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Weed characteristics, yield attributes and crop yield as influenced by integrated weed management in groundnut (*Arachis hypogaea*)-based intercropping system

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ABSTRACT

In field investigations during winter *(rabi)* seasons of 1992, 1994 and 1995 pre-sowing blanket application of glyphosate @ 1.0% recorded significantly maximum weed-control efficiency (57.45%) and weed-control index (68.9%) and increased the groundnut (*Arachis hypogaea*) pod-equivalent yield by 21.8% over the control. Intercropping of greengram (*Phaseolus radiatus* L.) in groundnut in 4:1 ratio gave 91.7% WCE and 57.6% WCI along with maximum groundnut pod-equivalent yield of 1,947.9 kg/ha. Weed population and dry-matter production of weeds were effectively suppressed with pre-emergence application of metolachlor @ 1.0 kg a.i./ha coupled with 1 hand weeding on 30 DAS and resulted in maximum groundnut pod-equivalent yield of 2,161.8 kg/ha compared with 945.7 kg/ha of unweeded control.

***Key words*:** Groundnut intercropping, Glyphosate, Integrated weed management

The practice of intercropping, besides offering assured crop productivity, maintains soil fertility through containing weed population. The yield reduction in groundnut due to weeds ranges from 17 to 88 %. Singh *et al.* (1992). The use of pre-emergence herbicides is effective only on annual weeds, leaving the sedges unchecked. Moreover, their prolonged application imparts resistance in the existing weed flora. Since the studies on integrated weed management for groundnut-based intercropping systems are limited, the present study was conducted to formulate a judicious combination of pre-sowing, translocative and pre-emergence herbicides along with manual weeding for effective weed management in groundnut-based intercropping system.

MATERIALS AND METHODS

Field experiments were conducted during winter (*rabi*) seasons of 1992, 1994 and 1995 at Regional Research Station, Vridhachalam in Tamil Nadu. The soil of the experimental site was sandy loam with

pH 6.8. The available soil N, P and K were 158.3, 35.1 and 79.6 kg/ha respectively. The experiments were laid out in split-plot design with three replications. In main plot, pre-sowing blanket application of 1.0% glyphosate (G_1), unsprayed control (G_2) and sole groundnut (I_1), groundnut + greengram (I_2) and groundnut + redgram (I_3) in 4:1 row, 30 cm apart, were allocated. In sub-plot different pre-emergence herbicides, viz. fluchloralin @ 1.0 kg a.i./ha (W_1), pendimethalin @ 1.0 kg a.i./ha (W_2) metolachlor @ 1.0 a.i./ha (W_3) and oxyflourfen @ 0.1 kg a.i./ha (W_4) in combination with 1 hand-weeding on 30 days after sowing (DAS) and 2 hand-weedings on 25 and 45 DAS alone (W_5) were compared with unweeded control (W_6). Forty-five days prior to sowing of crops the plots were formed, irrigated and the weeds were allowed to grow. When nutsedge attained 6-8 leaf stage (after 1 month), glyphosate @ 1% with 1% ammonium sulphate and Teepol @ 0.1% (10 ml glyphosate + 10 g ammonium sulphate+1 ml Teepol per litre water were uniformly mixed and sprayed through hand-operated knapsack sprayer fitted with ultra/low volume (VLV) spray nozzle. Fifteen days after the spray, field was prepared for sowing groundnut and intercrops. The pre-emergence herbicides as per the treatment were applied immediately after sowing. The data on weed flora of the experimental field, total weeds/m^2, dry-matter production of weeds (g/m^2) at harvest, yield attributes, yield of groundnut and intercrops were recorded. From the data on total weeds and dry-matter production of weeds, the weed-control efficiency (%) and weed-control index (%) were worked out. The data on total weeds and dry/matter production of weeds were subjected to log (x+2) transformation, and the data on weed-control efficiency and weed/control index were subjected to arc-sin transformation and analysed statistically.

RESULTS AND DISCUSSION

Weed flora

Regarding weed flora the relative dominance of *Cyperus rotundus* L. (nutsedge) was noticed irrespective of cropping seasons over the years. Among grasses, *Cynodon dactylon* L., *Panicum repens* L. and *Dactyloctenium aegypticum* Beauv showed higher dominance. Other important broad-leaved weeds were *Boerhaavia diffusa* L., *Gynandropsis pentaphylla* DC., *Cleome viscosa* L., *Amaranthus viridis* L. *Euphorbia hirta* L., *Phyllanthus niruri* L. and *Eclipta alba* Hassk.

Weed parameters

The mean weed density and their dry-matter production (DMP) were significantly reduced by different weed-control treatments. Pre/sowing blanket application of glyphosate recorded the lowest number of total weeds (51.6/m^2) and dry/matter production of weeds (WDMP) (39.4 g/m^2) compared with the control and resulted in increased weed-control efficiency (WCE) by 68.9%. As an effective post-emergence and translocative herbicide, glyphosate might have contained weeds by inhibiting protein synthesis and chlorophyll biosynthesis. The result confirms the find-

Table 1. Effect of integrated weed-control treatments on weed parameters at harvest (mean data of 3 years)

Treatment	Total weeds (m^2)	Weed-control efficiency (%)	Weed DMP (g/m^2)	Weed-control index (%)
Use of glyphosate				
G_1 Glyphosate spray	51.63 (1.72)	57.44 (49.31)	39.35	68.98 (56.18)
G_2 No glyphosate	155.73 (2,19)	38.32 (38.22)	94.24	39.71 (39.04)
CD (P = 0.05)	0.01	0.76	1.83	0.88
Crop combination				
I_1 Groundnut (sole)	113.15 (2.00)	43.80 (41.37)	72.12	50.74 (45.44)
I_2 Groundnut + greengram	95.26 (1.92)	51.70 (46.01)	61.80	57.61 (49.59)
I_3 Groundnut + redgram	102.63 (1.96)	48.15 (43.91)	66.47	54.68 (47.81)
CD (P = 0.05)	0.02	0.96	2.24	1.12
Weedicide application				
W_1 Flu. + H.W. at 30 DAS	83.72 (1.85)	64.68 (53.84)	45.61	71.86 (59.05)
W_2 Pen. + H.W. at 30 DAS	89.31 (1.88)	62.09 (52.24)	49.17	69.46 (57.28)
W_3 Met. + H.W. at 30 DAS	77.96 (1.80)	67.50 (55.68)	40.69	75.34 (61.90)
W_4 Oxy. + H.W. at 30 DAS	95.43 (1.93)	58.88 (50.24)	57.06	64.16 (53.70)
W_5 H.W. at 25 and 45 DAS	99.73 (1.94)	56.87 (49.87)	59.94	62.26 (52.48)
W_6 UWC	216.44 (2.32)	0.005 (1.28)	151.03	0.05 (1.281)
CD (P = 0.05)	0.03 1.5	3.96 1.93		

Figures in parentheses donote transformed values

Flu, Fluchloralln @ 1.0 kg a.i./ha; Pen, pendimethalin @ 1.0 kg a.i./ha; Met., metolachlor @ 1.0 kg a.i./ha; Oxy., oxyflourfen @ 0.1 kg a.i./ha; H.W., hand-weeding; UWC. unweeded control; DAS, day after sowing; Interactions were non-significant

ings of Manickam and Gnanamurthy (1994). Intercropping of redgram in groundnut was next in order regarding weed control, followed by sole groundnut. The vigorous growth habit and the dense crop canopy of greengram might have offered effective competition with weeds. The results were in line with the finding of Patterson (1982). The least weed density of 77.9/ m^2 and WDPM of 4.05 g/m^2 were registered under integrated application of pre-emergence metolachlor @ 1.0 kg a.i./ha followed by 1 hand-weeding at 30 DAS (W_3). The maximum WCE (67.5 %) and WCI (75.3 %) were also obtained under this treatment, followed by pre-emergence. fluchloralin and pendimethalin respectively @ 1.0 kg a.i./ha along with hand-weeding at 30 DAS. Through inhibiting protein synthesis, metolachlor might have affected a wide spectrum of weed species and effected appreciable reduction in weed density and WDMP. The result is in accordance with the finding of Guggari *et al.* (1995).

Yield attributes of groundnut and intercrops

The effect of pre-sowing blanket application of glyphosate on yield attributes of groundnut was pronounced with 31.6%increase in pods/plant, 7.6%in kernel weight and 2.4% in shelling percentage over unsprayed control. Similarly, the yield attributes, viz. pods/plant and test weight of both the intercrops were also improved under this treatment. High degree of weed control through glyphosate might have permitted groundnut and intercrops to exploit the available resources to the maximum extent and resulted in appreciable improvement in yield-attributing characters. On the contrary, the inhibiting effect of root exudates of nutsedge on germination and growth of groundnut and intercrops, as reported by Velu *et al.* (1992), might have affected the yield attributes under untreated control.

A distinct improvement in yield attributes of groundnut with 16.4 pods/plant, 27 g 100-kernel weight and shelling percent age 71.8 were documented under preemergence application of metolachlor @ 1.0 kg a.i./ha+1 hand-weeding at 30 DAS. compared with unweeded control with 10.6, 22.9 g and 66.9% respectively in pods/plant, 100-kernel weight and shelling percentage. The increased values of pods/plant and test weight noticed with both the intercrops also showed a similar trend. Pannu *et al.* (1991) documented that translocation and accumulation of photosynthates to pods and kernels were high under weed/free condition. The high degree of weed control as noticed with the above-mentioned treatment might have contributed appreciable increase in these yield-attributing characters.

Crop yield and groundnut-pod equivalent

Pre-sowing blanket application of glyphosate registered significantly maximum groundnut-pod yield of 1,829.2 kg/ha, which was 19.8% higher over unsprayed control. Similarly, an increase of 32.2 and 41.7% in the grain yield of greengram and redgram respectively was also recorded under this treatment. The increment in pod and grain yields of groundnut and intercrops resulted in an increase of 207.1 kg/ha of groundnut-pod equivalent over sprayed control. The consistent improvement in yield parameters of groundnut and intercrops obtained under glyphosate application might have imparted similar increase in yield.

The groundnut/pod yield (1,914.8 kg/ha) under pre/emergence application of metolachlor @ 1.0 kg a.i./ha along with hand/weeding at 30 DAS was significantly maximum. However, it was on a par with that of pre/emergence fluchloralin @ 1.0 kg a.i./ha and pendimethalin @ 1.0 a.i./ha applications followed by 1 hand-weeding at 30 DAS. The grain yields of both the intercrops were also higher under this treatment, resulting in a pod/equivalent yield of 2,161.8 kg/ha, which was 128.6% and 7.6% more over unweeded control and the recommended practice of hand/weeding at 25 and 45 DAS respectively. The accountable improvement in yield components and yield of both groundnut and intercrops under this treatment might have favourably reflected on groundnut-pod equivalent. The

Table 2. Effect of integrated weed–control treatment on yield attributes and yield of groundnut and intercrops (mean data of 3 years)

Treatment	Groundnut			Intercrops				Groundnut pod yield (kg/ha)	Gran yield (kg/ha)		Pond equivalent (kg/ha)
				Greengram		Redgram					
	Pods/ plant	100-kernel weight (g)	Shelling (%)	Pods/ plant	1,000-seed wt (g)	Pods/ plant	1,000-seed wt (g)		Greengram	Redgram	
Use of glyphosate											
G_1 Glyphosate	16.1	26.6	71.4	27.8	32.5	117.9	81.2	1,829.2	219.4	237.5	2,071.1
G_2 No glyphosate	12.2	24.7	69.0	24.8	31.5	112.6	79.2	1,526.0	166.0	167.7	1,699.0
CD (P = 0.05)	0.93	1.04	1.07	-	-	-	-	49.6	-	-	34.9
Crop combination											
t_1 Groundnut (sole)	13.9	25.3	69.6	-	-	-	-	1,808.3	-	-	1,809.0
t_2 Groundnut + greengram	14.5	25.9	70.8	26.3	32.0	-	-	1,617.7	192.7	-	1,947.9
t_3 Groundnut + redgram	14.1	25.6	70.2	-	-	115.3	80.2	1,552.7	-	202.6	1,898.5
CD (P = 0.05)	NS	NS	NS	-	-	-	-	60.7	-	-	42.7
Weedicide application											
W_1 Flu. + H.W. at 30 DAS	15.3	27.2	71.2	27.8	32.6	117.9	80.9	1,858.5	225.1	229.0	2,094.6
W_2 Pen. + H.W. at 30 DAS	14.9	26.3	70.9	27.2	32.4	116.8	80.6	1,849.8	180.0	224.3	2,076.8
W_3 Met. + H.W. at 30 DAS	16.4	27.0	71.8	29.6	33.4	121.0	81.8	1,914.5	237.2	244.5	2,161.8
W_4 Oxy. + H.W. at 30 DAS	13.9	25.8	70.3	25.8	31.8	117.6	79.9	1,807.3	212.8	211.0	2,026.6
W_5 H.W. at 25 and 45 DAS	13.5	25.5	70.2	25.3	31.5	113.3	79.5	1,794.3	205.5	203.1	2,008.3
W_6 UWC	10.6	22.9	66.9	22.5	30.2	108.2	78.3	840.9	95.8	103.4	945.7
CD (p = 0.05)	1.73	2.03	1.84	-	-	-	-	97.5	-	-	80.8

Explanation of abbreviations is given in Table 1

results were in agreement with the findings of Ramakrishna *et al.* (1991).

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