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Weed control in sorghum – groundnut mixture in the simultaneous farming system of Southern Guinea Savanna zone of Nigeria

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SUMMARY
Herbicide treatments were evaluated for weed control in a simultaneous farming system with sorghum – groundnut mixture. Sorghum (cv. SL – 1499) and groundnut (cv. EX – Dakar) were used in the two years respectively. Eight herbicide treatments compared with a hoe–weeded control and un–weeded check were laid out in a randomized complete design. Low rates of herbicide treatment followed by supplementary hoe–weeding (SHW) reduced weed infestation better than the higher herbicide rates without hoe–weeding, but compared well to the twice hoe–weeded control. Propachlor plus terbutryne at 3.5 + 1.5 kg a.i/ha, followed by SHW, was most promising in terms of selectivity in the component crops, with season long weed control. The findings of the study demonstrate that farmers can use mixtures of propachlor and linuron with terbutryne at 3.5 + 1.5 kg a.i/ha and 0.85 + 1.5 kg a.i/ha, respectively, to reduce labour input. In using any of these herbicides it is suggested that supplementary hoe–weeding be used at the appropriate time in order to have season–long weed control which is important for obtaining an optimum crop yield.

1 INTRODUCTION

Intercropping is a popular farming system among small–scale farmers in the tropics (Ruthenberg, 1980; Vandemeer, 1992). Some advantages of the practice include disease control (Messiaen 1994), reduced risk through diversification, optimal space utilization and differential exploitation of soil nutrients. In addition, there is the possibility that competition between crops could contribute to weed control (Schoohoven & Voyset 1993).

Sorghum–groundnut intercrop is one of the common mixtures among small-scale farmers in the Guinea Savanna zone of Nigeria. In the 'Gicci' system, one crop is placed in widely spaced rows, usually the early-planted cereals are done at right angles to the other crop, which might be a cereal or legume intercropped later. In the simultaneous system used here, the component crops of the mixtures are planted at the same time on the same row or in alternate rows.

Yield losses due to uncontrolled weeds are in the range of 40 – 60% for sorghum (Choudhary *et al.*, 1979), and 31 – 70% for groundnut (Lagoke *et al.*, 1981; Choudhary & Lagoke, 1985). Hoe weeding is the most common method of weed control in the Nigerian Savanna, but it is expensive, inefficient and highly labour-intensive. In addition, it can result in stand losses and possible damage to groundnut pegs with consequent reduction in pod yield if the operation is not done carefully

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(Choudhary & Lagoke, 1985). Consequently reducing reliance on weeding with hoe, and increasing use of chemicals may be desirable.

In the Nigerian Savanna, some workers have emphasized the need to supplement pre-emergence herbicide treatments with hoe weeding for season long weed control and increased yield (Bakut, 1985; Adigun *et al.*, 1987). Inspite of the high labour requirement and the cost of inputs, the use of pre emergence herbicides such as atrazine plus propachlor, metolachlor plus atrazine and atrazine plus linuron with supplementary hoe weeding has been profitable in various horticultural and field crops (Lagoke *et al.*, 1986). In a mixture of sorghum and groundnut, whose life cycles only partly overlap, it is obvious that a longer weed-free period is required to keep the two crops free of the adverse effects of weed infestation. Supplementary weed control or the use of persistent pre-emergence herbicide treatment therefore becomes important in this situation.

However, it is often difficult to select effective herbicides, which are not injurious to one of the crops. Akobundu (1978), however, demonstrated the possibility of chemical weed control in mixed cropping system, and indicated that inter-croping offered an opportunity for using a low rate of herbicides. Similarly, Ologunde and Lagoke (1982) reported effective weed-control in maize-melon mixture in the Southern Guinea with alachlor plus prometyne. In a legume-based mixture, a few herbicides such as alachlor plus prometryne, metolachlor plus prometryne, and metolachlor plus metobromuron were observed to be well tolerated by the component crops of the mixture, i.e. maize (*Zea mays* L.), cowpea (*Vigna unguiculata*) and soy bean (*Glycine max*. L) (Gworgwor, 1985; Lagoke & Olufajo, 1986). Similar season-long weed control was reported with terbutryne plus linuron followed by SHW in both Gicci and simultaneous system of sorghum-groundnut mixture (Gworgwor, 1985). Much information is still needed on the effectiveness of herbicides that can provide season-long weed control, especially in cereal-legume mixtures. The objective of this investigation was to evaluate several herbicide treatments for weed control in sorghum – groundnut mixture.

2 MATERIALS AND METHODS

Field trials were conducted during the rainy seasons of 2001 and 2002 on the Research Farm, University of Agriculture Makurdi (7°43'N; 8°28'E) in the Southern Guinea Savanna zone of Nigeria. The soils at the experimental sites were freely draining sandy loam with 12 – 14% clay. The experimental sites was ploughed and harrowed before application of single superphoshate and muriate of potash by broadcast at the rate of 25kg P and 45 kg K per hectare, respectively. This was followed by preparation of 0.75m wide ridges. The gross and net plot sizes were 4.5m^2 and 3.0m^2, respectively. The two outermost ridges were used as guard rows, and the four inner rows were harvested for final yield determination. Calcium Ammonium Nitrate (CAN) was equally split–applied by placement 15cm away from the sorghum plants at the rate 35kg N/ha, at 3 and 7 weeks after sowing. Four sorghum seeds (cv. SL - 1499) were sown at about 3cm depth per hole at a spacing of 30cm on alternate ridges. Groundnut (cv. EX - Dakar) was sown on the same day as sorghum on other ridges at a spacing of 25cm apart, using two seeds per hole at a depth of about 5cm. The sorghum plants were later thinned to two plants per stand at 2 weeks after sowing. Sowing was done on 24th and 14th June in 2001 and 2002, respectively, while harvesting was carried out on 16th and 27th October for groundnut and 17th and 28th November for sorghum in both years, respectively.

There were eight herbicide treatments compared with a hoe–weeded control and an un-weeded check laid out in a randomized complete block design and replicated three times. All herbicides were applied pre–emergence using a CP3 Knapsack sprayer. Cabaryl (trade name Vetox 85), was applied twice at the rate of 1.5kg a.i/ha as soon as stem-borer attack was noticed, as a blanket application on all treatments.

Observations taken included crop vigour, crop yield, weight of 1000 sorghum grains, weed cover score and weed dry matter production. All data were subjected to analysis of variance, and least significant

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difference (LSD) was used to compare treatment means where F–values were significant.

3 RESULTS AND DISCUSSION

In the two trials, the use of several herbicide mixtures applied pre–emergence and followed by one supplementary hoe weeding (SHW) gave season long weed control and better yields of both sorghum and groundnut in intercrop. In 2001, nearly all the low rates of the herbicide treatments supplemented by hoe weeding resulted in significantly lower weed cover, than the corresponding high herbicides rate without SHW. Pree plus terbutryne had comparable weed cover score to the hoe–weeded control. In 2002, however, propachlor plus terbutryne and pree plus terbutryne, both without SHW, gave comparable weed score at 9 weeks after sowing (WAS) to the hoe–weeded control (Table 1).

Table 1: Effect of weed control treatment on weed cover score and dry matter production in Sorghum – groundnut mixture at Makurdi, 2001 and 2002.

Treatments	Rate Kg a.i/ha	Weed cover score1		Weed dry matter	
		2001 9 WAS2	2002 9 WAS	2001 10 WAS	2002 8 WAS
Propachlor + Terbutryne	3.5 + 1.5	6.5	3.8	2845	1325
Propachlor + Terbutryne	2.5 + 1.5 f.b3 SHW4	1.6	2.3	848	1458
Linuron + Terbutryne	1.5 + 1.5	5.4	5.6	3142	1388
Linuron + Terbutryne	0.85 + 1.5f.b SHW	1.4	1.8	799	1815
Butachlor + Terbutryne	1.75 + 1.5	4.5	4.8	2334	1133
Butachlor + Terbutryne	1.5 + 1.5f.b SHW	1.4	2.0	1268	1275
Pree5 + Terbutryne	0.85 + 1.5	3.6	2.1	2213	1450
Pree + Terbutryne	0.75 + 1.5fb SHW	1.5	1.6	1370	1272
Hoe – Weeded (3&7 WAS)	-	1.3	1.6	729	520
Un – Weeded Check	-	10.0	8.8	3742	3520
S.E	-	1.45	1.20	822	275
LSD (P = 0.05)	-	2.97	2.71	1686	623

Key: 1 = Weed cover score scale 0 – 10; where 0 represent no weed and 10 full weed cover; 2 = W.A.S = Weeks after sowing; 3 = f.b = followed by; 4 = Supplementary hoe – weeding at 6 W.A.S; 5. = Metazachlor + antidote

From the results on weed cover it was apparent that the herbicide mixtures gave adequate weed control initially, although the effect was not sufficiently persistent for good yield. Supplementary hoe weeding of the plots with low herbicide rates therefore gave better weed control than the high herbicide rates alone. This effect was manifested in sorghum yield where the high rates of some of the mixtures were also phytotoxic to the corp. Among the herbicide treatments, therefore, propachlor plus terbutryne at 2.5kg a.i/ha followed by SHW gave season long weed control with high selectivity in both sorghum and groundnut, consequently resulting in better yields of both crops. This observation agrees with the previous one by Choudhary and Lagoke (1980) on the selectivity of propachlor and terbutryne in sorghum. The treatment did not have any adverse effect on the stand count and crop vigour of sorghum or groundnut in both years. Although the high herbicide rate in the mixture without SHW did not have adverse effects on sorghum growth and grain yield, it resulted in loss of stand and vigour both at 6 WAS and at harvest in groundnut and coupled with high weed infestation, resulted in low groundnut pod yields in both years (Table 2). This indicates that at high rate the herbicide is phytotoxic to groundnut.

On the other hand, pree and terbutryne mixture was the most effective on weeds, even at the high rate of 0.75kg a.i/ha without SHW. However, the pre–emergence application of the mixture at both low and high rates was phytotoxic to sorghum, depressing the vigour and yield of the crop despite the presence of an ‘antidote’. Although no

depression was observed in the growth of groundnut, high pod yield was only obtained in 2001 with the high herbicide rate without SHW. This may be attributed to high weed infestation on plots treated with high rates of the mixture without SHW later in the season as a result of intensive rain in 2002. Pree has been reported to give selective weed control in various legumes including cowpea, groundnut and soybean at various rates, as observed with groundnut in these trials (Lagoke & Olufajo, 1988).

Table 2: Effect of weed control treatments on crop vigour score of Sorghum and groundnut grown in mixture at Makurdi, 2001 and 2002.

Treatments	Rate (Kg a.i/ha)	Crop vigour score[1] at Sorghum		6 W. A. S	
		2001 9 WAS2	2002 9 WAS	2001	2002
Propachlor + Terbutryne	3.2 + 1.5	5.4	5.1	4.5	4.1
Propachlor + Terbutryne	2.5 + 1.5 f.b[3] SHW[4]	4.4	5.2	5.0	4.1
Linuron + Terbutryne	1.5 + 1.5	3.6	4.8	4.2	3.4
Linuron + Terbutryne	0.85 + 1.5f.b SHW	3.6	5.4	3.6	3.7
Butachlor + Terbutryne	1.75 + 1.5	2.5	3.1	4.5	4.6
Butachlor + Terbutryne	1.5 + 1.5f.b SHW	5.0	5.3	5.5	3.3
Pree[5] + Terbutryne	0.85 + 1.5	1.4	2.5	5.4	4.9
Pree + Terbutryne	0.75 + 1.5f.b SHW	3.8	3.0	5.0	4.3
Hoe – Weeded (3&7 WAS)	-	5.0	5.4	4.6	4.0
Un – Weeded Check	-	5.5	4.3	3.2	2.6
S.E	-	0.8	0.5	0.9	0.6
LSD (P = 0.05)	-	1.7	1.2	1.8	1.3

Key: 1 = Weed cover score scale 0 – 10; where 0 represent no weed and 10 full weed cover; 2 = W.A.S = Weeks after sowing; 3 = f.b = Followed by; 4 = Supplementary hoe – weeding at 6 W.A.S; 5 = Metazachlor + antidote.

Table 3: Effect of weed control treatments on grain yield and 1000 grain weight of sorghum and pod yield of groundnut grown in mixture at Makurdi, 2001 and 2002.

Treatment	Rate (Kg a.i/ha)	SORGHUM			Groundnut pod yield (kg/ha)	
		Grain Yield (Kg/ha)		1000 grain (g)		
		2001	2002	2001	2001	2002
Propachlor + Terbutryne	3.5 + 1.5	2386	2567	23.0	335	179
Propachlor + Terbutryne	2.5 + 1.5f.b1 SHW[2]	2444	3617	26.1	410	379
Linuron + Terbutryne	1.5 + 1.5	1703	1797	24.8	282	307
Linuron + Terbutryne	0.85 + 1.5f.b SHW	1869	2628	25.5	404	457
Butachlor + Terbutryne	1.75 + 1.5	1639	1658	21.8	414	221
Butachlor + Terbutryne	1.5 + 1.5f.b SHW	2008	2853	24.3	559	321
Pree[3] + Terbutryne	0.85 + 1.5	631	2064	18.5	437	186
Pree + Terbutryne	0.75 + 1.5f.b SHW	1511	2067	25.3	494	540
Hoe – Weeded (3&7 WAS)	-	2120	3221	27.2	503	421
Un – Weeded Check	-	2139	2647	20.4	157	128
S.E	-	539.6	519.6	4.1	100.7	132.2
LSD (P = 0.05)	-	1106.6	1065.7	8.2	200.6	271.4

1 = Followed by; 2 = Supplementary hoe – weeding at 6 WAS; 3 = Metzachlor + antidote

In both years sorghum grain yield did not differ significantly between the hoe–weeded and the un-weeded controls (Table 3). In 2001 only pree at 0.75kg a.i/ha treatment had significantly poor yield compared with the hoe–weeded and the un-weeded controls. No significant difference was observed between the rest of the herbicide treatments, while hoe weeding alone resulted in a comparably high sorghum grain yield to some of the herbicide treatments. The growth and yield of sorghum was not significantly reduced in the un-weeded plots while groundnut growth and yield were adversely affected. But, of significance is the fact that groundnut plants of the un-weeded plots, and those with poor weed control, were relatively tall compared with those with adequate weed control – probably due to shading responses, as was observed earlier by Gworgwor (1985) in a similar mixture Earlier reports by Lagoke *et al.* (1981), Bakut (1985) and Adigun *et al.* (1986) have emphasized the need to supplement pre–emergence herbicide treatments with post–emergence measures so as to get season long weed control in the Nigerian Savanna. Mixtures of selective herbicides to improve broad–spectrum weed control have been suggested for use in groundnut (Lagoke *et al.*, 1981). Such mixtures include terbutryne with some chloroacetamides such as metolachlor and alachlor.

In view of the increasing cost of hoe weeding, it is suggested that both of the mixtures tried in these trials are further evaluated with either SHW or post–emergence herbicide for season long weed control. Mixtures of pree and terbutryne may be tried at lower rates, or with increased concentration of 'antidote'.

Results from these experiments suggest that farmers can use herbicide mixture to reduce labour input from two hoe weedings to a single supplementary hoe weeding with a low rate of herbicide application, as manual labour input is one of the bottlenecks in crop production in the Nigerian Savanna. Herbicides showing promise in these trials include mixtures of propachlor and linuron with terbutryne at 3.5 + 1.5 kg a.i/ha and 0.85 + 1.5 a.i/ha, respectively. When using any of these herbicides it is suggested that supplementary hoe weeding be included at the appropriate time in order to have season long weed control, which is important for obtaining an optimum yield of the component crops.

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