weed count was also recorded for recording weed count a quadrate of 25 cm^2 was placed randomly and weed count take.

III. RESULTS AND DISCUSSIONS

The results generated from the experiment using bhindi crop and pineapple crop are presented here and the analysis has been carried out with different growth parameters.

Crop: Bhindi

A. Effect of mulch on growth parameters

a) Effect of mulch on height of plants

Table 1 shows the variation of height of plants in different treatments. The height of plants was found significantly influenced by mulching throughout the growth period

TABLE. 1
Height of plants Vs different treatments for Bhindi crop

Treatment	Height of the plants (cm)					
	2 WAS	4 WAS	6 WAS	8 WAS	10 WAS	12 WAS
Rubberized coir	7	15	27.2	39	50	62.5
Black needled felt	5	12	25	40	52	59
Natural needled felt	7	12	22	35	50	60
Black polythene	5	10	18	24	45	50
Transparent polythene	8	17	29	45	57	65
Control	5	10	15	22	32	40
CD (0.05)	1.2	2.3	1.3	2	1.9	2.4
SE	0.58	1.11	0.63	0.97	0.94	1.26

WAS – Weeks after sowing

All mulching materials were found beneficial in increasing the plant height. After four weeks of sowing, rubberized coir and transparent polythene were observed to be on par and superior to others in increasing the plant height. Transparent polythene showed significant superiority over all other treatments from six weeks after sow ing, till harvest followed by black

felt up to 10 WAS. At eight weeks after sowing, black needled feltwas found to be on par with rubberized coir and two weeks after this, rubberized coir and natural needled felt were on par. In the final stage, rubberized coir followed transport polythene needled felt.

b) Effect of mulch on Number of leaves

Table II shows the variation in number of leaves in different treatments. Mulching significantly influenced leaf production in bhindi from 4 WAS onwards.

At 6 WAS, transparent polythene showed significant superiority to other treatments. At 8 WAS natural needled felt, rubberized coir and transparent polythene were on par in increasing the leaf number. At 10 WAS and 12 WAS maximum number of leaves was produced by plants in rubberized coir, which was on par with transparent polythene.

c) Effect of mulch on lateral spread of the plant

Initially maximum lateral spread (cm^2) was attained by plants in natural needled felt followed by transparent polythene and rubberized coir, which were on par. The least lateral spread was noted in plants in control followed by black polythene throughout the growth period. 2 MAS onwards transparent

polythene performed better than all other treatments and was on par with rubberized coir at 2 MAS. Table III shows the variation in lateral spread in different treatments.

TABLE II
Number of leaves Vs different treatments for Bhindi crop

Treatments	Number of leaves					
	2 WAS	4 WAS	6 WAS	8 WAS	10 WAS	12 WAS
Rubberized coir	4	6	12.1	16.2	18.2	19.4
Black needled felt	5.12	5.9	9.2	12	12	12.1
Natural needled felt	4.6	8	12.6	14.8	15.1	16
Black polythene	4.2	7.6	9.8	11	12.6	12
Transparent polythene	5.3	12.3	16.8	16.8	18.1	18
Control	4.2	6.3	8.6	9.2	10.2	10.2
	NS	S	S	S	S	S
CD (0.05)	NS	1.9	2	2.1	2.1	2.3
SE ±	0.8	0.9	1	1.01	1.01	1.12

WAS – Weeks after sowing

TABLE III
Lateral spread Vs different treatments for Bhindi crop

Treatments	Lateral spread (cm^2)		
	1 MAS	2 MAS	3 MAS
Rubberized coir	106.266	285.986	795.292
Black needled felt	92.228	175.1	557.552
Natural needled felt	128.354	199.042	516.202
Black polythene	67.292	163.14	369.14
Transparent polythene	110.426	293.13	888.092
Control	21.416	84.912	213.21
CD (0.05)	14.2	29.3	39.4
SE m±	6.9	14.2	19.1

MAS – Months after Sowing

B. Effect of mulching on yield parameters

Number of days taken for flowering varied with different mulching materials. Plants mulched with transparent polythene flowered earlier

and this was on par with rubberized coir (Table IV). The plants in unmulched plots registered maximum number of days for flowering. Plants in transparent polythene recorded maximum number of fruits (29.6) and were on par with those in rubberized coir. Number of fruits in control plot was significantly inferior to all other treatments. The favourable influence of different mulch material in promoting crop growth helped in yield improvement.

TABLE. IV
Effect of mulching in different treatments for Bhindi crop

Treatments	Number of days to flowering	Number of fruits per plant	Fruit yield (t ha^{-1})
Rubberized coir	24.8	26.2	30.35
Black needled felt	29.8	20	17.09
Natural needled felt	28.2	22	21.98
Black polythene	26	18	15.24
Transparent polythene	24	29.6	35.23
Control	33	14.9	10.21
CD (0.05)	1.7	2.2	2.4
SE m $\pm$	0.84	1.05	1.14

Maximum fruit yield was noted in the treatment of transparent polythene (35.23 t ha^{-1}). Rubberized coir followed closely (30.35 t ha^{-1}) in performance and the control was the poorest. The influence of treatments on fruit number has reflected in yield.

Among the needled felts, natural needled felt performed better than black-needled felt. Mulching with coir materials registered a yield improvement ranging from 67 to 196 %. The water absorption capability and remarkable engineering properties of coir products might have promoted seed germination and seedling growth and supported perpetual living systems. These biodegradable products also serve as mulch and improve soil composition and reduce water evaporation losses (Lanka Santha and Calista Santha, 1997).

B. Effect of mulch on weed intensity

Weeds (No. / m^2) were noted in needled felts and control plot only. In the initial stage, black needled felt resisted weed growth. But after two months, weed population was almost similar in both the needled felts. Weed intensity was significantly higher in the control plot (see Table 5).

All the growth and yield parameters were found to be superior in transparent polythene and rubberized coir mulching. This might be due to the beneficial effect of increased moisture conserved in the soil and the absence of weeds. The favourable effect of polythene mulching in increasing bhindi yield was reported by Incalcaterra and Vetrano (1997). Though weed intensity was low in black polythene mulch, its influence was not reflected in yield. Among needled felts, natural needled felt performed better, compared to black needled felt.

Table V
Weed Intensity Vs different treatments for Bhindi crop

Treatments	Weed intensity (No./ m^2)		
	1 MAS	2 MAS	3 MAS P
Black needled felt	6.3	22.3	27.1
Natural needled felt	17.7	24	25.8
Control	39.4	38.4	52.4
CD (0.05)	11	10.6	10.4
SE m $\pm$	4.3	4.1	4.05

Crop: Pineapple

The suckers were planted during June-July. Observations were noticed on yield parameters and also on weed intensity.

A. Effect of mulch on yield parameters

a) **Length of fruits as influenced by mulch (cm)**

The results presented in Table VI revealed that mulching had no significant influence on length of fruits. Girth of fruits was significantly influenced by mulching. Controls, transparent and black needled were on par and inferior to other treatments in influencing the girth of pineapple. Rubberized coir was significantly superior to all other treatments and gave maximum girth of 37.9 cm. Mulching also influenced the weight of fruits. Among the six treatments, rubberized coir recorded the maximum fruit weight of 1.4 kg followed by natural needled felt and transparent polythene which were on par.

TABLE. VI
Variation in fruit parameters with different treatments for Pineapple crop

Treatments	Length of fruits (cm)	Girth of fruits (cm)	Weight of fruits (kg)
Rubberized coir	20.7	37.9	1.4
Black needled felt	20.1	33.4	1.2
Natural needled felt	21.6	34.2	1.3
Black polythene	20.4	33.7	1.2
Transparent polythene	20.8	33.5	1.3
Control	20.3	30.5	1.2
CD(0.05)	NS	3.54	0.17
SE m$\pm$	1.11	1.52	6.33

B. Effect of mulch on weed intensity

Mulching significantly influenced weed intensity (No. / m^2) throughout the crop period. From Table VII, it is evident that weeds appeared in black polythene from 7 MAP onwards whereas rubberized coir and transparent

polythene suppressed weed growth up to 8 MAP. In the initial stage of crop growth, i.e. up to 4 MAP, weeds were noted in needled felt and control plots only.

Among the needled felt plots, weed intensity was minimum in black needled felt. However, rubberized coir was significantly superior over all

other mulch treatments in suppressing weed growth and recorded the least weed intensity throughout the crop growth. From the initial stage of crop growth, weed intensity was found more in the control treatment.

C. Effect of mulch on soil temperature

Transparent polythene recorded the highest temperature(°C) throughout the crop period owing to the storing and warming up of heat energy in the soil. This was followed by black polythene. Lowest temperature was recorded in the rubberized coir (see Table VIII). by black needled felt, natural needled felt, black polythene, transparent polythene and minimum in the control.

TABLE. VII
Weed Intensity Vs different treatments for pineapple crop

Treatment	1 MAP	2 MAP	3 MAP	4 MAP	5 MAP	6 MAP	7 MAP	8 MAP	9 MAP	10 MAP	11 MAP	12 MAP
Rubberized coir	0	0	0	0	0	0	0	21.3	30.8	32	30.2	29.5
Black needled felt	4.3	7.6	16.2	28.8	62.6	68.6	117	118	121	156	152	151
Natural needled felt	11	23	50.7	72.8	74.9	95	105	118	132	162	160	166
Black polythene	0	0	0	0	0	0	11.2	22.8	41.8	53.2	68.7	95.6
Transparent polythene	0	0	0	0	0	0	0	10.5	15.8	20.4	42.4	67.8
Control	31	78	126	187	224	276	296	299	313	349	361	391
CD (0.05)	11	13	10.8	11.3	14.2	14.6	14.8	16.7	18.4	20.2	29.1	29.4
SE m+/-	6.1	6.3	4.2	5.8	6.1	6.9	7.1	6.8	9.2	10.9	14.6	14.8

MAP- Months after planting

TABLE. VIII

Soil temperature Vs different treatments

Table. IX
Soil moisture Vs different treatments

Treatments	February			March				
	1	2	3	4	1	2	3	4
Rubberized coir	30	30	31	31	30.5	30	30.5	31
Black needled felt	30.5	30.5	30	30	30.5	30.5	30.8	31.1
Natural n eedled felt	30.5	30.5	30	30	30.5	30.5	31	30.5
Black polythene	32	31	31	31	31	32	32.5	31.5
Transparent polythene	35	35	34	34	35.5	35	32.5	34.5

D. Effect of mulch on soil moisture

Table IX shows that all mulched treatments were superior to control in consuming soil moisture. Maximum soil moisture conservation was noticed in rubberized coir (22.31 %) followed.

Table. IX

Soil temperature Vs different treatments

Treatments	Moisture content (%)
Rubberized coir	22.31
Black needled felt	21.06
Natural needled felt	20.76
Black polythene	17.07
Transparent polythene	18.65
Control	16.52
CD(0.05)	0.2705

IV. CONCLUSION

The results reveal that mulching with rubberized coir and transparent polythene are ideal for improving the yield and yield attributes of bhindi whereas rubberized coir was the best for pineapple. Weed growth shall be controlled by mulching with transparent polythene, black polythene and rubberized coir. Observing the bio-degradability and ecofriendly nature of rubberized coir it is inferred that rubberized coir can serve as a good mulch material for bhindi and pineapple without any yield reduction and with minimum weed problem.

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