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INFLUENCE OF DIFFERENT RATES OF METOLACHLOR AND WEEDING REGIME ON CROP VIGOUR AND YIELD COMPONENTS OF SWEET POTATO (*Ipomoea batatas* L.) AT AFAKA, KADUNA, NIGERIA.

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ABSTRACT

The field experiment was conducted at the Research farm of the Department of Federal College of Forestry Mechanization, Afaka, Kaduna, to determine the influence of different rates of metolachlor and weeding regime on crop vigour and yield components of sweet potato (*Ipomoea batatas*). The experiment was carried out during 2019/2020 and 2020/2021 raining seasons. The trial consisted of four weeding regimes at 3, 6, 9 and 12 weeks after planting (WAP), two rates of metolachlor (3.0 kg a.i./ha^{-1} and 2.0 kg a.i/ha^{-1}), hoe weeded control at 4 and 8 weeks after planting (WAP), weed free treated plots and weedy check plots. Making a total of eleven treatments, laid out in a randomized complete block design (RCBD) replicated three times. The gross and net plot sizes were 6.75 m^2 (3 m x 2.25 m) and 2.25 m^2 (3 m x 0.75 m) respectively. The result showed that in 2019/2020 the weed free treated plots and the plots with the application of metolachlor at 3.0 kg a.i/ha^{-1} plus weeding regime at 3 WAP resulted in comparable higher crop vigour, higher number of tubers per plot, and higher tuber weight per plot than all the other treatments. While the weedy check plots recorded the least vigorous crops and the least significant tuber weight per plot than all the other treatments. At 2020/2021 the plots with the application of metolachlor at 2.0 kg a.i./ha^{-1} plus weeding regime at 12 WAP and the weed free treated plots recorded the highest vigorous crops. The highest number of tubers per plot and the highest weight of tubers per plot at harvest was recorded by the weed free treated plots (9.10a) followed by the plots with the application of metolachlor at 3.0 kg a.i./ha^{-1} plus weeding regime at 3 WAP (7.60b). The study therefore recommended the use of the weed free treated plots and the plots with the application of metolachlor at 3.0 kg a.i./ha^{-1} plus weeding regime at 3 WAP in the study area for better yield of sweet potato

Keywords: Sweet Potato; Metolachlor; Weeding regime; Influence; Rates.

INTRODUCTION

Sweet potato (*Ipomoea batatas* L.) is a dicotyledonous plant that belongs to the morning glory family *convulvulaceae*. Sweet potato is native to the Americas. In 2020, global production of sweet potato was 89 millon tonnes led by China with 53% of the world total. Secondary producers were Malawi, Tanzania and Nigeria (Leksrisompong *et al*., 2012). Nigeria produces 2-5 % of the world's sweet potatoes. Nigeria is the third largest sweet potato producer in terms of quantity after China and Uganda. Cultivation is concentrated in Northern, Semi-arid agro ecological zone. Though area harvested has increased by more than 3.22%. Since 1990, the average yield in 2010 was only 2.9 MT/ha^{-1}, down from 5.1 MT/ha^{-1} in 1990 and 1960s; when yield was once as high as 12.4 MT/ha^{-1} (Walker *et al*., 2011). Sweet potato shoot tips and leaves are consumed throughout the world both raw and cooked. In addition to human consumption, sweet potato is utilized for animal feed and processed products such as starch, flour, and dye used to add pigment to food and fiber (Meyers *et al*., 2015). Effects of weed competition in sweet potato in the early part of the season during the first 28 -42 DAP substantially reduced crop production in the later part of the growth cycle (after 110 DAP).This was probably due to a partial suppression of vine growth early on, which reduce tuberous root initiation and thus limited the number of root tubers that could develop in the later stages of crop growth. Weeds are a major challenge to sweet potato production. With pigweed (*Amaranthus spp*, yellow nutsedge (*Cyperus rotundus* L.) and purple nutsedge (*Cyperus rotundus* L.) being problematic in the Southern U.S (Kelly *et al.*, 2006). Moody and Ezumah (1974) reported yield losses of 22, 78 and 91 % due to uncontrolled weed growth in Hawaii, West Indies and Nigeria respectively. These low yields are as a result of socio-economic constraints in the production of sweet potato. These socio-economic constraints include poor post-harvest handling and storage facilities, lack of processing skills, lack of clean seeds and poor seed distribution system, and poor agronomic varieties (Njeru *et al*., 2004 and Gichuki, *et al*., 2006).

Chemical weed control is an alternative to manual weeding because it is cheaper, faster and gives better weed control (Chikoye *et al*., 2005, Chikoye *et al*., 2007). Herbicides are also used to control weeds in sweet potato. Metolachlor is a soil - applied herbicide that inhibits the biosynthesis of fatty acids, lipids, proteins, isoprenoids and flavonoids in susceptible plant species. With transplanted plants, it is broadcast applied after transplanting for preemergence control of small-seeded broad leaf weeds, grasses and yellow nutsedge (Meyers and Shankle, 2007). Based on the foregoing this study was conducted with the objective of determining the influence of different rates of metolachlor and weeding regime on crop vigour and yield components of sweet potato.

MATERIALS AND METHOD

The field experiment was conducted during the wet season of 2019/2020 and 2020/2021 at the research farm of Federal College of Forestry Mechanization, Afaka, Kaduna (Latitude $10^0$35' $10^0$34'N and Longitude $7^0$21' and $7^0$20'E (Otegbeye *et al.,* 2001) Physical and chemical properties of the soil profile (0-30 cm) of the experimental site was taken for analysis. The treatments consist of four weeding regimes, 3 weeks after planting (WAP), 6 weeks after planting (WAP),9 weeks after planting (WAP) and 12 weeks after planting (WAP). Two rates of metolachlor (3.0 kg a.i/ha^{-1} and 2.0 kg a.i/ha^{-1}), hoe weeded control at 4 and 8 weeks after planting, weed free plots and weedy check arranged in a randomized complete block design (RCBD), replicated 3 times. The gross plot size was 6.75 m^2 (3 m x 2.25 m) and net plot size was 2.25 m^2 (3 m x 0.75 m). The sweet potato vines were used as the planting material. The vines were buried into the soil and planted with a spacing of 75 cm x 30 cm apart. The herbicide (metolachlor) was applied as pre-emergence (a day after planting) using a knapsack sprayer with a green deflector nozzle at a swathe width of 75 cm kept at a pressure of 2.1 kg/m^2 to give a spray volume of 250 L/ha^{-1}. The weeding regimes 3, 6, 9 and 12 WAP were carried out at their respective periods. Data collected include weed dry weight, Crop vigour score, number of potato tubers per plot, weight of potato tubers per plot. The most common weed species observed at the experimental site and their intensity of occurrence is shown in Table 1. The common dominant weed species were grasses such as *imperata cylindrical*, *Enchinochioa cruspavonis*, *Eleusine indica*, *Axonopus compressus*. This was followed by sedges such as *Cyperus esculatus*, *Cyperus differmis* Linn and some broad leaf weeds such as *Amaranthus spinosus* Linn and *Sida acuta* with moderate infestation. The high infestation by grasses could have been due to their ability to shed high amount of seeds. It could also have been due to their ability to exhibit a perennial nature (Fabunmi *et al*., 2012). Couple with their ability to make use of the available resources for survival in the season (Olorunmaiye *et al*., 2013). All data collected were subjected to analysis of variance (ANOVA) as described by Snedecor and Cochran (1967). The significant differences among the means were compared using Duncan Multiple Range Test (DMRT) (Duncan, 1955).

RESULTS AND DISCUSSION

The soil at the experimental site was a sandy loamy soil. The value of the Nitrogen content of the soil was 0.02%, organic matter content value was 0.65%, C.E.C value was 1.35%

WEED DRY WEIGHT g/m^2

At harvest in 2019/2020 the weedy check recorded significantly higher weed dry weight than all the other treatments. The weed free treated plots and the plots with the application of metolachlor at 2.0 kg a.i/ha^{-1} plus weeding regime at 9 (WAP) produced the least weed dry weight. In 2020/2021 the rates of metolachlor and weeding regime did not have any significant effect on weed dry weight. The high weed dry weight mean value recorded by the weedy check plots is an indication that the weedy check fevours the crop that had no application of metolachlor and no weeding. (Olorukokooba *et al*., 2022) reported similar findings on turmeric (*Curcuma longa* L.) (Table 2).

CROP VIGOUR SCORE

In both years the weed free treated plots produced significantly higher vigorous crops compared with all the other treatments. In 2019/2020 the least vigorous crops were produced by the weedy check plots. In 2020/2021 the plots with the application of metolachlor at 3.0 kg a.i/ha^{-1} plus weeding at 9 WAP and the plots with the application of metolachlor at 2.0 kg a.i./ha^{-1} plus weeding regime at 6 WAP recorded the least significant vigorous crops. The observed lower vigorous crops by the weedy check plots could be attributed to hazardous effects of weeds resulting from interference and competition with the crops for the available growth factors (moisture, nutrients, sunlight and space). This finding is in line with the work of David *et al. 1*996 who reported that weeds reduce plant size by competing with crops for water, nutrients and light. The comparative vigour score observed by the hoe weeded control plots and all the other treatments was an indication of good tolerance of sweet potato to rates of metolachlor and good weed control.

NUMBER OF TUBERS PER PLOT

In 2019/2020, weed free treated plots resulted in significantly higher number of tubers per plots at harvest than all the other treatments that were statistically similar other. Except the plots with the application of metolachlor at 3.0 kg a.i./ha^{-1} plus weeding regime at 3 WAP that was next to the plots with the highest number of tubers per plot. In 2020/2021 the weed free treated plots recorded significantly higher number of tubers per plot compared with the other treatments. This was followed by the plots with the application of metolachlor at 3.0 kg a.i/ha^{-1} plus weeding at 3 WAP. The weedy check plots produced the least number of tubers per plot (Table 2).

WEIGHT OF TUBERS PER PLOT

At harvest in 2019/2020, the plots with the application of metolachlor at 3.0 kg a.i./ha^{-1} plus weeding regime at 3 WAP and the weed free treated plots produced the highest weight of tubers per plot compared with the other treatments. The weedy check plots recorded the least weight of tubers per plots. In 2020/2021, The

weed free treated plots also recorded the highest weight of tubers per plot compared with the other treatments. This was followed by the plot with the application of metolachlor at 3.0 kg a.i./ha^{-1} plus weeding at 3 WAP. The weedy check plots produced the least weight of tubers per plot. The highest weight of tuber per plot recorded by the weed free treated plots and the plots with the application of metolachlor at 3.0 kg a.i./ha^{-1} plus weeding regime at 3 WAP is an indication of good weed control at the early stage of the sweet potato growth as reported by Levett (2009), that the partial suppression of the potato vine by weeds at the early stage of the sweet potato growth, reduced tuberous root initiation and thus limited the number of tubers that could develop at the later stages of the sweet potato growth. Also, avoidance of regular hand weeding at the later stage of the sweet potato growth could also have resulted to the high tuber number and high tuber weight per plot at harvest. As reported by Levett (2009), that lower yield occurred as a result of regular hand weeding after 56 DAP, probably due to disturbance of the vine canopy.

CONCLUSION AND RECOMMENDATION

From the result obtained in the study carried out at the Federal College of Forestry Mechanization, Afaka, Kaduna ,Crop Production Department, experimental site, on influence of different rates of metolachlor and weeding regime on crop vigour and yield components of sweet potato (*Ipomoea batatas*), the weed free treated plots and the plots with the application of metolachlor at 3.0 kg a.i./ha^{-1} plus weeding regime at 3 WAP, performed better than the other treatments and should be recommended and encouraged to be used by farmers when planting sweet potato in the study area for good yield and productivity.

Table 1: List of Common Weed Species and level of infestation at the Experimental Site in Afaka, Kaduna during 2019/2020 and 2020/2021 rainy season

Types of weeds	2019/2020	2020/2021
SEDGES		
Cyperus esculetus	**	**
Cyperus difformis Linn	**	*
Cyperus iria	*	*
GRASS WEEDS		
Imperata cylindrical	***	**
Cynodon dactylon Linn	**	***
Enchinochioa cruspavonis	***	**
Eleusine indica L	***	***
Axonopus compressus	***	**
BROAD LEAVED WEEDS		
Amaranthus spinosus	**	*
Ipomea cornea	*	*
Tridax procombens Linn	***	**
Sida acuta	**	*
Key:Level of infestation		

High infestation *** Moderate infestation **

Table 2: Effect of rates of metolachlor and weeding regime on weed dry weight and crop vigour of sweet potato during 2019/2020 and 2020/ 2021 rainy season at Afaka, Kaduna.

Treatments	Rates (kg a.i./ha)	Weed dry weight (g/m^2)2019/2020	2020/2021	Crop vigour score 2019/2020	2020/2021
Metolachlor at 3.0 kg a.i./ha^{-1} + weeding regime at 3 WAP[1]	3.0	9.80ab	10.20a[2]	7.67ab	8.33ab
Metolachlor at 3.0 kg a.i./ha^{-1} + weeding regime at 6 WAP	3.0	7.97bc	12.60a	7.33bc	7.33b
Metolachlor at 3.0 kg a.i./ha^{-1} + weeding regime at 9WAP	3.0	6.40c	12.93a	7.33bc	7.33b
Metolachlor at 3.0 kg a.i./ha^{-1} + weeding regime at 12 WAP	3.0	10.83ab	13.63a	7.33bc	8.33ab
Metolachlor at 2.0 kg a.i./ha^{-1} + weeding regime at 3 WAP	2.0	6.87c	12.07a	6.67bcd	8.33ab
Metolachlor at 2.0 kg a.i./ha^{-1} + weeding regime at 6 WAP	2.0	7.33bc	13.17a	7.00bc	7.33b
Metolachlor at 2.0 kg a.i./ha^{-1} + weeding regime at 9 WAP	2.0	4.40d	10.77a	7.33bc	8.33ab
Metolachlor at 2.0 kg a.i./ha^{-1} + weeding regime at 12 WAP	2.0	8.67b	12.33a	7.33bc	8.67a
Hoe weeded control	-	6.83c	13.09a	7.00bc	8.00ab
Weed free	-	5.03d	10.30a	8.62a	8.67a
Weedy check	-	11.80a	14.00a	5.62d	8.33a
SE (±)	-	1.765	1.339	0.225	0.376

[1]WAP-Week after planting

[2]Means in the same column of treatments followed by unlike letter (s) are significantly different at $p \leq 0.05$ using Duncan Multiple Range Test.

Table 3: Effect of rates of metolachlor and weeding regime on number of tubers and weight of tubers per plot of sweet potato during raining seasons of 2019/2020 and 2020/ 2021 rainy season at Afaka, Kaduna.

Treatments	Rate (kg a.i./ha^{-1})	Number of tubers per plot 2019/2020	2020/2021	Weight of tubers per plot 2019/2020	2020/2021
Metolachlor at 3.0 kg a.i./ha^{-1} + weeding regime at 3 WAP[1]	3.0	17.00b	17.00b[2]	36.04a	7.60b
Metolachlor at 3.0 kg a.i./ha^{-1} + weeding regime at 6 WAP	3.0	14.00c	14.67bc	22.40ab	6.57bc
Metolachlor at 3.0 kg a.i./ha^{-1} + weeding regime at 9 WAP	3.0	12.67c	13.33cd	17.80bc	5.47cd
Metolachlor at 3.0 kg a.i./ha^{-1} + weeding regime at 12 WAP	3.0	11.33c	13.33cd	15.40c	5.53cd
Metolachlor at 2.0 kg a.i./ha^{-1} + weeding regime at 3 WAP	2.0	14.00c	13.67c	22.00ab	5.73cd
Metolachlor at 2.0 kg a.i./ha^{-1} + weeding regime at 6 WAP	2.0	13.67c	14.33bc	17.40bc	5.40cd
Metolachlor at 2.0 kg a.i./ha^{-1} + weeding regime at 9 WAP	2.0	12.67c	13.67c	19.06b	5.43cd
Metolachlor at 2.0 kg a.i./ha^{-1} + weeding regime at 12 WAP	2.0	13.00c	14.33bc	12.06c	4.60d
Hoe weeded control	-	14.00c	12.67cd	17.08bc	6.57bc
Weed free	-	20.00a	20.33a	34.00a	9.10a
Weedy check	-	11.33c	10.33d	8.00d	1.77e
SE (±)	-	0.486	0.949	1.540	0.582

[1]WAP-Weeks after planting

[2]Means in the same column of treatment followed by unlike letter(s) are significantly different at $p \leq 0.05$ using Dancan Multiple Range Test.

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