ECO-FRIENDLY METHODS OF SPEARGRASS (*Imperata cylindrica* L.*)* CONTROL IN THE DERIVED SAVANNA ZONE OF NIGERIA.

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Abstract

Spear grass (Imperata cylindrica, L.) is one of the most serious weed problems facing farmers in the derived savanna zone of Nigeria. The study was designed to evaluate various control methods that would effectively control this noxious weed and increase crop yield in an environmentally sustainable way. The treatments were laid out in a randomized complete block design and these included: Glyphosate only applied at 1.8kg per hectare eight weeks after planting cassava; Glyphosate applied at 1.0kg per hectare eight weeks after planting cassava followed by the planting of Mucuna pruriens; Hand weeding followed by the planting of Mucuna pruriens eight weeks after planting cassava; and Three hand weedings at four, eight and twelve weeks after planting cassava. Analysis of variance (ANOVA) was used to analyse the data. Glyphosate effectively eliminated Imperata shoot both at 1.8kg and 1.0kg active ingredient per hectare but not all the rhizomes were killed. Imperata rhizome dry weight were significantly (P < 0.05) lower in glyphosate plus M. pruriens cover crop (0.5kg/ha) seconded by hand weeding plus M. pruriens cover crop (4.0kg/ha) as against 8.6kg/ha and 25.7kg/kg obtained in glyphosate alone and hand weeding alone, respectively. Cassava tubers and stem yields were significantly (P < 0.05) high in glyphosate applied at 1.0kg/ha plus M. pruriens cover crop (34.9kg/ha and 76.8 bundles/ha respectively). The next significantly (P < 0.05) high yield of cassava tubers and stems (29.5kg/ha and 65.4 bundles/ha respectively) were obtained in glyphosate alone treatment. There was no significant (P > 0.05) difference between Hand weeding plus M. pruriens cover crop and Hand weeding alone in terms of cassava tuber and stem yields. Glyphosate (1.0kg/ha) plus M. pruriens cover crop was recommended as the best method of speargrass (Imperata cylindrica, L.) control.

Keywords: Ecofriendly, Speargrass control, Cassava, Derived Savanna zone, Nigeria.

Introduction

Spear grass (*Imperata cylindrica* L.*)* has become one of the most serious weed problems facing farmers in the derived savanna zone of Nigeria. The weed retards growth, causing yellowing of leaves and subsequent death of crops, leading to severe yield loss (Onokpise et al., 1999 and Elmore 1986). This rhizomatous and aggressive plant may reproduce by seed following human disturbance (Sagise, 1976). Burning appears to induce flowering, but the seeds are mostly sterile (Akobundu and Agyakwa, 1998). However, the persistence and aggressiveness of *Imperata cylindrica* (L.) rhizomes is the main mechanism of survival and spread, and its resilience makes it difficult to control. It is widespread in the savanna region and extends into cleared forest areas. Onokpise *et al.*, (1999) estimated that the weed infests over 52% of the farmers' fields in the forest-savanna transition zone of Nigeria alone. There are indications that the use of glyphosate "round up", though effective in reducing shoot growth has not been effective in containing the rhizomatous growth of spear grass (Towson and Butler, 1990). Secondly, the high cost, scarcity and indiscriminate use of large quantities of the chemical are of concern regarding the health risk, damage to the environment and affordability by the small-scale rural farmers (Hicks, 1982; WCED, 1987 and Towson and Butler, 1990). There is therefore the need to find a method of control of this noxious weed that is more efficient and ecofriendly. The study was designed to evaluate various control

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methods that would effectively manage *Imperata cylindrica (L)* and increase crop yield in an environmentally sustainable way.

Location of the Experimental Site

The experiment was carried out in the Cross River Agricultural Development Project (CRADP) farm at Ogoja in 2000 and repeated in 2001. It commenced in April of each year, which is the beginning of the raining season and terminated in April of the following year (52 weeks).

Materials and Methods

Four treatments were each replicated four times in a Randomized Complete Block Design (RCB). The treatments were; Glyphosate only applied at 1.8kg per hectare, eight weeks after planting cassava, Glyphosate applied at 1.0kg per hectare eight weeks after planting cassava followed by the planting of *Mucuna pruriens* 14 days later.

One hand weeding followed immediately by the planting of *Mucuna* at eight weeks after planting cassava and another three hand weeding at four, eight and twelve weeks after planting cassava.

The entire land area was 27m by 34m (0.092 hectares). This was Sub-divided into four blocks of 7m by 27m (0.019ha) each with 2m inter block spaces. Each block was further sub-divided into four plots of 7m by 6m (0.0042ha). This was done after the entire area had been ploughed, harrowed and ridged. There were six ridges of 1m x 7m (0.0007ha) per plot.

Weeds were pressed down from the top of the ridge before application of glyphosate to prevent the chemical from making contact with the cassava. A Knapsack sprayer was used in the application of glyphosate

The application of glyphosate at 8 weeks after planting cassava was done to allow enough time for as many of the *Imperata* rhizomes as possible to sprout.

The treatments were randomized within each block using the random number approach. The cassava cultivar used was TMS 30572. Twenty five centimeters long cuttings were planted at a spacing of 1m x 1m at the crest of the ridge. This gave a plant population of 10,000 stands per hectare.

Mucuna pruriens was planted at a spacing of 50cm by 100cm, two seeds per stand giving a plant population of 40,000 per hectare.

The following data were collected:

i. Imperata shoot dry weight (kg/ha at 32 weeks after planting).
ii. Imperata rhizome dry weight (kg/ha at 0 to 30cm soil depth)
iii. Cassava tubers yield (t/ha)
iv. Cassava stem yield (Bundles/ha)
v. *Mucuna pruriens* biomass (kg/ha)

Data Analysis

Data was analysed using analysis of variance (ANOVA) followed by the least significant difference (LSD) test where necessary.Student's t-test was used to compare *Mucuna pruriens* biomass production in the two treatments in which the cover crop was used (Gomez and Gomez, 1984).

Results and Discussion

Glyphosate, while being able to eliminate *Imperata* shoot both at 1.8kg and 1.0kg active ingredient per hectare, was unable to kill all the rhizomes, hence the high biomass of *Imperata* (437kg/ha) at 32 weeks after planting in glyphosate alone applied at 1.8kg/ha (Table 1). This is in line with Onokpise *et al* (1999) who reported that glyphosate was unable to kill all unattached rhizomes underground.

Similarly, *Imperata* rhizome dry weight were significantly ($P<0.05$) lower in glyphosate followed by *M. pruriens* (0.5kg/ha) seconded by one hand weeding followed by *M. pruriens* with 4.0 kg/ha compared with 8.6kg/ha and 25.7kg/ha obtained in glyphosate alone and three hand weedings respectively (Table 2). The highest *Imperata* shoot dry weight of 2137 kg/ha obtained in hand weeding alone coincided with the highest rhizome dry weight in this treatment. This confirms that mechanical slashing could not effectively control *Imperata* shoots or rhizomes. The relatively low *Imperata* dry weight of 0.5kg/ha in glyphosate (1.0kg/ha) followed by *M. pruriens* planted at 8 weeks after planting cassava, illustrated the suppression and shadding effect of *Mucuna* on the growth rate and

vigour of regeneration of *Imperata* from underground rhizomes. *Imperata cylindrica(* L.) is a light loving plant which can be shaded and weakened under a dense canopy (NRI *et al.,* 1986; Chikoye, 1998 and Eussen and Soejani, 1975). Thus, the fast growing leguminous vines of *M. pruriens* quickly covered, shaded out and suppressed *Imperata cylindrica* (L.). The combination of *M. pruriens* and cassava canopies at 32 weeks after planting provided this required dense canopy shade.

The yield of cassava both in terms of stems and tubers (Tables 3 and 4) was significantly ($P < 0.05$) highest when glyphosate was applied at 1.0kg/ha followed by planting of *M. pruriens* (75 bundles/ha and 33.9t/ha respectively). This was followed by glyphosate alone at 1.8kg/ha. The result could be attributed to the effective eradication of competing *Imperata* weed by glyphosate during the critical weed interference period, which is four weeks after planting (Akobundu, 1983). Also the introduction of *M. pruriens* at 8 WAP after applying 1.0kg/ha glyphosate in addition to suppressing *Imperata cylindrica* (L) must have offered other benefits such as increased soil fertility (fixation of nitrogen, transformation of mineral phosphorus into organic phosphorus), prevented soil erosion, improved soil structure, improved moisture retention and microclimate moderation as well as stimulated soil flora and fauna as had been earlier suggested by NRI *et al* (1986). The yield of cassava stems and tubers in hand weeding followed by planting of *M. pruriens* at eight weeks after planting (52 bundles/ha and 22.5 kg/ha respectively) though moderate had the advantage of a pure organic background, little environmental damage, no health risk, cheaper and readily available inputs (manual labour and cover crop). The low yield of cassava stems and tubers obtained in hand weeding alone (49 bundles/ha and 19.2kg/ha respectively) showed the disadvantage of a purely manual method compared with that which combines chemical and biological methods. The high yield of *M. pruriens* in glyphosate followed by *M. pruriens* compared to its yield in Hand weeding followed by *M. pruriens* (Table 5) may be attributed to the quick establishment of *M. pruriens* in a weed free environment provided by glyphosate at the early stage.

Excess chemicals are washed by run off water from sprayed fields into streams, rivers and even underground water causing serious pollution (WCED, 1987). Thus the chemical could be absorbed by aquatic life as well as by primary consumers (herbivores) grazing on sprayed vegetation.

The reduction of the quantity of glyphosate required to effectively control *Imperata cylindrica* from the manufacturer's recommended rate of between 2.2kg and 2.8kg active ingredient per hectare to 1.0kg active ingredient per hectare would be significant both in terms of the amount spent and the quantity used. This represents a reduction of three to five litres of glyphosate chemical thus, reducing the health risk to man and the environment for every hectare sprayed with glyphosate, without compromising the effectiveness of controlling *Imperata cyclindrica* (L) weed. The integrated weed management approach of reduced chemical (1.0kg/ha) followed by the planting of a cover crop (*M. pruriens*) was recommended as the most viable option for controlling *Imperata cylindrica* (Linn.)

Conclusions and Recommendations

Glyphosate alone applied at 1.8kg active ingredient 8 weeks after planting cassava, could not eliminate all the underground *Imperata* rhizomes; while, Glyphosate applied at 1.0kg per hectare, eight weeks after planting cassava followed by the planting of *Mucuna pruriens*, controlled both *Imperata* shoots and rhizomes and gave the highest yield of cassava cuttings and tubers. It was recommended that 1.0kg glyphosate active ingredient per hectare applied 8 weeks after planting cassava followed by the planting of *Mucuna* 2 weeks thereafter, should be used to control *Imperata*

cylindrica in cassava farms as this method is effective, ecofriendly and gives high yield of cassava tubers and stems.

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Table 1. *Imperata* Shoot dry weight (kg/ha) at 32 weeks after planting cassava (mean for 2000 and 2001).

	Replications/Blocks					
Treatments	**I**	**II**	**III**	**IV**	**Treatment Total**	**Mean**
1.8kg/ha Glyphosate 8WAP	408	450	424	466	1748	437
1.0kg/ha Glyphosate 8WAP fb *Mucuna*	136	167	145	164	612	153
Hand weeding fb Mucuna 8WAP	241	265	301	301	1108	277
Three hand weeding (4, 8 and 12 WAP)	2095	2145	2156	2150	8546	2137
Total	2880	3027	3026	3081	12014	

Note: (1) L.S.D $_{(0.05)}$ =7.63 (2) fb= Followed by

Table 2. Rhizome dry weight (kg/ha) at 0-30cm soil depth.

	Replications/Blocks					
Treatments	**I**	**II**	**III**	**IV**	**Treatment Total**	**Mean**
1.8kg/ha Glyphosate 8WAP	7.5	7.3	12.7	6.9	34.4	8.6
1.0kg/ha Glyphosate 8WAP fb *M. pruriens*	0.6	0.5	0.6	0.4	2.1	0.5
Hand weeding fb Mucuna 8WAP	3.3	4.9	4.4	3.4	16.0	4.0
Three hand weedings (4, 8 and 12 WAP)	10.0	11.3	27.4	12.2	60.9	25.7
Total	21.4	24.0	45.1	22.9	113.4	

Note: L.S.D. $_{(0.05)}$=6.08.

Table 3. Effect of glyphosate, *Mucuna* and Hand weeding on the yield of cassava cuttings (bundles, Mean for 2000 and 2001).

	Replications/Blocks					
Treatments	I	II	III	IV	Treatment Total	Mean
1.8kg/ha Glyphosate WAP	62	62.5	67.5	69.5	261.5	65.4
1.0kg/ha Glyphosate WAP fb *Mucuna*	75.5	78.5	78.0	75.0	307.0	76.8
Hand weeding fb Mucuna 8WAP	52.5	57.0	57.0	56.0	222.5	55.6
Three hand weedings (4, 8 and 12 WAP)	46.0	49.0	53.0	49.5	197.5	49.4
Total	236.0	247.0	255.5	250.0	988.5	

Note (1): LSD $_{(0.05)}$ =1.65

(2): A bundle of cassava cuttings is made up of 50 cuttings each 1metre in length.

Table 4. Effect of *Mucuna,* Glyphosphate and Hand weeding on the yield of cassava tubers (t/ha, Mean for 2000 and 2001).

	Replications/Blocks					
Treatments	**I**	**II**	**III**	**IV**	**Treatment Total**	**Mean**
1.8kg/ha Glyphosate 8WAP	28.6	31.1	27.9	30.4	118.0	29.5
1.0kg/ha lyphosate 8WAP fb *Mucuna*	35.0	33.6	35.0	36.0	139.6	34.9
Hand weeding fb Mucuna 8WAP	27.4	23.2	22.0	25.3	97.9	24.5
Three hand weedings (4, 8 and 12 WAP)	19.4	17.0	17.7	20.6	74.7	18.7
Total	110.4	104.9	102.6	112.3	430.2	

Note: LSD $_{(0.05)}$ = 1.16

Table 5. *Mucuna* yield (Kg/ha, Mean for 2000 and 2001).

	Treatment		
Block	**1.0kg/ha Glyphosate 8WAP fb *Mucuna***	**Hand weeding fb Mucuna 8WAP**	**Difference**
I	579.5	425.5	154^{d}
II	587.5	416.5	171^{a}
III	588.5	431.0	157.5^{c}
IV	591.0	427.5	163.5^{b}
Total	2346.5	1700.5	646
Mean	586.6	425.1	161.5

$t_{cal.}$ = 43.47 t_{tab} (0.05) = 3.182

Note: Mean values with different superscripts are significantly different (P < 0.05).