

Integrated weed management in rainfed groundnut (*Arachis hypogaea*) in acid lateritic soils of West Bengal

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ABSTRACT

A field experiment was conducted during rainy season (*kharif*) of 2002 and 2003, to study the comparative performance of cultural, chemical and integrated methods of weed control in rainfed groundnut (*Arachis hypogaea* L.) in acid lateritic soils of West Bengal. Pre-emergence application of fluchloralin, pendimethalin, metolachlor and oxyfluorfen with or without hand weeding at 20 days after sowing (DAS) effectively controlled the weed population compared with the unweeded control. Among the weed management practices, pendimethalin @ 0.75 kg a.i./ha applied at pre-emergence coupled with one hand weeding at 20 DAS was found promising in reducing the weed density/unit area and in enhancing the yield attributing characters and pod yield of groundnut in addition to benefiting monetary returns. This combination was comparable to that of hand weeding twice at 20 and 40 DAS which yielded the best result.

Key words : Weed-control, Groundnut

Groundnut is grown during monsoon under upland situation; particularly in the western parts of West Bengal. The excessive occurrence of weeds limits the full expression of yield potential of this crop during monsoon. Early control of weeds (first 30 days) in groundnut is very critical (Kalaisetvan *et al.*, 1991) and if not done, the yield reduction due to weeds ranges from 17 to 88% depending upon season (Singh *et al.*, 1992). Yield losses caused by weeds during *kharif* are more because of frequent rains and favourable temperature for luxuriant growth of weeds which requires repeated weeding operations; which is expensive, tedious and labour oriented. Chemical control of weeds forms an excellent alternative to manual weeding (Sumathi *et al.*, 2000). However, pre-emergence application of herbicides may allow the emergence of weeds after some time. Therefore, the concept of integrated weed management by combining physical methods with herbicides are required for higher groundnut yield and monetary returns (Patil *et al.*, 1994). Keeping this in view, the present study was, therefore, undertaken with an objective to find out an effective and economic method of weed control for *kharif* groundnut under rainfed conditions.

MATERIALS AND METHODS

A field experiment was conducted during the rainy season of 2002 and 2003 at the Regional Research Station (Red & Laterite Zone), B. C. K. V., Jhargram, under rainfed conditions. The soil of the experimental site was sandy clay loam, acidic in reaction (pH 5.60, available nitrogen 185.16 kg/ha, available phosphorus 10.87 kg/ha and available potassium 200.73 kg/ha.

The experiment had 10 treatments including pre-emergence application of herbicides, viz., fluchloralin, pendimethalin, metolachlor and oxyfluorfen alone and in combination with one hand-weeding at 20 days after sowing (DAS) compared with two hand-weeding at 20 and 40 DAS (local cultural practice) and unweeded control (Table 1). The experiment was laid out in randomized block design with three replication. The groundnut variety 'TAG 24' was sown at a spacing of 30 cm x 10 cm during third week of July in each year after the onset of monsoon rains. A basal dose of 20 kg N, 60 kg P₂O₅ and 40 kg K₂O/ha was applied through urea, single super phosphate and muriate of potash respectively. Gypsum @ 400 kg/ha was applied to the crop equally at basal and 30-35 days after sowing. The pre-emergence herbicides as per the treatment were applied immediately after sowing. The spray volumes of

herbicides were used @ 500 litres/ha and sprayed with manually operated knapsack sprayer fitted with flat fan-nozzle. All other recommended package of practices were followed. Weed samples were collected from 1m² quadrat at harvest for weed density and weed-dry matter. Yield and yield attributes of groundnut were recorded at crop harvest. All the data were statistically analysed. Weed-control efficiency was calculated as per Somani (1992). The average annual rainfall of this region was 1200 to 1400 mm during May to October due to southwest monsoon.

RESULTS AND DISCUSSIONS

Weeds

In experimental plots, the pre-dominant weeds were *Cyperus rotundus* L., *Echinochloa colonum* (L.) Link., *Cynodon dactylon* (L.) Pers., *Euphorbia hirta* L., *Digera muricata* (L.) Mart., *Leucas aspera* Spreng., *Achyranthes aspera* L. and other weeds during kharif season.

The mean weed density and dry weight of weeds at harvest were significantly reduced in all the weed-control treatments compared to unweeded control (Table 1). Among the weed-control methods, hand-weeding twice at 20 and 40 days after sowing (DAS) showed the best result in reducing weed density per unit area, weed dry weight and enhancing weed-control efficiency. Increasing the concentration of all herbicides resulted in increased weed control, however, lower the concentration of all the herbicides, followed by one hand-weeding at 20 DAS i.e., integrated weed management had more effect on weed control. This was because of pre-emergence application of herbicide alone might have reduced the weed density at the early phase of crop growth, but later stage (harvest) more weeds per unit area was recorded with the crop. However, herbicides in combination with hand-weeding effectively reduced the weed growth and population up to harvest. Nimju (1992) also reported superiority of herbicides coupled with 1 manual weeding to check the weed growth effectively. Among the herbicides treatments, pre-emergence application of pendimethalin @ 0.75 kg a.i./ha coupled with 1 hand-weeding at 20 DAS showed its superiority by recording lower weed density and dry weight of weeds as compared with the other herbicides, followed by fluchloralin @ 0.9 kg a.i./ha +1 hand-weeding at 20 DAS. This combination of pendimethalin at 0.75 kg a.i./ha +1 hand-weeding at 20 DAS was

comparable with that of hand-weeding twice at 20 and 40 DAS. The excellent performance of pendimethalin might have attributed to better control of weeds and its effect on wide spectrum of weed species. Mehra (1989) also reported a very good control of weeds with pendimethalin in groundnut. Thus the groundnut needed integration of pendimethalin @ 0.75 kg a.i./ha with 1 hand-weeding at 20 DAS as a measure for weed control. The results are in conformity with reports of Sumathi *et al.* (2000). Pre-emergence application of metolachlor and oxyfluorfen at 0.75 kg a.i./ha concentration or at lower concentration with 1 hand-weeding at 20 DAS had markedly reduced weed density and weed dry weight than that of unweeded control, but their effectiveness in weed control did not match with pendimethalin which might be due to the escape of some weed species.

The weed-control efficiency was 85.3% with hand-weeding twice at 20 and 40 DAS, closely followed by pre-emergent pendimethalin @ 0.75 kg a.i./ha coupled with 1 hand-weeding at 20 DAS (84.1%). This results are similar to the report of Gnanamurthy and Balasubramaniyan (1999) where pre-emergence application of fluchloralin 0.9 kg a.i./ha along with 1 hand-weeding at 20 DAS was the best treatment in controlling weeds which gave 80.0% weed control efficiency. Unweeded control plot was severely infested with weeds indicating need for better weed control (Table 1).

Crop

Cultural practices (i.e., hand-weeding twice at 20 and 40 DAS) or chemical weed control (1 hand-weeding at 20 DAS) or integration of chemical and cultural control (1 hand-weeding at 20 DAS + 1 hand-weeding at 20 DAS) recorded significantly higher number of pods/plant, shelling (%) and 100 seed weight compared with unweeded control (Table 1). Hand-weeding twice at 20 and 40 DAS showed the best result in respect of yield attributes and pod yield of groundnut. Among the herbicides tried, pre-emergence application of pendimethalin @ 0.75 kg a.i./ha with 1 hand-weeding at 20 DAS had a pronounced effect on yield attributes as compared with other herbicides. Guggari *et al.* (1995) also reported similar and effective effect of pendimethalin in the control of weeds in groundnut crop. The high degree of weed control was noticed with the above-mentioned integrated

Table 1 Effect of weed control method on weed population, weed dry weight and weed-control efficiency in groundnut

Treatment	Weed density (No./m ²)			Weed dry weight (kg/ha)			Weed-control efficiency (%)		
	2002	2003	Mean	2002	2003	Mean	2002	2003	Mean
Control (no weeding)	16.14 (259.8)	16.89 (284.3)	16.51 (272.05)	1134.3	1091.4	1112.8			
HW twice at 20 and 40 DAS	5.99 (34.9)	6.86 (46.1)	6.42 (40.5)	146.3	180.0	163.1	87.1	83.5	85.3
Fluchloralin 1.25 kg a.i./ha	9.01 (80.2)	9.45 (88.4)	9.23 (84.3)	268.8	303.4	286.1	76.3	72.2	74.2
Pendimethalin 1.00 kg a.i./ha	7.96 (62.5)	8.97 (79.6)	8.46 (71.05)	225.7	256.3	241.0	80.1	76.5	78.3
Metolachlor 1.50 kg a.i./ha	9.52 (89.7)	10.10 (101.2)	9.81 (95.45)	307.3	343.7	325.5	72.9	68.5	70.7
Oxyfluorfen 0.2 kg a.i./ha	10.36 (106.3)	11.13 (122.9)	10.74 (114.6)	343.6	415.8	379.7	69.7	61.9	65.8
Fluchloralin 0.9 kg a.i./ha + HW at 20 DAS	7.21 (51.0)	9.01 (80.3)	8.11 (65.65)	183.7	258.6	221.1	83.8	76.3	80.0
Pendimethalin 0.75 kg a.i./ha + HW at 20 DAS	6.67 (43.6)	7.38 (53.5)	7.02 (48.55)	150.8	209.5	180.1	86.7	80.8	83.7
Metolachlor 1.0 kg a.i./ha + HW at 20 DAS	7.79 (59.7)	9.31 (85.8)	8.55 (72.75)	224.5	282.6	253.5	80.2	74.1	77.1
Oxyfluorfen 0.1 kg a.i./ha + HW at 20 DAS	8.62 (73.4)	9.73 (93.7)	9.17 (83.55)	262.0	327.4	294.7	76.9	70.0	73.4
CD (P = 0.05)	1.27	1.31		48	61				

HW, Hand-weeding; DAS, Days after sowing

Figures in parentheses are original values, values are $\sqrt{x+1}$ transformed.

Table 2 Effect of weed control method on yield attributes and pod yield of groundnut (mean data of two years)

Treatment	Pods/plant	Shellin g (%)	100-kernel wt. (g)	Pod yield (kg/ha)			Yield increase over control (%)	Net return (Rs/ha)	Benefit : Cost ratio
				2002	2003	Mean			
Control (no weeding)	5.4	60.6	26.48	526	358	460		2511	0.38
HW twice at 20 and 40 DAS	15.3	72.3	32.97	1665	1267	1466	219	16939	1.37
Fluchloralin 1.25 kg a.i./ha	10.1	66.3	29.65	1341	967	1154	151	12099	1.10
Pendimethalin 1.00 kg a.i./ha	11.6	68.4	30.07	1385	1067	1226	167	13423	1.21
Metolachlor 1.50 kg a.i./ha	9.7	65.5	28.25	1292	854	1073	133	10503	0.96
Oxyfluorfen 0.2 kg a.i./ha	8.9	63.1	27.83	1181	765	973	112	8841	0.83
Fluchloralin 0.9 kg a.i./ha + HW at 20 DAS	13.8	70.2	31.76	1573	1175	1374	199	15888	1.37
Pendimethalin 0.75 kg a.i./ha + HW at 20 DAS	14.6	71.7	33.04	1639	1233	1436	212	16994	1.45
Metolachlor 1.0 kg a.i./ha + HW at 20 DAS	12.2	67.7	30.21	1400	1106	1253	172	13352	1.14
Oxyflurfen 0.1 kg a.i./ha + HW at 20 DAS	10.3	66.5	29.69	1320	972	1146	149	11825	1.06
CD (P = 0.05)	2.15	3.87	2.63	194	145	164			

HW, Hand weeding; DAS, Days after sowing

might have contributed appreciable increase in these yield-attributing characters.

Integrated approach of weed-control (herbicide + manual weeding) produced significantly higher pod yield over the chemical control and unweeded control (Table 2). The groundnut pod yield under pre-emergence pendimethalin at 0.75 kg a.i./ha integrated with 1 hand-weeding at 20 DAS was significantly superior to other herbicide treatments, however, it was at par with that of pre-emergence fluchloralin @ 0.9 kg a.i./ha along with 1 hand-weeding at 20 DAS. This treatment combination increased the pod yield (212%) over the unweeded control (Table 2). This might be due to the combined action of pre-emergence application of pendimethalin which suppressed the initial weed growth and manual removal of weeds which emerged later. Further, the high yields with this integrated weed management might also be due to efficient utilization of available nutrients by the crop otherwise utilized by the weeds. Pannu *et al.* (1991) documented that translocation and accumulation of photosynthates to pods and kernels were high under weed free condition. Hence, lower weed density and lower dry weight of weeds and higher yield attributing characters under this combined treatment resulted higher pod yield of groundnut.

Economics

Effectiveness of herbicide + hand weeding on weed growth would cost less on manual weeding. Reduction in the cost of cultivation thus enabled to realize higher monetary returns with pre-emergence spray of pendimethalin at 0.75 kg a.i./ha + 1 hand-weeding at 20 DAS which gave highest benefit : cost ratio compared with other weed-control treatments (Table 3). Patil *et al.* (1994) emphasized the need for adoption of herbicide spray with manual weeding for higher pod yield and monetary returns.

Thus, under present situation integrated method of weed control with pre-emergent pendimethalin 0.75 kg a.i./ha supplemented with 1 hand-weeding at 20 DAS in groundnut fields is an effective and economically viable method during labour scarcity in peak *kharif* season in lateritic zone of West Bengal.

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