

**EVALUATION OF CHEMICAL AND MECHANICAL WEED CONTROL METHODS IN SOYABEAN (GLYCINE MAX L. MERR) PRODUCTION.**

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**ABSTRACT**

Field trials were conducted in the Southern Guinea Savannah Agro Ecological zone of Nigeria, during the 1999 and 2000 cropping seasons, to evaluate the effectiveness of different weed control treatments in Soyabean production. Ten weed control treatments consisting of wheel type weeder (3 and 6 weeks after planting (WAP)); hoe weeding (3 and 6 WAP); pre-emergence application of metolachlor (2-chloro-N-(2-ethyl-6-methylphenyl)-N-(2-methoxy-1-methylethyl) acetamide] + prometryn [N<sup>1</sup> bis (1-methylethyl)-6-(methylthio)-1, 3, 5-triazine 2, 4- diamine] (codal)<sup>3</sup> at 1.0kg a.i./ha; imazaquin [2-(4,5-dihydro-4-methyl-4(1-methylethyl)-5- exo-1 H-imidazol-2-yl)3-quinoline carboxylic acid] at 0.18 kg a.i/ha followed by fluazifop butyl 2[4-(5-trifluoromethyl)-2-pyridyloxy] phenoxy propanoic acid] at 0.25kg a.i/ha; codal at 1.0kg a.i/ha fb wheel type weeder at 3 WAP; imazaquin + pendimethalin [N-(1-ethylpropyl)-3, 4-dimethyl 2, 6-dinitrobenzenamine] (squadron)<sup>4</sup> at 1.1kg a.i/ha; squadron at 1.1kg a.i/ha fb wheel type weeder at 3 WAP; imazethapyr(+)-2-[4, 5-dihydro-4-methyl-4-(1-methylethyl)-5-oxo-1H-imidazol-2-yl)-5-ethyl-3-pyridine carboxylic acid] + pendimethalin (Pursuit plus)<sup>5</sup> at 1.1kg a.i/ha; pursuit plus at 1.1kg a.i/ha fb wheel type weeder at 3 WAP and no-weeding were tested. The experiment was laid out in a randomized complete block design with four replications. Pre-emergence applications of squadron, pursuit plus, codal each followed by wheel type weeder at 3 WAP respectively, and imazaquin fb fluazifop-butyl at 3 WAP were the best treatments in terms of weed control while in terms of phytotoxicity, pursuit plus was moderately phytotoxic to the crop, whereas imazaquin fb fluazifop butyl at 3 WAP was the least phytotoxic. The grain yield result for the two years demonstrated that imazaquin fb fluazifop butyl at 3 WAP, squadron fb wheel type weeder at 3 WAP and wheel type weeder at 3 and 6 WAP effectively controlled weeds and gave grain yields that were as good as two hoe weedings.

**Key Words:** Chemical & Mechanical weed control, weeder

**INTRODUCTION**

World production of soyabean has been on the increase due to increasing demand for edible oils and protein feed supplements worldwide. Soyabean accounts for approximately 20% of the world supply of fats and oils (Singh and Rachie, 1987). Dependence on soyabean for food and animal feed has increased rapidly in many countries, particularly in Nigeria during the last three decades. However, in Nigeria the average yield of the crop on farmers' field remains at less than one tonne per hectare (Nyiakua, 1982) whereas research results showed that soyabean cultivars (e.g. TGX 342-375 D) could attain a yield of more than three tones per hectare when cultural practices are optimal (IITA, 1984).

Weed interference has been identified as a major production constraint in soyabean production in Nigeria (Ayeni and Oyekan 1992). Yield losses caused by un-controlled weed growth in soyabean were estimated at 60%, 53% and 40% in Nigeria, Ghana and Zaire respectively (Akobundu,1980). Weed interference in soyabean can be reduced by many interventions such as hoe-weeding, mechanical, cultural, chemical and biological weed control methods but no single method has been found to give effective and season-long control in all environments and cropping systems (Poku and Akobundu, 1985).

The objective of this study was therefore to evaluate some mechanical and chemical weed control methods and their combinations in soyabean production.

## MATERIALS AND METHODS

Two experiments were conducted at the research farm of the National Centre for Agricultural Mechanization at Idofian via Ilorin ( 8° 26' N; 4°30'E and 370m above sea level) in the southern Guinea savannah agro-ecological zone of Nigeria between June and October in 1999 and 2000. The experimental site had been under fallow for two years before the commencement of the experiment. The predominant weed species on the site before the experiment included *Rottboellia cochinchinensis*, *Brachiaria deflexa*, *Cynodon nlemfuensis*, *Setaria barbata*, *Amaranthus spinosus* and *Commelina benghalensis*. The soil of the farm was sandy loam and had 17.8% clay, 13.6% silt, 68.6% sand and 3.1% organic matter contents.

The land was prepared by ploughing and harrowing once. Single super phosphate fertilizer was applied by broadcasting just before harrowing at the rate of 60kg/ha of P<sub>2</sub>O<sub>5</sub>. The variety of soyabean planted (TGX-1440-1) was obtained from the International Institute of Tropical Agriculture, Ibadan. Four seeds were sown per hole and later thinned to three per stand on the flat at a spacing of 60cm by 25cm.

The ten weed control treatments evaluated included mechanical weeding with a wheel type weeder at 3 weedings at 3 and 6 WAP; pre-emergence application of formulated mixture of metolachlor and prometryn (codal) at the rate of 1.0kg a.i./ha; pre-emergence application of imazaquin at the rate of 0.18kg a.i./ha fb fluzifop-butyl at 0.25kg a.i./ha at 3 WAP; pre-emergence application of metolachlor plus prometryn fb wheel type weeder at 3 WAP; pre-emergence application of a formulated mixture of imazaquin plus pendimethalin (Squadron) at 1.1kg a.i./ha fb wheel type weeder at 3WAP; pre-emergence application of formulated mixture of imazethapyr plus pendimethalin (Pursuit plus) at the rate of 1.1kg a.i./ha; pre-emergence application of Pursuit plus at 1.1kg a.i./ha fb wheel type weeder at 3 WAP and no-weeding as control.

The experimental design was randomized complete block with four replications. Plot size was 20m by 3.6m and a space of 5 metres wide separated each replicate from the other. All pre emergence herbicides were applied 2 days after planting with a lever-operated Knapsack sprayer.

Phytotoxicity and weed control ratings were taken at 6 and 9 WAP respectively. Phytotoxicity rating was taken on a scale of 0-10, where 0 represents no injury to crop and 10 represents all dead plants. Weed control effectiveness was visually rated by two independent assessors on a scale of 0-100%, where 0% represents no weed control and 100% represents excellent weed control. Other data collected on the experiment included weed biomass, plant height, number of pods per plant, weight of 500 seeds, crop biomass and grain yield at crop harvest. All data were subjected to analysis of variance and treatment means separated using Duncan Multiple Range Test (DMRT).

Codal is a formulation of Ciba-Geigy Limited, Switzerland containing metholachlor and prometryn.

Squadron is a formulation of American Cyanamid Company, New Jersey, U.S.A. containing 3.84% imazaquin and 21.85% pendimethalin per litre. Pursuit Plus is a formulation of American Cyanamid Company, New Jersey, U.S.A. containing 2.25% imazaquin and 30.73% pendimethalin per litre.

## RESULTS AND DISCUSSION

### Phytotoxicity ratings

Table 1 shows the phytotoxicity of the different herbicide treatments to soyabean. In 1999, the phytotoxicity of imazethapyr + pendimethalin (Pursuit plus) and imazethapyr + pendimethalin fb wheel type weeder was moderately high (50%) measuring 5.0 on the scale (about 50% kill) while Imazaquin fb fluzifop-butyl gave minimal (10%) phytotoxicity (about 10% kill). In the year 2000, phytotoxicity of the herbicides were generally lower on soyabean crop compared with the year 1999 with the exception of plots treated with imazethapyr + pendimethalin which still maintained moderately high phytotoxicity (about 50% kill).

Metolachlor + prometryn, metolachlor + prometryn fb wheel type weeder, imazaquin + pendimethalin fb wheel type weeder, imazaquin + pendimethalin and imazaquin fb fluzifop butyl all had significantly lower phytotoxicity to soyabean than imazethapyr+pendimethalin and imazethapyr+

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pendimethalin fb weeder. The moderately high phytotoxicity rating recorded for imazethapyr+ pendimethalin in this experiment was equally reported by Adesina *et al* (1998) where imazethapyr + pendimethalin at 1.02 and 1.75kg a.i./ha was reported to produce moderately high phytotoxic symptoms to soyabean. Fadayomi and Olofintoye (2005) also reported Weed control ratings

Table 1 shows the weed control ratings and weed biomass as affected by different weed control treatments. In 1999, all the herbicide treatments gave good weed control up to 9 WAP. Wheel type weeder at 3 & 6 WAP and all herbicide treatments were good and as effective as two hoe-weedings. Excellent weed control (100%) was achieved in the herbicide treatments that were followed by wheel type weeder. In 2000, all the herbicide treatments similarly gave good weed control up to 9 WAP. Wheel type weeder at 3 and 6 WAP was equally comparable in effectiveness with hoe weedings at 3 and 6 WAP.

**Table 1. Effect of weed control methods on phytotoxicity, weed control ratings and weed dry weight.**

Weed Control Treatments	Rate	Phytotoxicity <sup>1</sup> ratings at 6WAP*		Weed Control <sup>2</sup> rating at 9 WAP*		Weed dry weight(t/ha) at 16 WAP*	
		1999	2000	1999	2000	1999	2000
Wheel type weeder at 3 and 6 WAP	-	0	0	80d	88bc	16.9ab	1.1c
Hoe-weeding at 3 and 6 WAP	-	0	0	85cd	95ab	10.7bd	0.4c
Metolachlor + Prometryn	1.0kg a.i/ha	2.0bc	1.0bc	95ab	78dc	14.4ad	1.1c
Imazaquin fb	0.18kg a.i/ha						
Fluazitop-butyl	0.25kg a.i/ha	1.0c	2.0b	90bc	95ab	6.0d	0.7c
Metolachlor + Prometryn fb							
Wheel type weeder at 3 WAP	1.0kg a.i/ha	2.0bc	1.0bc	100a	95ab	16.0ab	1.0c
Imazaquin + Pendimethalin	1.1kg a.i/ha	3.0ab	1.0bc	93abc	85cd	14.5ad	1.1c
Imazaquin + Pendimethalin fb							
Wheel type weeder at 3 WAP	1.1kg a.i/ha	2.0bc	1.0bc	100a	100a	8.3bd	0.3c
Imazethapyr + Pendimethalin	1.1kg a.i/ha	5.0a	5.0a	100a	75e	9.8bd	6.8a
Imazethapyr + Pendimethalin fb							
Wheel type weeder at 3 WAP	1.1kg a.i/h	5.0a	5.0a	100a	98a	6.7d	1.9bc
No weeding control	-	0	0	6e	8f	21.2a	3.7b
Standard error	0.63	0.60	2.85	2.71	2.68	0.70	

1. Phytotoxicity to crop was rated on a scale of 0-10, where 0 represents no injury and 10 represent all dead plants.

2. Weed control ratings was done on a scale of 0-100 where 0 means no weed was controlled and 100 means excellent weed control.

\* WAP = weeks after planting

\* Means, followed by the same letter within a column are not significantly different (P>0.05).

**Table 2: Effects of weed control treatments on dry matter production and yield components of soyabean**

Weed Control Treatments	Number of pods/plant 1999-2000		Weight of 500 seeds (gm) 1999-2000		Dry matter Production (t/ha) t/ha 1999-2000		Grain Yield 1999-2000	
Wheel type weeder at 3 and 6 WAP	107ah	115ab	65.0a	49.9b	3.7ac	6.1a	1.44ac	1.46a
Hoe-weeding at 3 and 6 WAP	133ad	118a	64.3a	48.0b		4.0ab	5.7ab	1.50ab
Metolachlor + Prometryn	122ag	95ad	63.0a	46.9b		2.3fg	5.4ad	0.90f
Imazaquin fb								
Fluazitop-butyl	141a	84bd	64.9a	49.8b		4.2a	4.8ac	1.61a
Metolachlor + Prometryn fb								
Wheel type weeder at 3 WAP	132ae	100ad	63.0a	56.5b		3.0bd	5.1ac	1.21bf
Imazaquin + Pendimethalin	130af	99ad	60.2a	50.5b		3.2bd	5.7ab	1.23be
Imazaquin + Pendimethalin fb								
Wheel type weeder at 3 WAP	137ab	102ac	58.7a	47.5b		3.5ad	5.6ac	1.36ad
Imazethapyr + Pendimethalin	133ad	89ad	66.1a	47.5b		2.3fg	3.2g	0.94ef
Imazethapyr + Pendimethalin fb								
Wheel type weeder at 3 WAP	136ac	90ad	59.2a	43.9b		2.5eb	3.2g	1.11cf
No weeding control	59i	79d	66.8a	48.8b		2.7dg	3.8dg	1.07df
Standard error	12.84	9.62	2.55	2.31		0.28	0.51	0.11

moderate injuries on cowpea seedlings 5 WAP when imazethapyr + pendimethalin was applied at rates ranging from 0.66 to 1.65kg a.i./ha.

**Weed dry weight**

In 1999, weed biomass at harvest in the unweeded treatment (21.2t/ha) was significantly higher than those obtained in all the other weed control treatments. The lowest weed biomass among the herbicide treatments was obtained in plots treated with imazaquin fb fluazifop butyl and imazethapyr + pendimethalin fb wheel type weeder. The reduction in weed biomass in these plots could be explained in that imazaquin and imazethapyr are pre-emergence, selective broadleaf herbicides for broad spectrum weed control in cowpea and soyabean (Poku and Akobundu, 1988) while fluazifop butyl and pendimethalin are for grass-weed control (Balthazar and Barium, 1986; Olofintoye, 1997). The combination of imazaquin fb fluazifop-butyl and imazathapyr + pendimethalin separately broadened their spectrum of weeds controlled.

In 2000, weed dry matter at harvest was significantly higher in the unweeded plot (3.7t/h) than in all other weed control treatments, with the exception of plot treated with imazethapyr + pendimethalin (6.8t/ha). This was due to moderately high phytotoxicity of the herbicide on soyabean (50% kill) and this reduced the crop population density which subsequently allowed weeds to grow tremendously towards harvest time.

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### **Crop growth and yield components.**

Table 2 shows the effects of weed control treatments on soyabean dry matter production, yield and yield components.

### **Dry matter production.**

In 1999, soyabean dry matter production was highest in the imazaquin fb fluzafop-butyl treated plots (4.2t/ha) which was closely followed by hoe-weeding (4.0t/ha) and wheel type weeder (3.7t/ha), while the dry matter production obtained in the plots treated with imazethapyr plus pendimethalin was as low as those obtained in unweeded plots.

In 2000, however, crop dry matter production was highest in wheel type weeder (6.1t/ha), closely followed by hoe-weeding (5.7t/ha) and plots treated with imazaquin plus pendimethalin (5.7t/ha) while the lowest dry matter was again obtained in plots treated with imazethapyr plus pendimethalin (3.2t/ha). The moderately high phytotoxicity rating recorded for plots treated with imazethapyr plus pendimethalin (pursuit plus) as obtained in table 1 could be responsible for the significantly low soyabean dry matter production recorded for the imazethapyr + pendimethalin treatments in 1999 and 2000.

The unweeded plot was among the lowest in soyabean dry matter production because weeds were left to compete with crops unchecked, and abundant weed growth has been reported to depress the growth of crops (Smartt, 1961).

### **Number of Pods per Plant**

In 1999, there was significant difference in the average number of pods produced per plant across the treatments. Imazaquin fb fluzafop-butyl produced the highest number of pods (141) which was closely followed by imazaquin + pendimethalin fb weeder treatment (137pods). All the treatments produced significantly higher number of pods than unweeded plot. This suggest that application of these herbicides and other mechanical methods suppressed the growth of weeds, early enough to allow soyabean produce significantly higher number of pods per plant than unweeded check.

However, the result of year 2000 showed that there was no significant difference in number of pods per plant. Reduced number of pods per plant in 2000 as compared with 1999 figures could be attributed to low amount of rainfall in year 2000 most especially in the month of October (which was just 75mm) when the process of grain filling was taking place.

### **Weight of 500 seeds**

Table 2 shows the weights per five hundred seeds for the year 1999 and 2000. The weights per 500 seeds were not significantly affected by the weed control treatments during the two years of experimentation. This observation agrees with work by Adetiloye and Salau (2000) who reported that one hundred seed weight of soyabean was not affected by weed control treatments.

### **Grain Yield**

There was significant difference among the treatments in grain yield in 1999 and 2000 (Table 2). In 1999, good crop yields compared with hoe-weeded control plots were observed in treatments with wheel type weeder, imazaquin fb fluzafop-butyl and imazaquin + pendimethalin fb wheel type weeder. Imazaquin fb fluzafop-butyl produced the highest grain yield possibly due to minimal phytotoxicity to crop and broadened spectrum of weeds controlled. In the 2000 trial, all the treatments gave good grain yields compared with the hoe-weeded control which was also the case in all herbicide treatments except those treated with imazethapyr + pendimethalin and imazethapyr + pendimethalin fb wheel type weeder.

## **CONCLUSION AND RECOMMENDATION**

Evaluating the various weed control treatments tested in this experiment between 1999 and 2000 by examining their performance in terms of low phytotoxicity to soyabean, weed control efficiency and grain yield

production, it appears that wheel type weeder at 3 & 6 WAP; imazaquin fb fluazifop-butyl at 3 WAP; imazaquin + pendimethalin fb wheel type weeder at 3 WAP could be applied for effective weed control on soyabean field. It is also apparent that pre-emergence applications of imazaquin fb fluazifop-butyl and imazaquin + pendimethalin would be promising for weed control on large scale soyabean farms.

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