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WEED MANAGEMENT IN GROUNDNUT CULTIVATION IN THE RED YELLOW LATASOLS

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ABSTRACT

One of the major constraints associated with groundnut (*Arachis hypogaea*) cultivation in the Red Yellow Latasols (RYL) is the lack of appropriate weed management practice. This necessitates to ascertain an efficient and economical weed control approach to overcome the problem. In this context a field experiment was carried out at the Regional Agricultural Research and Development Centre, Kilinochchi during *maha* 91/92. The treatments consisted of two pre-emergent herbicides (alachlor and oxyfluorfen), hoeing, hoeing followed by (*fb*) hand weeding, hand weeding once and hand weeding twice along with untreated control. These treatments were tested for their efficiency in controlling weeds in groundnut, variety South China (an erect type), over a cropping period of 110 days. The weed composition in this study was assessed at 90% grasses (40% *Leptochloa chinensis*, 30% *Echinochloa colonum* and 20% *Cenchrus echinatus*), and 10% broad leaf and sedges. The weed suppression was assessed in terms of weed dry weight at 60 Days After Emergence (DAE) of the crop. Weed suppression was significantly higher (low weed dry weight) in all the treated plots than the control plot. Among the treatments tested, hand weeding twice (21 and 42 DAE), hoeing *fb* hand weeding (21 and 42 DAE) and pre emergent application of alachlor (1.5 kg a.i.ha^{-1}) gave better weed suppression than the other treatments imposed. The corresponding weed dry weight values at 60 DAE were 5.22, 4.99 and 7.88 gm^{-2}. In general, weed control enhanced the crop yield. However, significantly high yields were recorded in plots treated with two hand weeding (4.67 mt/ha), hoeing *fb* hand weeding (4.61 mt/ha) and pre emergent application of alachlor (4.49 mt/ha) compared with other plots. Although the highest yields were recorded from these treated plots, the ratio of marginal return to marginal cost was higher (20.6) for controlling weeds through application of alachlor than through the other methods. The results indicated that application of alachlor is a more effective and economical method for weed control in groundnut cultivation in the RYL.

KEY WORDS: Alachlor, Groundnut, Hoeing, Oxyfluorfen, Pre emergent, Weed

INTRODUCTION

Groundnut (*Arachis hypogaea* L.) is one of the traditional highland leguminous crops grown mainly during the *maha* season (October – March) as a rainfed crop in the Northern dry zone of Sri Lanka. The total extent under groundnut cultivation in the country is about 12,000 ha (Ministry of Agriculture and Lands, 1998) and it is estimated that about 25 percent of this total extent is cultivated in the Northern dry zone (Regunathan, 1984).

Groundnut is often a major export crop in many tropical countries. However, being an important dietary oil seed, the greatest proportion of the world production is consumed by growers, either as nuts or oil (Weiss, 1983). In Sri Lanka the crop is grown mainly for its kernels, which are roasted, fried and salted and consumed. It is also used in the local confectionary industries. Groundnut is also an important crop for the resource poor farmers in the rural area, as it provides a significant source of cash income for them.

Among the many constraints such as weed competition, plant diseases, insect pests and improper management which affect the yields of groundnut,

non adoption of proper weed management practices considered to be the most detrimental for increased production. The yield reduction due to weed competition is very high, which was estimated as much as 50% in erect and 20% in spreading types (Kulkani *et al.*, 1963). For weed control in groundnut, traditional method of hand weeding is not economical due to high labour wages. Application of pre emergence herbicides, which are commonly available in the market, could be used effectively and economically for weed control in groundnut. In late 1980's chemical weed control in groundnut gained a wide acceptability (Kulanthaivelu and Shankaran, 1986). However, in Sri Lanka the efficacy of these herbicides were not compared with traditional hand weeding and inter-cultivation and thus the chemical weed control method needs to be ascertained along with traditional hand weeding and inter-cultivation methods. Thus an experiment was designed to identify an efficient and economic weed control method in groundnut grown in Red Yellow Latasols.

MATERIALS AND METHODS

This experiment was conducted at the Regional Agricultural Research and Development Centre, Kilinochchi during *maha* 1991/1992 in a randomized complete block design with three replications. The major soil group of the area is the Red Yellow Latasols (Panabokke, 1967). The soil is well drained, deep (75 cm) with moderate fertility especially poor in phosphorus and water holding capacity. The sandy clay loam of the red coloured soil was loose and friable and had a bulk density of 1.5 g cm^{-3}. The pH was 7.6 in the upper 20 cm. The soil consists of 26° % clay, 2.7% fine silt, 3.7% silt, 7% very fine sand, 21.6% fine sand, 23 ° % medium sand and 16 ° % fine gravel and course sand (Jinadasa, 1983). Two pre-emergence weedicides namely Alachlor 1.5 kg ai/ha and Oxyfluorfen 0.18 kg ai/ha were tested with other weed control treatments such as hoeing at 21 days after emergence (DAE), hoeing followed by (*fb*) one hand weeding at 42 DAE, hand weeding once at 21 DAE, and hand weeding twice at 21 and 42 DAE, with an unweeded control. The experimental plot size was 2.7 m by 3.0 m. The test plots were separated by a spacing of 30 cm between the plots and the replicates were separated by a spacing of 60 cm. All the plots received a basal application of inorganic fertilizer mixture containing 14 kg of N, 46 kg of P2 O5-and 30 kg of K2O per hectare as urea, concentrated super-phosphate and muriate of potash respectively. A top dressing of 14 kg of N per hectare was supplied at 4 weeks after emergence of the crop. Aldrin was applied to the test plots at the rate of 2.5 kg a.i. per hectare to control ants and termites. The seed of the variety South China pretreated with captan 1 g per kg was sown at a depth of 1 inch at the rate of one seed per hill at a spacing of 15 cm within the rows and 45 cm between the rows. One day after sowing the pre emergence component of the two weedicides (Alachlor and Oxyfluorfen) was applied, soon after hand watering, using a high volume knapsac sprayer. All the plots

were hand watered with equal volume of water before the weedicides treatments were imposed. Pest and disease control was done according to the recommendations of Department of Agriculture. The crop was established under rainfed condition, but supplementary irrigation was done as and when necessary. At 60 DAE of the crop weeds were sampled in all the plots randomly from the sampling area using a quadrant size of 25 cm x 25 cm. Four distructive samples were taken from each plot, dried in an oven maintained at 50^0 C for 72 hours and the dry weight was recorded. At 65 DAE plant height was recorded in 5 randomly selected plants from all the plots. At harvest 5 plants from each plot was used to study the number of pods and weight of pods. Harvesting was done on the 110 th day after sowing and the yield data was recorded from a net plot size of 1.8 m x 2.7 m. For yield measurements the matured pods were removed manually and dried to a constant weight after harvest and weighed using an electronic balance. Yield parameters, dry weight of weeds and other parameters were subjected to statistical analysis. Marginal returns and marginal benefit/ cost ratio for different weed control methods were also analysed.

RESULTS AND DISCUSSIONS

The major weed species and its composition observed in the experimental area is shown in table 1. Among the weed species the grasses occupied 90%, broad leaves 8% and the sedges 2.0%, respectively. Significant weed suppression was observed in all the treated plots compared to the untreated plots. Although the lowest dry weight of weeds of 4.99 g/m^2 obtained with hoeing fb hand weeding, the dry weight of weeds obtained with other treatments such as two hand weeding and pre-emergence application of Alachlor and Oxyfluorfen were not significantly different to hoeing fb hand weeding. However, the dry weight of weeds of these treatments were significantly lower than the dry weight of weeds obtained with hoeing and one hand weeding at 21 DAE (table 2).

Table1. Weed species and its composition.

Weed species *	%
Leptochloa chinensis (L.) Nees (G)	40.0
Cenchrus echinatus L. (G)	30.0
Echinochloa colona (L.) Link (G)	20.0
Richardia braciliensis (Moq.) Gomez (B.L)	05.0
Celosia argentea L. (B.L)	1.5
Euphorbia hirta L. (B.L)	1.5
Cyperus rotundus L. (S)	02.0

* G= Grass, B.L= Broad Leaf, S= Sedges

Table 2. Dry weight of weeds and pod yield of groundnut as influenced by various weed control treatments in Red Yellow Latasols – *maha* 1991/1992.

Treatment	*Herbicide rate kg ai/ha*	*Application time* [a]	*Weed dry wt. g/sqm. at 60 DAE*	*Pod yield (mt/ha)*
Alachlor	1.5	Pre	7.88 d *	4.49 a *
Oxyfluorfen	0.18	Pre	10.49 cd	3.95 b
Hoeing	-	21 DAE	23.40 b	3.81 b
Hoeing fb Hand weeding	-	21 & 42 DAE	4.99 d	4.61 a
Hand weeding once	-	21 DAE	15.44 c	4.01 b
Hand weeding twice	-	21 & 42 DAE	5.22 d	4.67 a
Unweeded control	-	-	38.82 a	2.94 c
CV (%)		24.15	7.89	

a; pre = pre emergence, DAE= days after emergence

* Values followed by the same letter do not differ significantly according to DMRT at p = 0.05

The pod yield results clearly showed the increased yield with corresponding reduction of dry weight of weeds obtained with different weed control treatments. While all the treated plots gave significantly higher pod yield than the untreated (2.94 mt/ha) control, the highest pod yield (4.67 mt/ha) was obtained with two hand weedings (table 2). However the yield obtained with treatments hoeing fb hand weeding (4.61 mt/ha) and pre-emergence application of Alachlor (4.49 mt/ha) were not significantly different from the yield obtained with two hand weedings. Although significant reduction of dry weight of weeds recorded with pre-emergence application of oxyfluorfen, the pod yield also reduced in this treatment and this could be attributed to the effect of oxyfluorfen on groundnut as indicated by reduction in plant height (table 4). The yields obtained with hoeing (3.81 mt/ha) at 21 DAE, one hand weeding (4.01 mt/ha) at 21 DAE and pre-emergence application of oxyfluorfen (3.95 mt/ha) were significantly higher than the untreated control, but significantly lower than the plots treated with two hand weedings, hoeing fb hand weeding and with pre-emergence application of alachlor.

Weed suppression was significant in all the tested plots and gave significantly higher number of pods and pod weight compared to the control plots. However, the pod number and the pod weight were not significantly different among the treated plots (tables 2 and 3).

Table 3. Number of pods and pods weight of 5 plants of groundnut as influenced by various weed control treatments in Red Yellow Latasols. *Maha* 1991/1992.

Treatment	*Herbicide rate kg ai/ha*	*Application time* [a]	*No: of pods*	*Pods weight (g)*
Alachlor	1.5	Pre	237 a *	215 a *
Oxyfluorfen	0.18	Pre	205 a	196 a
Hoeing	-	21 DAE	194 a	190 a
Hoeing fb Handweeding	-	21 & 42 DAE	241 a	214 a
Hand weeding once	-	21 DAE	207 a	199 a
Hand weeding twice	-	21 & 42 DAE	246 a	239 a
Unweeded control	-	-	103 b	96 b

a; pre= pre-emergence, DAE = Days after emergence

* Values followed by the same letter do not differ significantly according to DMRT at p= 0.05

Table 4. Effect of different weed control treatments on plant height of groundnut at 65 DAE. *maha* 1991/1992

Treatment	*Herbicide rate kg ai/ha*	*Application time* [a]	*Mean plant height (cm)*
Alachlor	1.5	Pre	47.5 b *
Oxyfluorfen	0.18	Pre	42.8 c
Hoeing	-	21 DAE	53.9 ab
Hoeing fb Handweeding	-	21 & 42 DAE	51.5 ab
Hand weeding once	-	21 DAE	51.9 ab
Hand weeding twice	-	21 & 42 DAE	51.3 ab
Unweeded control	-	-	51.9 ab
CV (%)		5.32	

a; pre= pre-emergence, DAE = Days after emergence

* Values followed by the same letter do not differ significantly according to DMRT at p= 0.05

A negative linear relationship between the dry weight of weeds and the plant population of groundnut at harvest (figure 1) indicated that increased dry weight of weed has a direct impact on plant population which in turn can affect the final yield. Figure 2 shows a negative linear relationship between dry weight of weeds and final yield and reveals that reduction of 47 kg of pods of groundnut for every 1 g dry weight of weeds present per square meter of the plot. The effective control of weeds achieved with pre emergence application of alachlor without significant reduction in the yield of groundnut in the present experiment is a confirmation of the work of Singh *et al.*, (1972), and Reddi *et al.*, (1976). They reported that herbicides such as alachlor (1.0 to 1.5 ai/ha) as pre emergence application have proved to be effective for weed control in groundnut.

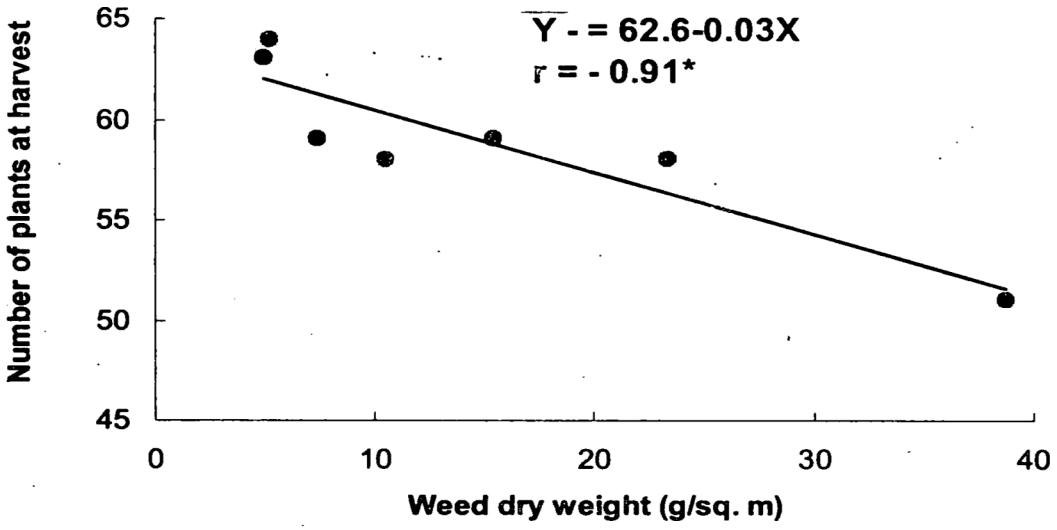

Figure 1. Relationship between dry weight of weeds and number of plants at harvest.

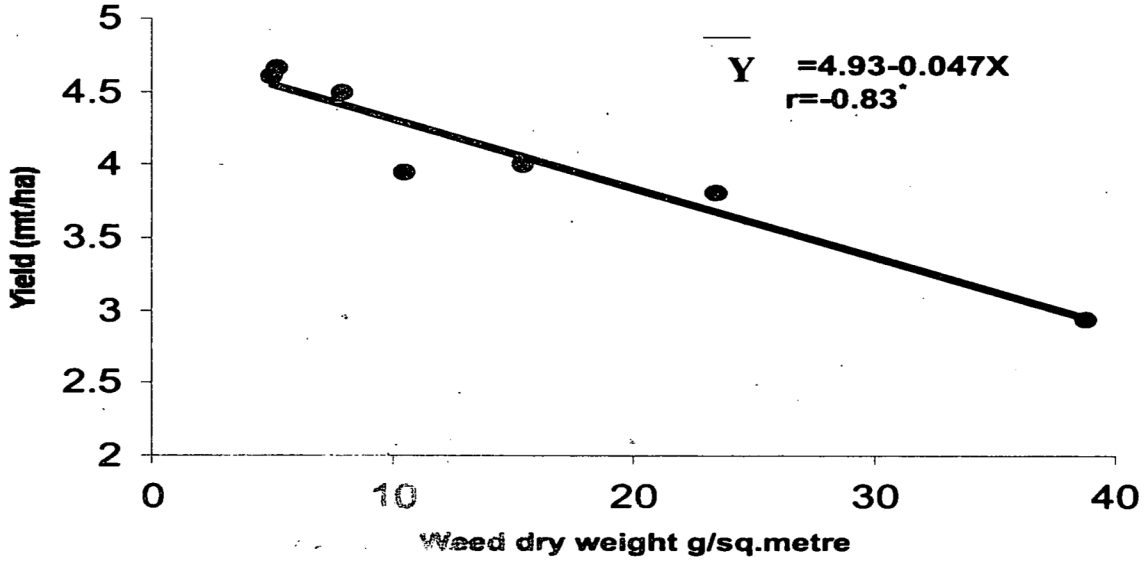

Figure 2. Relationship between dry weight of weeds and yield.

The estimated cost for different weed control treatments indicated that the highest cost of Rs. 8646.00 per hectare incurred for two hand weeding operations at 21 and 42 DAE followed by Rs. 6550.00 per hectare for hoeing fb hand weeding at 21 and 42 DAE. The cost for one hand weeding at 21 DAE was also high and was Rs. 4716.00 per hactare. Among the treatments the lowest cost incurred for both pre emergence herbicides application treatments namely alachlor and oxyfluorfen and the cost for these two treatments were Rs. 2250.00 and Rs. 2475.00 respectively (table 5). The highest cost for two hand weedings (66 man days x Rs. 131/= per hectare) and hoeing fb hand weeding (50 man days x Rs. 131.00 per hectare) was due to higher labour requirement and wages. While the experimental results showed a high yield of 4.67 and 4.61 mt/ha obtained with two hand weeding and hoeing *fb* hand weeding the yield of 4.4 9 mt/ha obtained with pre-emergence application of alachlor is comparable with two hand weedings and hoeing *fb* hand weeding with less labour utilization and also with low input cost. Between the two pre emergence herbicides tested, alachlor gave the comparable yield with the treatments two hand weedings and hoeing *fb* one hand weeding in addition to good control of weeds. The total return and cost ratio was also higher (20.6) with alachlor treatment (table 5). Thus application of alachlor at the rate of 1.5 kg ai per hectare as a pre-emergence weedicide controlled the pre dominated grass weeds effectively and economically in groundnut cultivation under Red Yellow Latosols soil condition.

Table 5. Returns and Costs

Treatment	*Herbicide rate kg ai/ha and application time*	*Pod yield mt/ha*	*Cost of treatments Rs/ha*	*Returns on treatment Rs/ha*	*Returns/ Cost*
Alachlor	1.5	4.49	2250	46500/=	20.6
Oxyfluorfen	0.18	3.95	2475	30240/=	12.2
Hoeing	21 DAE	3.81	2620	25920/=	9.9
Hoeing fb Hand weeding	21 and 42 DAE	4.61	6550	49980/=	7.6
Hand weeding once	21 DAE	4.01	4716	32070/=	6.8
Hand weeding twice	21 and 42 DAE	4.67	8646	51810/=	6.0
Unweeded control	-	2.94	-	-	-

Cost of 1 litre of alachlor = Rs. 565.00, Cost of 1 litre of Oxyfluorfen =Rs. 1125.00, Selling price of 1 kg of groundnut pods Rs.30.00, Wage rate calculated at Rs. 131.00 per man day and Rs. 15.00 for spraying weedicide per tank (15 litres).

CONCLUSION

Alachlor was found to be one of the highly suited pre-emergence herbicides for effective weed control in groundnut in Red Yellow Latasols. The use of this herbicide reduces the input cost and increases the benefit/ cost ratio.

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