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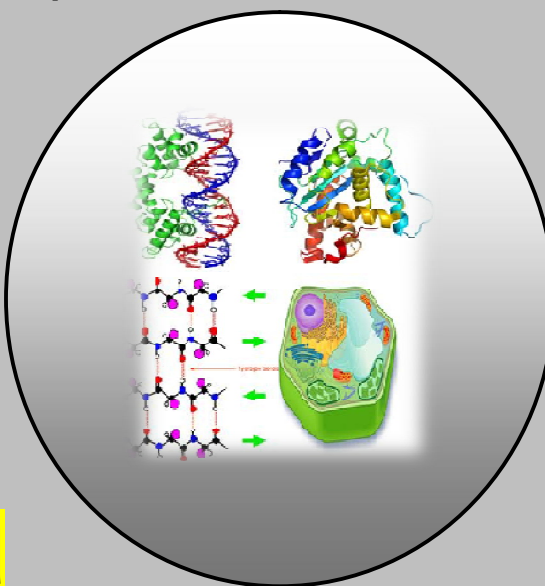
L.U. Okonmah and O.M. Agbogidi

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Management of Spear Grass (*Imperata cylindrica* L) Using Different Methods of Weed Control

*** L.U. Okonmah and **O.M. Agbogidi**

***Department of Agronomy, ** Department of Forestry and Wildlife,
Faculty of Agriculture, Delta State University, Asaba Campus, Nigeria**

ABSTRACT

A study was conducted in 2008 at the Research /Training Farm of the Department of Agronomy, Delta State University, Asaba Campus, Nigeria with the objective of identifying the best method to control spear grass weeds at a reduced and affordable cost. The treatments included spear grass + 2 hand weeding, spear grass + Bahama, spear grass + Glyphosphate and spear grass integrated with 2 hand weeding, Bahama and glyphosphate. The experiment was laid out in a randomized complete block design and replicated three times. The results showed that Bahama had more superior contents of chemical nutrients including nickel and copper. The roots of Bahama also had more profuse rhizomatous roots which enabled it to colonize and suppressed the growth of spear grass hence more effective biological control at reduced cost as its height and weight significantly reduce ($P \geq 0.05$) when compared to the other treatments. Spear grass + glyphosphate also had appreciable control of spear grass. It is therefore recommended that Bahama as a biological control measure be used for the effective management of spear grass infested areas like Anwai area of Delta State.

Keywords: *Spear grass, Bahama grass, biological control, hand weeding.*

INTRODUCTION

Spear grass is a rhizomatous perennial grass belonging to the family Panicoideae and tribe Andropogoneae. Widely grown in the tropics but constitutes a serious problem in South Eastern Asia, parts of the United States of America and most parts of West Africa including Nigeria (Garritty *et al.*, 1997). The grass infests land, competing with crops; injure humans and highly fire resistant (Chikoye *et al.*, 2000). Crop production in Nigeria has not reached its maximum potential due in part to the problems associated with spear grass infestation (Akobundu, 2000).

In the same vein, Bahama grass (*Cynodon dactylon* L) belonging to the sub-family Chloridoideae and tribe Chlorideae is a common weed found in West African Countries. These weed species have negative effects on plant growth development and yields hence, accounts for food insecurity in many African Countries Weed control measures include cultural (hand weeding), mechanical (slashing, mowing (Akobundu, 2000), chemical (use of herbicides (Akobundu, 2000), biological (using cover crops, predators (Okonmah, 2004) and integrated methods (combination of two or more of the above methods e.g. biological and chemical (Okonmah, 2004). If food insecurity is to be tackled, the weeds must be vigorously eradicated for the proper development of crops using various methods to achieve optimum yields. It is against this background that a study as this has been embarked upon with the main objective of identifying the best method to control spear grass weed at a reduced cost with a view to increasing yield of agricultural crops and reducing poverty level of the rural populace.

MATERIAL AND METHODS

Study location

The study was conducted in 2008 at the Research/Training farm of the Department of Agronomy, Delta State University, Asaba Campus, Delta State, at latitude 6° 14'N and longitude 6° 49'E (Asaba Meteorological Station, 2008).

Land preparation

A land containing a colony of spear grass was marked out and the area was 14 x 19m. The grown spear grasses were slashed to the ground level to allow for fresh growth and for proper introduction of the various treatments. The plot size was 4 x 4m and each was demarcated by a meter apart. The experiment was laid out in a randomized complete block design and replicated three times using four treatments as follows.

- (a) Spear grass + 2 hand weeding
- (b) Spear grass + Bahama grass
- (c) Spear grass + Glyphosphate
- (d) Spear grass + 2 hand weeding, Bahama grass + Glyphosphate

Data collected were spear grass plant height, spear grass weight, soil physico-chemical parameters, and chemical composition of spear grass and Bahama grass, Length of Bahama grass and leaf numbers of spear grass were taken fortnightly. Plant height was determined by measuring the height of the grass from the soil level to the terminal bud using a measuring tape fortnightly until 10 weeks of age following the procedure of (Agbogidi and Okonmah, 2011) while the plant weight of spear grass was determined by using weighing balance.

Soil analysis

Composite soil sample was collected from 0 – 20cm depth with augur prior to treatment application. The samples were air-dried in a room temperature of 25 – 27°C for four days and then passed through a 2mm mesh sieve and neatly packed in a properly labeled air-tight polythene bags for physio-chemical analysis at the National Institute for Oil Research (NIFOR) near Benin-City, Edo State. The particle size distribution was determined by the hydrometer method (Bouyoucous, 1951) while bulk density was by core method (Blake and Hartge, 1986).

Soil pH was determined in distilled water using a soil: liquid ratio of 1:1, Electrical conductivity was measured by a conductivity bridge (Chandos Conductivity Model A19 Bridge) (Obi, 1990). Phosphate – Phosphorus was measured in soil extracts by the ascorbic acid method (IITA, 1979; Obi, 1990). Total nitrogen was determined by the regular Macro-Kjeldahl digestion technique (Jackson, 1964). Nitrate-nitrogen was determined by the phenoldisulphonic acid method (Esu, 1999), Organic carbon was measured by the wet combustion method (Walkley and Black, 1934) and converted to organic matter by multiplying the values of organic carbon by a factor of 1.724 following Allison (1965). C/N ratio was calculated by dividing %carbon values by that of the total nitrogen following the procedure of (Esu, 1999). Exchangeable calcium and magnesium were determined on atomic absorption spectrophotometer while sodium and potassium were determined on flame photometer (Udo and Ogunwale, 1986): ammonium acetate extracts of soil samples were used in these exchangeable bases determination (Obi, 1990). Determination of exchangeable acidity (H^+ and Al^{3+}) was by KCl extraction method (McLean, 1965). Total Exchangeable Bases (TEB) was calculated by adding the values of all the exchangeable cations (Ca, Mg, Na and K) (IITA, 1979). Total Exchangeable Acidity (TEA) was calculated as the sum of exchangeable H^+ and Al^{3+} ions (IITA, 1979). Effective Cation Exchangeable Capacity (ECEC) was calculated by adding the values of the TEB and TEA. The base saturation (BS) was calculated by dividing the values of TEB by the ECEC and multiplying by 100 following the methods of Agbogidi (2006).

Plant tissue analysis

The two experimental materials: spear grass and Bahama grass were carefully collected by uprooting. The roots were carefully dusted to remove soil particles, placed in different envelopes before oven – drying. The plant tissues were dried at a minimum temperature of $65^{\circ}C$ for 8 hours: The plant materials were later ground with an agate mortar to achieve fine grinding; 1.0g of each of the ground materials was weighed into a conical flask for wet ashing, which involved decomposition of the plant tissue in a mixture of strong acids comprising nitric, sulphuric and perchloric of $50^{\circ}C$ in a furnace for 4 hours until grey coloured indicating that complete ashing has been achieved (Obi, 1990).

After ashing, Na and K were determined by flame photometer (Association of Official Analytical Chemist (AOAC) (1985). The heavy metals: Mn, Fe, Ni, Zn and C by atomic absorption spectrophotometer (AAS) (Association of Official Analytical Chemist (AOAC) (1985). Phosphorus by calorimeter method (Obi, 1990). Total exchangeable bases (TEB) were calculated by adding the values of all the exchangeable cations (Ca, Mg, Na and K). Effective cation exchangeable capacity (ECEC) was calculated by adding the values of the TEB and total base saturation (BS) was calculated by dividing the values of TEB by the ECEC and multiplying by 100 following the above stated authors for soil analysis.

Statistical analysis

All the data collected were subjected to analysis of variance while the significant means were separated with the least significant difference using SAS (2005).

RESULTS AND DISCUSSION

Table 1 shows the soil physio-chemical properties before the experiment. The soil is sandy loam in texture with characteristics of 84.60% sand, 6.92% silt and 8.48% clay. The pH 6.2 indicated that the experimental site is slightly acidic. Both the organic matter (2.64 gkg^{-1}) and total nitrogen (0.9 gkg^{-1}) are relatively low (Table 1). The plant height (cm) of spear grass as influenced by the various treatments is presented in Table 2. The result indicated that the plant height of spear grass increased with time. The plant height value of spear grass + 2 hand weeding showed significant differences ($P < 0.05$) when compared with the values obtained for the other treatments (Table 2). The weight of spear grass that had 2 hands weeding was significantly different from other treatments those of other treatments: spear grass + bahama grass, spear grass + Glyphosphate and spear grass integrated with 2 hand weeding Bahama grass and glyphosphate (Table 3). Similarly, the weight of the test plant increased with time (Table 3). From the results of chemical composition of spear grass and Bahama at harvest is presented in Table 4, it is evident that Bahama grass showed superior contents of chemical nutrients. For example, while 1.10 gkg^{-1} was obtained for Bahama grass nitrogen, 0.08 gkg^{-1} was recorded for spear grass. Bahama also had nickel and copper. Besides, research on the effects of nickel and heavy metals found in Bahama grass showed that high concentration of nickel on sandy soil can clearly damage plants (Agbogidi *et al.*, 2007; Sobolev and Megonia, 2008). Nickel can also reduce the growth rate of algae which could result in the diminishing growth of spear grass as observed in Table 1. There were however, various values obtained for cations (Ca^{2+} , Mg^{2+} , K^{+} and Na^{+}) measured in the two plant species. The length of bahama grass (cm) is presented in Table 5. The table indicated that the length of the grass increases with time, The observed 6.20 value of the pH of the soil indicates that the soil is slightly acidic and this can be attributed to the high rainfall prevalent in the area leading to excessive leaching of the basic cations from the surface area of the soil. The low organic content and total nitrogen could be attributed to the effects of soil erosion leaching and bush burning predominant in the study area. Similarly, the low exchangeable cations may be due to the low clay activity and low organic content of the soil. The CEC was average (15.20 cmol/kg-1) while the base saturation indicates that the study area has low fertility status which may be due to the long usage of the area for serious cropping without replenishing the lost nutrients through fertilizer application. The results of the pre-planting soil analysis agree with the findings of (Enwezor, 2005 and Egbuchua, 2007). The increased plant height and weight of spear grass with time is expected as a feature of crops and living organisms. Bahama grass had more nitrogen when compared to spear grass (Table 4). From the values obtained in the two plants, the two weed species showed that they fall within the tolerable levels. This indicates that they may not hinder or obstruct the uptake of other nutrients in the soil. The special growth pattern and the root system of Bahama grass where it spreads everywhere demonstrated ability for biological weed control. This could have adversely affected the spear grass by suppressing its growth hence more effective among the treatments adopted. This observation is in harmony with earlier reports by (Okonmah, 1988, Okonmah, 2004, Chikoye *et al.* 2000 and Chikoye *et al.* 2004).

There was also, an appreciable effect in the control of spear grass treated with glyphosphate when compared with those with 2 hand weeding and a combination of 2 hand weeding, glyphosphate, and Bahama. This finding agrees with that of (Terry *et al.* 1997 and Okonmah *et al.* 2005) who reported that Egusi/melon significantly suppress weed in maize cassava mixed cropping.

The spear grass plus Bahama was observed as the most effective control measure to spear grass weed at reduced and affordable cost followed by spear grass plus glyphosphate hence spear grass plus Bahama is recommended to farmers in Anwai area of Delta State, Nigeria. Further research is required on the effect of nickel found in Bahama grass against spear grass.

Table 1. Physiochemical properties of soil before experiment.

Soil properties	Values
Sand (%)	84.60
Silt (%)	6.92
Clay (%)	8.48
pH (H ₂ O)	6.20
Organic matter gkg ⁻¹	2.64
Total N	0.9
Available P (mgkg ⁻¹)	8.27
Exchangeable cation (cmo/kg ⁻¹)	
Ca	1.30
Mg	1.16
K	0.21
Na	0.43
CEC (cmo/kg ⁻¹)	15.20
% BS(Base saturation)	20.4

Table 2. Plant height (cm) of spear grass as influenced by the various treatments.

Treatments	Weeks after planting (WAP)				
	2	4	6	8	10
SG + 2 hand weeding	30.07	56.8	43.9	44.6	73.38
SG + Bahama	19.51	32.2	35.2	44.2	52.37
SG + Glyphosphate	24.42	11.6	41.7	54.1	57.51
SG + Glyphosphate	29.13	38.4	41.2	48.6	55.95
Bahama + 2 hand weeding					
LSD _{0.05}	14.01	37.5	9.68	10.41	42.07

SG = spear grass

Table 3. Weight (g) of spear grass as affected by the various treatments.

Treatments	Weeks after planting (WAP)				
	2	4	6	8	10
SG + 2 hand weeding	21.57	4.11	11.74	18.28	19.00
SG + Bahama grass	18.97	1.20	9.97	11.78	13.65
SG + Glyphosphate	20.68	1.10	10.76	13.88	14.63
SG + Glyphosphate	21.30	3.99	12.68	17.50	17.60
Bahama + 2 hand weeding					
LSD _{0.05}	2.28	0.72	0.88	1.27	0.10

SG = spear grass

Table 4. Chemical composition of spear grass and Bahama grass at harvest.

Parameters	Spear grass	Bahama grass
Total N (gkg ⁻¹)	0.08	1.10
Total P (mgkg ⁻¹)	4.50	9.84
Total C (gkg ⁻¹)	1.25	0.95
Exchangeable cations (c mol/kg⁻¹)		
Ca ²⁺	1.10	1.70
Mg ²⁺	0.56	0.76
K ⁺	2.40	3.41
Na ⁺	0.07	0.07
Heavy metals (mgkg⁻¹)		
Pb	Nil	Nil
Cu	0.21	2.87
Zn	5.23	5.23
Cd	Nil	Nil
Mn	0.88	0.79
Fe	3.25	1.45
Cr	1.38	0.40
N ₁	Nil	0.88
C:N	15.63	0.86

Table 5. Length of Bahama grass (cm) at 2, 4, 6, 8, 10 and 12 weeks after planting.

Treatment	length of Weeks After Planting					
Bahama Grass						
	7.33	15.15	19.13	21.33	24.57	34.00

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Corresponding Author: Dr. O.M. Agbogidi, Department of Forestry and Wildlife, Faculty of Agriculture, Delta State University, Asaba Campus, Nigeria **Email:** omagbogidi@yahoo.com
Cell: 07038679939 / 08056306219