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Effect of soil solarization on weed growth and yield of *kharif* groundnut (*Arachis hypogaea*)

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ABSTRACT

A field investigation was carried out at UAS, Bangalore during 1995 and 1996 to study the effect of soil solarization on weed growth and yield of groundnut. The increase in soil temperature due to transparent polyethylene of 0.050 mm and 0.075 mm and black polyethylene was 9.5°C, 8.1 to 8.8°C and 2.0 to 3.4°C, respectively over control. There was a significant reduction in weed count and weed dry weight even up to the harvest of groundnut due to solarization with transparent polyethylene. The transparent polyethylene of 0.050 mm was superior than of 0.075 mm. Solarization for 45 days with transparent polyethylene caused maximum reduction in weeds. The black polyethylene did not help in suppressing weeds and was on par with control. Maximum pod yield was recorded by weed free check (21.26 q/ha) but on par with transparent polyethylene 0.050 mm for 45 days (20.64 q/ha).

Key words: Solarization, Groundnut, Weed, Yield

Soil solarization is a method of heating the surface soil by using polyethylene sheets placed on moist soil to trap the solar radiation and in turn to raise the soil temperature to kill the weed seeds in the soil. The soil temperature in solarized plots at 5 cm soil depth reached above 50°C (Katan, 1980). Investigations have indicated that the weeds can be reduced by the rise in soil temperature due to solarization. There are many locations in India experiencing extreme summer. Many experiments were conducted to study the effect of soil solarization on disease control (Fastim *et al.*, 1987 and Hankin *et al.*, 1982). In India, solarization can also be used effectively for weed control (Yaduraju and Ahuja, 1990). However no systematic effort has been made so far on the efficacy of soil solarization for weed control in crops. Hence, an investigation was carried out.

MATERIALS AND METHODS

A field experiment was conducted at Bangalore during 1995 and 1996. The experiment consisted of 10 treatments replicated thrice in a randomized block design. The treatments included were transparent polyethylene (TP) 0.050 mm and 0.075 mm for 15, 30 and 45 days, black polyethylene (BP) for 45 days, no sheet (control), weed free check and pendimethalin (1 kg/ha) as a

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pre-emergence application.

The polyethylene sheets in the solarized plots were spread on 24 April in 1995 and 16 April in 1996. The polyethylene sheets were removed after the respective period of solarization. Groundnut cv. TMV 2 was sown immediately after solarization. Weeds were removed in weed free check as and when emerged. During the solarization period, soil temperature was recorded at 5 days interval at 2.30 to 3.30 pm, using soil thermometer at 5 cm soil depth.

RESULTS AND DISCUSSION

Effect on soil temperature

In 1995, the maximum soil temperature recorded by TP 0.050 mm, 0.075 m and BP reached 50.5, 49.1 and 45.5°C respectively, being higher over control by 9.5, 8.1 and 4.5°C (Table 1). The corresponding figures for 1996 were 53.0, 52.3 and 46.5°C which were higher over control by 9.5, 8.8 and 3.0°C. The results are in agreement with those of Horowitz *et al.* (1983). The higher temperature achieved under TP was mainly attributed to the maximum transmittance of incoming short wave radiation. It was also seen that thinner TP is comparatively more effective than thicker one owing to its higher radiation transmittance. These findings are in agreement with those of Lodha (1989). There was an increase in the frequency of the daily soil temperature maxima crossing the limits of 40 and 45°C with the increase in duration of solarization. When duration of soil solarization increased from 15 to 45 days with TP 0.050 mm, the frequency for temperature exceeding 45°C increased from 22 to 100%. This might be due to the fact that soil solarization requires longer period for CO_2 build up and temperature accumulation.

Effect on weeds

Solarization with TP 0.050 mm and 0.075 mm for 45 days significantly reduced the weed count and weed dry weight (Table 2). The effect could be attributed to higher soil

Table 1. Effect of soil solarization on soil temperature maxima

Treatment	Maximum soil temperature (°C)		Frequency (%) with temperature exceeding	
	1995 (37.00)[a]	1996 (38.20)[a]	40.0°C	45.0°C
TP 0.050 mm for 15 days	47.2	47.5	88.8	22.2
TP 0.050 mm for 30 days	48.5	52.0	100.0	55.5
TP 0.050 mm for 45 days	50.5	53.0	100.0	100.0
TP 0.075 mm for 15 days	47.3	46.0	66.6	22.5
TP 0.075 mm for 30 days	48.0	51.0	77.7	55.5
TP 0.075 mm for 45 days	49.1	52.3	100.0	88.8
TP 0.125 mm for 45 days	45.5	46.5	68.8	66.6
No sheet control	41.0	43.5	77.7	
Weed free	42.1	44.5	77.7	
Pendimethalin 1.0 kg/ha	41.0	43.5	66.6	
CD (P = 0.05)	2.32	2.29		

a = Maximum air temperature; TP = Transparent polyethylene; BP = Black polyethylene

Table 2. Effect of soil solarization on weed count, weed dry weight and yield of groundnut (pooled data of 2 years)

Treatment	Weed count (m^2)		Weed dry weight ($g/0.25m^2$)		Pod yield (g/ha)	Haulm yield (g/ha)
	90 DAS	At harvest	90 DAS	At harvest		
TP 0.050 mm for 15 days	11.22 (125.00)	11.15 (124.33)	5.52 (30.00)	5.87 (34.00)	10.55	15.58
TP 0.050 mm for 30 days	8.77 (76.66)	9.17 (84.16)	3.93 (15.00)	4.18 (17.05)	14.82	20.60
TP 0.050 mm for 45 days	6.77 (45.66)	7.18 (51.33)	2.93 (8.10)	3.31 (10.49)	20.64	28.64
TP 0.075 mm for 15 days	11.74 (138.00)	12.02 (145.33)	5.78 (33.50)	5.95 (35.00)	10.00	17.66
TP 0.075 mm for 30 days	9.75 (95.15)	10.38 (107.66)	4.12 (16.50)	4.47 (20.60)	13.26	19.07
TP 0.075 mm for 45 days	7.08 (49.83)	7.30 (53 66)	3.17 (9.56)	3.80 (14.00)	19.60	26.92
TP 0.125 mm for 45 days	12.87 (165.33)	13.26 (175.83)	5.43 (29.00)	6.40 (40.50)	10.58	19.42
No sheet control	13.21 (175.00)	13.45 (181.66)	7.41 (54.50)	7.66 (58.24)	4.68	9.88
Weed free	0.71 (0.00)	0.71 (0.00)	0.71 (0.00)	0.71 (0.00)	21.26	29.81
Pendimethalin 1.0 kg/ha	8.66 (75.00)	9.36 (87.50)	4.12 (16.50)	4.58 (20.50)	14.68	21.87
C.D. at 5%	0.81	1.10	0.44	0.30	1.76	1.74

$\sqrt{(X + 05)}$ transformation
Figures in parentheses indicate the original values

temperature (Elmore *et al.*, 1993). The soil temperature crossed the lethal limit with higher frequency in these treatments. Greater rise in soil temperature by TP 0.050 mm might have caused the death or damage of the weed seeds present in the soil to a greater extent, thus reducing the weed emergence and weed dry weight to the minimum. Pendimethalin was not effective in controlling weeds particularly *Acanthospermum hispidum* when compared with TP 0.050 mm for 45 days.

Effect on crop yield

The maximum pod yield (21.26 q/ha) was recorded by weed free check being on par with TP 0.050 mm and 0.075 mm for 45 days. The increase in pod yield with weed free check, TP 0.050 mm and 0.075 mm for 45 days over control was 78.0, 77.3 and 76.1% respectively. The maximum reduction in weed count and weed dry weight in these treatments resulted in greater availability of resources leading to higher pod and haulm yields. The yield in pendimethalin

treated plots was on par with TP 0.050 and 0.075 mm for 30 days but significantly inferior when compared to TP 0.050 and 0.075 mm for 45 days.

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