

Groundnut (*Arachis hypogaea*) response to herbicides, plant geometry and plastic mulches under irrigated condition*

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Earlier harvest, reduced evaporation, fewer weed problems, reduced fertilizer leaching and soil compaction and elimination of root pruning, increased crop growth and reduced drowning of crops were the advantages on the use of plastic mulches for vegetable production (Dean McCraw and James 1999). However unlike in vegetables, very limited work has been done on use of polyethylene film mulch in other crops, especially in groundnut at global level. But polyethylene film mulch has been considered as one of the most important practices for increasing production in groundnut in China. This so called 'White Revolution' (using transparent polyethylene film mulch) is viable for both cold regions (northern China) as well as for semi-tropical regions of the southern China and was working satisfactorily in all the soils across different seasons (Hu *et al.* 1995).

This new technology that made a revolution in Chinese groundnut (*Arachis hypogaea* L.) production is of promising to India as per the research report of AICRP – Groundnut (1999). In contrast to the above, black and white polyethylene film mulches were reported to be better than transparent polyethylene film mulch for groundnut production during both dry and wet seasons (Subrahmanian *et al.* 2006). Black polyethylene film gave effective weed control by cutting down solar radiation by more than 90%, resulted in etiolated growth and the eventual death of weeds under the film. Depending on the degree of opacity of white mulch, the use of a herbicide might be needed to control weeds (Ham *et al.* 1993).

The recommended plant spacing for groundnut is 30 cm × 10 cm to maintain 33 plants/m². However, a spacing of 20 cm × 20 cm with 2 seeds/hill was the outcome of research for polyethylene film mulched groundnut (Subrahmanian *et al.* 1999). Hence, in depth study on plant geometry is required. Such studies were not attempted in

groundnut for different colours of polyethylene film mulch, viz black and white. Hence, the present investigation was planned to study the performance of white and black polyethylene film mulches in groundnut and also to assess the need of herbicide application for black and white plastic mulches and the need for change in the recommended spacing.

Field experiments were conducted during dry season of 2002 (June–September) and wet season of 2002–03 (December–March) at Vridhachalam (11° 30' N, 79° 26' E, 46.7 m altitude). The soil was red sandy loam in texture, low in available N (160 kg/ha), moderate in available P₂O₅ (17.5 kg/ha) and available K₂O (145 kg/ha) with a pH of 7.3. The experiment was conducted in split-plot design. Two colours of polyethylene film mulch (black and white) and herbicide treatments (Fluchloralin @ 2.0 litres/ha and no herbicide application) were assigned to main plots, while 3 plant geometry (30 cm × 10 cm, 20 cm × 20 cm and 20 cm × 15 cm) were allotted to the sub-plots. The treatments were replicated thrice. Polyethylene sheets of 7-micron thickness with holes made in the polyethylene sheets at the required spacing of (30cm × 10 cm, 20 cm × 20 cm and 20 cm × 15 cm) were spread over the soil in the mulched plots and groundnut sowing was done. 'VR I 2' groundnut was dibbled in the holes. A uniform fertilizer schedule of 17 : 35 : 54 kg N, P₂O₅ and K₂O/ha was applied at sowing. Fluchloralin, the recommended herbicide for groundnut was applied at 2.0 litres/ha (1.0 kg ai/ha). The pegging percentage and pod-setting ratio were computed by using the formula suggested by Buong and Kyu (1997). To determine effect of treatments on yield, data on number of matured pods/plant, 100-kernel weight, per cent shelling and pod yield were recorded after the harvest. Kernels of each treatment in duplicate samples were analyzed for oil content in Soxhelt apparatus and it was reported also as oil yield by multiplying oil content (%) with seed weight. Kernel samples of each treatment were taken and analyzed for total N by Microkjeldahl's method. The N content of seed was multiplied by the factor 6.25 (Dubetz and Wells, 1968) to get the crude protein content of the kernels.

Short note*

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Table 1 Effect of polyethylene film mulches, herbicide application and plant geometry on flowering behaviour of groundnut during dry and wet seasons

Treatment	Days to 50% flowering in single plant		Total number of flowers/plant (A)		Total pegs/plant (B)		Pegging percentage (B/A)		Matured pods/plant (C)		Pod setting percentage (C/A)	
	Dry	Wet	Dry	Wet	Dry	Wet	Dry	Wet	Dry	Wet	Dry	Wet
<i>Mulch</i>												
Black	29.72	34.94	74.72	65.32	24.64	29.69	32.98	45.45	14.33	18.18	19.48	27.91
White	29.78	35.39	62.79	56.73	18.29	20.46	29.13	36.07	10.63	14.22	16.96	25.15
LSD ($P=0.05$)	NS	NS	4.21	5.43	3.29	2.81	2.19	2.68	1.08	0.81	2.01	2.21
<i>Herbicide</i>												
Herbicide application	29.39	35.66	72.70	65.13	23.87	31.62	33.18	49.31	14.06	18.61	19.51	28.78
No herbicide	30.11	34.67	64.81	56.92	19.07	26.52	29.56	47.00	10.91	13.79	16.94	24.28
LSD ($P=0.05$)	0.56	0.61	4.21	5.43	3.29	2.81	2.19	2.68	1.08	0.81	2.01	2.21
<i>Plant geometry</i>												
30 cm × 10 cm	30.00	34.92	65.32	58.02	20.13	27.48	30.89	47.80	12.65	16.05	19.38	27.68
20 cm × 20 cm	29.92	35.00	74.27	64.33	21.28	29.67	29.03	46.78	12.15	16.30	16.48	25.29
20 cm × 15 cm	29.33	35.58	66.68	60.73	22.98	30.07	34.20	49.88	12.65	16.25	18.81	26.64
LSD ($P=0.05$)	0.55	NS	7.58	3.73	NS	NS	NS	NS	NS	NS	NS	NS

Table 2 Effect of polyethylene film mulches, herbicide application and plant geometry on the yield components, dry pod yield, harvest index and oil content of groundnut during dry and wet seasons

Treatment	100-kernel weight (g)		Shelling per cent		Dry pod yield (kg/ha)		Harvest index (HI)		Oil content (%)		Oil yield (kg/ha)		Crude protein (%)	
	Dry	Wet	Dry	Wet	Dry	Wet	Dry	Wet	Dry	Wet	Dry	Wet	Dry	Wet
<i>Mulch</i>														
Black	44.18	42.09	66.60	69.09	2041	2451	0.229	0.249	46.80	46.77	634	796	24.69	24.63
White	43.65	41.36	66.05	67.95	15.87	2029	0.231	0.223	46.50	46.47	488	648	24.27	24.24
LSD ($P=0.05$)	NS	NS	NS	NS	146.9	222.8	NS	NS	NS	NS	27.35	24.87	0.077	0.076
<i>Herbicide</i>														
Herbicide application	45.28	42.65	67.65	70.33	2059	2517	0.241	0.252	46.86	46.84	641	835	24.90	24.85
No herbicide	42.55	40.81	65.00	66.72	1569	1963	0.219	0.220	46.44	46.40	481	609	24.06	24.01
LSD ($P=0.05$)	1.81	1.75	1.81	2.04	146.9	222.8	0.022	0.029	NS	NS	27.35	24.87	0.077	0.076
<i>Plant geometry</i>														
30 cm × 10 cm	44.15	41.87	67.12	68.21	1837	2284	0.236	0.237	46.65	46.60	577	733	24.38	24.33
20 cm × 20 cm	44.76	42.55	67.17	69.95	1758	2202	0.216	0.210	46.65	46.69	539	710	24.69	24.52
20 cm × 15 cm	43.54	41.19	67.07	66.47	18.47	2235	0.238	0.260	46.65	46.57	567	723	24.38	24.45
LSD ($P=0.05$)	NS	NS	NS	NS	NS	NS	NS	0.033	NS	NS	NS	NS	NS	NS

Polyethylene film mulches did not differ between them for days to 50% flowering. Black polyethylene film mulch had the highest number of flowers, total pegs/plant and pegging per cent compared to the white polyethylene film mulch (Table 1). The flowering in tomato was advanced by 10 days, 8 days and 7 days, respectively in black, white and transparent polyethylene film mulches, respectively as compared to control (Chakraborty and Sadhu 1994). Black polyethylene film mulch significantly had more number of matured pods/plant compared with the white polyethylene film mulch. Unlike the number of mature pods, colours of polyethylene film mulch did not influence significantly 100-kernel weight and shelling per cent (Table 2) during both the

seasons. However, polyethylene film mulch had a significant influence on pod yield of groundnut (Table 2) during both the seasons. Of the two colours of polyethylene film mulches, black polyethylene film mulch registered significantly higher pod yield of 2 041 and 2 451 kg/ha, respectively, during dry and wet seasons compared with the white polyethylene film mulch (1 587 and 2 029 kg/ha). Polyethylene film mulch did not have a greater influence on oil content during both the seasons, while it had a significant impact on oil yield and protein content during both the seasons. Graham *et al.* (1995) reported that black polyethylene film mulch was preferred for growing early spring tomatoes (grown as single crop), because of its warming effect on the soil around the roots,

while it was believed by the farmers that this black polyethylene film mulch though suitable for tomato, it was detrimental to cucumber for the belief that accumulation of heat under mulch would affect cucumber in mid summer for the cropping system tomato (*Lycopersicon esculentum* L. Mill. nom. cons.)–cucumber (*Cucumis melo* L.) system (tomato planted in April and cucumber in the same field during July to August). Results obtained in this experiment further strengthen the suitability of black polyethylene film mulch for both wet and dry seasons. Similar findings were earlier reported by Subrahmaniyan *et al.* (2006).

Herbicide applied treatment made the groundnut crop to come for early to 50% flowering (Table 2) compared with the no herbicide application. Herbicide also played significant role in determining the flower production/plant and had exerted a significant influence on total pegs/plant and pegging per cent during both the seasons. Significantly more number of matured pods/plant (14.06 and 18.61, respectively during dry and wet seasons) was observed with herbicide application compared with the no herbicide (10.91 and 13.79) application. Herbicide application exerted a significant influence on the pod yield (Table 2) in both the seasons. Jensen *et al.* (1989) reported that polyethylene film mulches improved the efficacy of herbicides by reducing the volatilization losses and photo-degradation.

The effects of plant geometry on majority of the growth and yield parameters were non-significant. As a result plant geometry did not influence the pod yield of groundnut (Table 2) during both the years. Similarly, the quality parameters were not significantly differed between different spacing. In the present investigation, interestingly, the pod yield was not altered by the 3 spacings evaluated though the plant geometry differed for few growth and yield parameters during both the seasons. Uniform plant population of 33 plants/m² was maintained in all 3 plant geometry studied and hence no difference between plant geometry in the present investigation. Agasimani *et al.* (1989) studied 16 different spacings for groundnut and found that 20 cm × 15 cm gave maximum pod yield. However, the yield was comparable with 30 cm × 10 cm and 20 cm × 20 cm (single seed). This indicated that altering the plant geometry without disturbing the total population/unit area (33 plants/m²) did not affect the yield in groundnut.

SUMMARY

Experiments were conducted during dry season of 2002 and wet season of 2002–03 to study the influence of plant geometry and herbicides polyethylene film mulch (black and white polyethylene film mulch) on growth yield of groundnut. The results revealed that the highest pod yield of 2 041 and 2 451 kg/ha was observed with black polyethylene film mulch, respectively in dry and wet seasons compared to 1 587 and 2 029 kg/ha of white polyethylene mulch. Herbicide application significantly improved majority of the growth

and yield attributes and pod yield. During both dry and wet seasons, most of the yield and growth attributes and pod yield were not significantly influenced by different plant geometry studied. Summarizing the results, though no significant interaction was obtained, it is recommended to use black polyethylene film mulch with herbicide application under normal population of groundnut irrespective of plant geometry to increase the productivity of irrigated groundnut

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