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Growth, Yield and Yield components of Sesame (*Sesamumindicum* L.) as Influenced by Crop Variety and Different Rates of Herbicides in Mubi, Adamawa State, Nigeria.

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***Abstract*— *The experiment was conducted to evaluate the growth and yield performance of sesame (SesamumindicumL.) using four levels of herbicides (butachlor and diuron) to control weeds. Field trials were conducted in 2011 and 2012 cropping seasons at the Food and Agricultural Organization (FAO)/Tree Crop Programme (TCP) Farm, Adamawa State University Mubi, Adamawa State, Nigeria. The experiment was laid out in a Complete Randomized Block Design with sesame varieties (Kenana and Muva Local) assigned to the main plot and herbicide levels: Butachlor and diuron (0.5, 1.0, 1.5, 2.0 kg a.i.ha^{-1}) assigned to the sub plot treatment which was replicated three times. Growth and yield performance parameters measured were plant height, number of leaves per plant, stem girth, number of capsules per plant and total yield (kg/ha). Result showed that both kenana and muva local were significantly affected by herbicide levels in terms of plant height, number of leaves per plant, stem girth, number of capsules per plant and the total yield.Kenana variety showed superior performance in terms of yield over Muva Local. Application of butachlor at the doses of 0.5, 1.0, 1.5, 2.0 kg a.i.ha^{-1} decreased weeds infestation up to 6WAS compared to the unweeded check and was at par with the hoe – weeded check, but inferior performance to the hoe-weeded check in 2011and combined analysis. Diurons at 1.0-2.0 kg a.i.ha^{-1} suppressed weed infestation up to 9WAS compared to the unweeded and were at par with the hoe-weeded treatment. Among the herbicides butachlor at 1.0 kg a.i.ha^{-1} and diuron 0.5 kg a.i.ha^{-1} produced comparable grain yield to the hoe-weeded treatment in the two seasons and the combined analysis. It is recommended that kenana variety and butachlor at 1.0 kg a.i.ha^{-1} and diuron 0.5 kg a.i.ha^{-1}should be used by farmers for effective weed control and increased yield.*

***Keywords*— Herbicides, variety, growth, sesame, yield**

I. INTRODUCTION

Sesame (*Sesamumindicum*. L.) also known as beniseed is one of the oil seed crops grown in Nigeria. The crop originated in southern parts of Africa andsesame seeds are rich in edible oil (46-52%). After extraction of oil the sesame cake makes very good feed as it is a rich source of protein, carbohydrate and minerals such as calcium and phosphorus (Singh, 2005). The oil is used as cooking oil, anointing oil, manufacturing of perfumed hair oil and medicinal purposes. In Nigeria it is common to find fried sesame seed sold sole or mixed with groundnuts and taken as snacks. The young leaves of the crops are used in soup making in some areas, while the dried stems may be burnt as fuels with the ash used for local soap making (Singh *et. al., 2007*).

In response to the growing export market demand, Nigeria's production of the crop has increased consistently from about 15,000 metric tonnes in 1980 to about100,000 metric tonnes in 2006. Annual exports of sesame from Nigeria have been valued at about US $200 million (USAID, 2010). The country is the main supplier of sesame seed to Japan which is the world's largest importer. Although the country has an estimated 3.5 million hectares of land suitable for the crop, only about 335,000 ha are currently used for sesame production (USAID, 2010). Therefore, there is a vast potential for increased production. In view of the potentials of sesame in contributing significantly to livelihood of rural dwellers and the growth of national economy the Raw Materials Research and Development Council (RMRDC ABUJA), commenced the promotion of the crop through the establishment of 500 ha foundation seed farms in Nasarawa and Benue states in 2006 (USAID, 2010).

Sesame is basically a crop of the warm regions of the tropics and sub-tropics. It grows in plains as well as up to an elevation of 1250 meters. It requires fairly hot conditions during growth to produce maximum yield. A temperature of 25-27^{0}C encourages rapid germination and initial flower formation. Low temperature during flowering can result in the production of sterile pollen or pre - flower drop (Singh, *et. al., 2007*). Sesame can be grown on a wide variety of Soil types ranging from sandy-loam to heavy black soil, with a pH ranging from 5.5 to 8.2 (Singh, 2005).

Weed infestation has been one of the major threats to sesame production. Poor weed management could cause significant reduction in yield. The traditional methods of weeds control, hoe weeding and hand pulling are the commonest methods used by farmers in Nigeria (Imoloami, *et. al*, 2011). This method is not only labor intensive, expensive and strenuous, but can also cause mechanical damage to growing branches and roots of plants. In addition to high cost, labor availability is uncertain thus making timeliness of weeding difficult to attain, which could lead to greater yield losses (Adigun *et al.*, 1993).

Therefore, it is important to employ various weed control practices which is economically viable and does not tamper with plant growth and yield.

II. MATERIALS AND METHODS

Experimental site

The experiment was conducted during 2011 and 2012 cropping seasons at Food and Agriculture Organisation (FAO)/ Tree Crop Programme (TCP), Adamawa State University, Mubi, (latitudes 9°30' to 11 ° 00'N and longitudes 12°00' to 13°45'E), at an altitude of 696 metres above sea. In the area rainfall starts in the month of April and terminates in the month of October with a unimodal peak in the month of August (ADSU Metrological Unit, 2011).

Treatments and Experimental Design

The experiment was laid out in split – plot design with three replications. Kenana and Muva local varieties comprised the main treatment. The sub- treatments consisted of butachlor at four rates (0.5, 1.0, 1.5, 2.0 kg a.i. /ha) and diuron at four rates (0.5, 1.0, 1.5, 2.0 kg a.i. /ha) along with hoe weeded and unweeded checks.

Land preparation

The experimental site was ploughed and harrowed with tractor. Suitable seedbed was then prepared before sowing.

Crop establishment

Sowing was done on July 26 and August 1,in 2011 and 2012 respectively.Seeds were sown on the flat at the spacing of 45cm ×15cm at 5-6 seeds/hill and thinned to 2 plants / hill at 2 Weeks After Sowing(WAS).

Herbicides application

Herbicides were applied using knapsack sprayer (CP15) with red nozzle. After calibration using area – volume method, the herbicides were applied at the rate for each treatment.

Fertilizer application

NPK(15:15:15) and Urea(46%) fertilizers were applied at the rate of 30 kg N, 60 kg P_20_5 and 30 kg K_20 per hectare (Singh,*et.al*.,2007). The whole doses of P_20_5 and K_20 along with half the rate of N was applied at sowing. The remaining half dose of N was applied at 6 weeks after sowing (WAS).

Harvesting

Harvesting was done manually by cutting at the base of the crop using sickle and the harvested plants were assembled on a polythene bag for sun drying after which it was threshed by gentle shaking and winnowed.

Data collection

Data on the following parameters on sesame growth and development were collected by observation and measurement.

Plant height (cm)

Plant height was taken at 4, 8, and 12 WAS. This was done by selecting and tagged three plants randomly from each net plot and taking their height from

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ground level to the tip of its highest point and the mean determined.

Number of leaves per plant

Number of leaves per plant was taken at 4,8, and 12 WAS. Leaves were counted from 3 randomly selected and tagged plants per plot and the mean determined.

Stem girth

Stem girth was taken at 6, 9 and 12 WAS from three randomly selected plants using Vernier calipers and the mean determined.

Number of capsules per plant

The number of pods from each net plot was counted at harvest and divided by number of plants in the respective plot.

Grain yield (kg/ha)

Grain yield was determined by weighing the grain from each net plot after threshing and winnowing. The weight was converted to yield per hectare using the formula below:

$$\text{Grain yield} = \frac{\text{(Grain yield/plot (kg) x } 10{,}000m^2)}{\text{Net plot size } (20m^2)}$$

Statistical Analysis

The data collected was subjected to statistical analysis of variance (ANOVA) using Statistical Analysis Software (SAS:R-Version,2005) package.

and the treatment means was separated using Duncan Mutiple Range Test (DMRT) at 5 % (0.05) level of probability.

III. RESULTS

Influence of crop variety and herbicide on plant height.

The data on plant height at 4, 8 and 12 WAS are presented in Table 1. At 4 WAS Kenanavariety produced significantly taller plants than Muva in 2011 and the combined analysis; but was at par in 2012. At this stage in the two years and the combined analysis, the unweeded check produced the tallest plants that were only comparable to the hoe- weeded and to butachlor at 0.5 kg a.i. in 2011 only. The hoe- weeded treatment in turn exhibited plants that were appreciably taller than that of the remaining treatments except butachlor at 1.0kg a.i.in 2012, butachlor at 0.5 kg a.i. in both years and combined analysis. Butachlor at 0.5 kg a.i. dose produced plants that were markedly taller than those of butachlor at 2.0 kg a.i. diuron at 1.5 and 2.0 kg a.i rates in the two years and combined analysis. Throughout the study at this stage, diuron at 2.0 kg a.i. showed the shortest plants.

At 8WAS, the two varieties exhibited plants of similar height in the two years and combined analysis. At this growth stage also in the two years and the combined analysis, the hoe- weeded treatment produced the tallest plants which were at par with plants of unweeded- check and diuron at 0.5kg a.i. rate. In 2011 and 2012 plant heights of hoe- weeded treatment was also comparable to those from butachlor at 0.5 and 1.0 kg a.i. rate. It was followed by the unweeded- check, which exhibited appreciably taller plants than butachlor at 2.0 kg a.i.,diuron at 1.5 and 2.0 kg a.i. rates in the both years and the combined analysis. The shortest plants were produced by diuron at 2.0kg a.i./ha in the investigation at this stage.

At 12 WAS the two varieties did not differ significantly in height in the two years and combined analysis. At this growth stage in 2011 and 2012 and the combined analysis, hoe-weeded treatment had the tallest plants. In 2011 plants of the treatment were comparable in height to those of butachlor and diuron at 0.5 kg a.i./ha; and only surpassed plants treated with 2.0 kg a.idiuron rate in 2012. In the combined analysis, plants of the treatment were considerably taller than those of butachlor at 2.0 kg a.i and diuron at 1.5 and 2.0 kg a.i/ha. The 2.0 kg a.idiuron rate exhibited the shortest plants throughout the study. There was no significant interactive effect of variety and herbicide on plant height at 4, 8 and 12WAS.

Table 1: Influence of crop variety and herbicides on plant height of sesame at 4,8,12 WAS grown atMubi, in 2011 and 2012 rainy seasons.

	Plant height (cm)								
	4 WAS			8 WAS			12 WAS		
Treatment	2011	2012	Combined	2011	2012	Combined	2011	2012	Combined

Variety									
Kenana	16.88a	19.48	18.18a	82.07	93.81	87.94	93.65	166.16	127.47
Muva	12.04b	16.04	14.04b	72.82	85.51	79.17	88.78	147.58	120.61
SE ±	0.78	0.66	0.46	8.29	5.02	4.09	11.55	5.81	5.33
Level of signif.	*	Ns	*	Ns	Ns	Ns	Ns	Ns	Ns
Herbicide									
Butachlor (kg a.i.ha^{-1})									
0.5	16.98ab	23.41bc	20.20bc	87.30ab	104.79abc	96.04b	103.62ab	163.70a	133.66ab
1.0	15.28bc	20.26bcd	17.77cd	82.87ab	102.26abc	92.56b	96.12b	166.97a	131.55ab
1.5	14.72bc	17.64de	16.18de	82.03abc	96.97bcd	89.50bc	95.55b	163.52a	129.53ab
2.0	10.95de	15.78def	13.36ef	64.66c	90.36cd	77.51d	77.47c	163.97a	120.72b
Diuron (kg a.i.ha^{-1})									
0.5	14.96bc	19.82cd	17.39cd	92.53a	103.47abc	97.99ab	107.13ab	150.53a	128.83ab
1.0	15.10bc	12.63ef	13.86 ef	80.54b	75.89de	78.21cd	96.80b	165.77a	131.28ab
1.5	12.53dc	12.20f	12.37f	64.32c	59.44ef	61.88e	76.55c	152.74a	114.64b
2.0	8.48e	5.81g	7.15g	47.99d	43.06f	45.52f	60.57d	103.94b	82.25c
Hoe-Weeded	19.07a	25.22ab	22.14ab	94.80a	123.68a	109.23a	113.07a	183.37a	148.22a
UnweededCheck	19.23a	28.86a	24.05a	86.87ab	114.39ab	100.63ab	96.60b	165.87a	131.23ab
SE ±	1.05	1.64	1.03	3.83	6.65	3.83	4.47	12.02	11.93
Level of sign	*	*	*	*	*	*	*	*	*
Int. var x trt.	Ns	Ns	Ns	Ns	Ns	Ns	Ns	Ns	Ns

Mean values followed by the same letter(s) in each treatment group are not significantly different at P=0.05 (DMRT)

WAS= Weeks after Sowing

*=Significantly different at 5% level of probability.

Ns= Not significant at 5% level of probability

Influence of crop variety and herbicide on number of leaves per plant.

Numbers of leaves per plant at 4, 8 and 12 weeks after sowing are shown in Table 2. In both years and the combined data, the two varieties recorded similar number of leaves per plant at 4 and 8 WAS. However at 12 WAS Muva local exhibited higher number of leaves per plant than Kenana variety.

At 4WAS in the two years and the combined analysis, the hoe- weeded treatment produced the highest number of leaves per plant, which was comparable to those of unweeded- check, butachlor and diuron at 0.5kg a .i .rates. Also it was at par with butachlor at 1.0 kg a.i. rate in the two years and diuron at 1.0 kg a.i.in 2011 only. Increasing butachlor rate to 2.0 kg a.i. only reduced number of leaves per plant below that of the lower doses of butachlor and diuron in 2011; while diuron at 2.0 kg a.i.

reduced the number of leaves significantly below all other treatments throughout the study at this stage.

At 8WASand in 2011 and the combined analysis, all rates of butachlor, the hoe-weeded treatment, the unweeded check,0.5 and 1.0 kg a.i. diuron rates exhibited comparable number of leaves. Application of 2.0 kg a.i. diuron produced the lowest number of leaves per plant at this stage but was comparable only to diuron at 1.5 kg a.i. in 2012 and the combined data. Neither herbicide treatment nor hoe- weeding had any significant effect on number of leaves per plant in 2012.

At 12WAS in the two years and the combined data, application of 1.0 kg a.i. diuron produced the highest number of per plant but comparable with diuron at 0.5 kg a.i. rate. It was also at par with butachlor at 0.5, 1.0, 2.0 kg a.i.anddiuron 1.5 kg a.i. dose in 2011. Similarly it was comparable to butachlor at 1.0, 1.5 kg a.i. and diuron at 1.0 kg a.i. rate in 2012. Varying rates of butachlor had no significant effect on number of leaves per plant at this stage in the study. In the two years and the combined data at this stage the unweeded check exhibited the lowest number of leaves per plant but at par with hoe –weeded and diuron at 2.0 kg a.i. rates.

Table 2: Influence of crop variety and herbicides on number of leaves per plant of sesame at 4, 8, 12 WAS in 2011 and 2012 cropping seasons.

	Number of leaves per plant								
Treatment	4 WAS			8 WAS			12 WAS		
	2011	2012	Combined	2011	2012	Combined	2011	2012	Combined
Variety									
Kenana	7.03	14.34	10.68	38.86	38.00	35.69	79.10b	91.66b	85.38b
Muva	6.07	14.46	10.28	33.38	45.25	42.05	118.18a	139.50a	128.84a
SE ±	0.35	0.13	0.47	7.78	5.49	4.30	6.06	4.75	3.16
Level of sign.	Ns	Ns	Ns	Ns	Ns	Ns	*	*	*
Herbicide									
Butachlor									
(kg a.i ha^{-1})									
0.5	7.33ab	16.68ab	12.00ab	43.00a	45.68	44.33a	101.17abc	113.00bc	107..08bc
1.0	7.0 0ab	15.33abc	11.17bc	38.17ab	45.68	41.92a	109.17abc	123.33ab	116.25bc
1.5	6.67bc	15.00bc	10.83bc	38.33ab	42.18	40.25a	86.67bcd	120.67abc	103.67bc
2.0	5.00d	15.68abc	10.33bc	36.17ab	44.00	40.08a	99.33abcd	115.00bc	107.17bc
Diuron (kg a.iha^{-1})									
0.5	7.00ab	16.50ab	11.75abc	43.00a	45.33	44.17a	118.83ab	135.67ab	127.25ab
1.0	7.33ab	13.00cd	10.17c	35.68ab	42.67	39.17ab	135.17a	157.00a	146.08a
1.5	6.00c	10.83d	8.42d	29.33b	32.68	31.00bc	107.33abc	123.67ab	115.25bc
2.0	4.00e	6.50e	5.25e	19.00c	26.00	22.50c	69.83cd	83.33cd	76.58de
Hoe-Weeded	8.00a	18.68a	13.33a	38.33ab	48.33	43.33a	90.67bcd	100.00bcd	95.33cd
Unweeded Check	8.00a	18.00ab	13.00a	40.83a	46.50	43.67a	61.00d	72.33d	66.67e
SE ±	0.30	0.99	0.52	3.24	4.74	3.46	11.73	11.60	8.25

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Level of sign	*	*	*	*	Ns	*	*	*	*
Int. var x trt	Ns	Ns	NsNsNs	Ns	NsNs*				

Mean values followed by the same letter(s) in each treatment group are not significantly different at P=0.05 (DMRT)

WAS= Weeks after Sowing

*= Significantly different at 5% level of probability.

Ns= Not significant at 5% level of probability

Influence of crop variety and herbicides onstem girth.

Data on stem girth at 6, 9 and 12 WAS are shown in Table 3. At 6 WAS, in the two years and the combined analysis, the two varieties exhibited stems of similar girth. It was only in 2012 that herbicides affected stem girth significantly at 6 WAS. In 2012, butachlor at 0.5 kg a.i. produced stems with the thickest girth which were only considerably thicker than those of diuron at 1.0, 1.5 and 2.0 kg a.i./ ha and unweeded check. Diuron at 2.0 kg a.i dose exhibited stems with thinnest girth at his stage.

At 9 WAS, in the two years and the combined data Muva local produced stems with significantly thicker girth than Kenana variety. At this stage herbicide showed significant effect on stem girth only in 2012 and combined analysis, whereby only unweeded check recorded significantly thinner stem girth than any of the other treatments which were all invariably at par.

At 12WAS, varieties only differed in plant height in the combined analysis with Muva local producing stems of thicker diameter than Kenana. At this stage herbicide affected stem girth significantly. In 2011and combined analysis, whereby in both cases, the hoe- weeded treatment produced stems with the thickest girth. However in 2011 the hoe-weeded treatment produced stems that were only significantly thicker than unweeded check and diuron at 2.0 kg a.i/ha. However, in the combined analysis, the hoe-weeded treatment exhibited stems with similar stem girth only with butachlor at 1.0 kg a.i./ha, diuron at 0.5 a.i./ha and 1.0 kg a.i./ha. Application of iuron at 2.0 kg a.i. produced stems with the thinnest diameter in 2011 and combined analysis.

There was no interaction between variety and herbicide treatments at 6 and 12 WAS, while at 9 WAS in 2012 and combined analysis showed significant interaction was observed between variety and herbicide.

Table 3: Influence of crop variety and herbicides on stem girth of sesame at 6, 9 and 12 WAS in 2011 and 2012 cropping seasons.

	Stem Girth (mm)								
	6 WAS			9 WAS			12 WAS		
Treatment	2011	2012	Combined	2011	2012	Combined	2011	2012	Combined
Variety									
Kenana	10.19	7.90	9.04	9.77b	10.43b	10.10b	19.99	20.84	20.41b
Muva	8.04	8.67	8.35	11.77a	12.51a	12.14a	21.08	22.48	21.78a
SE ±	2.12	0.39	1.06	0.15	0.07	0.13	0.29	0.54	0.26
Level.ofsigf.	Ns	Ns	Ns	*	*	*	Ns	Ns	*
Herbicide									
Butachlor									
(kg a.i.ha^{-1})									
0.5	22.64	10.50a	16.57	10.58	11.64a	11.11a	20.30abc	21.75	21.03c
1.0	8.36	9.04abc	8.70	11.30	11.96a	11.63a	21.65ab	22.75	22.20ab

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1.5	8.21	8.75abcd	8.48	10.89	11.55a	11.23a	20.23abc	21.00	20.62bcd
2.0	8.10	8.67abcd	8.38	10.98	11.83a	11.41a	20.65abc	21.68	21.16bcd
Diuron(kg a.i.ha^{-1})									
0.5	8.93	9.56ab	9.24	11.30	11.83a	11.57a	21.45ab	22.92	22.18abc
1.0	6.98	7.33cd	7.16	11.39	11.92a	11.65a	21.47ab	22.18	21.82ab
1.5	6.78	6.71de	6.75	10.51	11.09a	11.80a	20.18abc	20.33	20.26dc
2.0	4.67	5.30e	4.99	10.62	11.50a	11..06a	18.55c	20.25	19.40d
Hoe- Weeded	9.87	10.28a	10.07	10.70	11.35a	11.03a	22.17a	24.33	23.25a
Unweeded Check	7.14	7.62bcd	7.38	9.21	9.79b	9.50b	19.30bc	20.68	19.98d
SE±	4.42	0.61	2.23	0.51	0.43	0.33	0.70	0.80	0.53
Level of Sign	Ns	*	Ns	Ns	*	*	*	Ns	*
Int. var x trt.	Ns	Ns	Ns	Ns	*	*	Ns	Ns	Ns

Mean values followed by the same letter(s) in each treatment group are not significantly different at P=0.05 (DMRT)

WAS= Weeks after Sowing

*= Significantly different at 5% level of probability

Ns= Not significant at 5% level of probability

Influence of crop variety and herbicide on number of capsulesper plant.

Influence of crop variety and herbicide on number of capsules per plant in 2011 and 2012 cropping seasons are presented in Table 4. In the two years and the combined analysis Kenana variety produced appreciably higher number of pods than the Muva variety. In 2011 and 2012, the hoe-weeded treatment and all herbicide treated plots produced similar number of pods per plant that were appreciably higher than that of the unweeded check, except that it was at par with the 2.0kg a.i. rate of diuron in 2011. In the combined analysis the hoe-weeded treatment and all rates of Butachlor, 0.5 and 1.0 kg a.i. rates of diuron exhibited comparable number of pods per plant which were significantly higher than that of unweeded treatment. Also diuron at the rates of 1.5 and 2.0 kg a.i.ha^{-1} recorded similar number of pods per plant that were remarkably higher than that of unweeded check. It was only in the combined analysis that there was significant interaction between variety and herbicide.

Table 4.Effect of variety and herbicides on number of capsules per plant in 2011 and 2012 cropping seasons.

	Number of capsules /plant		
Treatment	2011	2012	Combined
Variety			
Kenana	90.80a	103.11a	96.96a
Muva	61.36b	74.40b	67.88b
SE ±	4.61	1.58	2.09
Level of signf.	*	*	*
Herbicides			
Butachlor(kga.i.ha^{-1})			

0.5	100.67a	117.17a	105.92ab
1.0	84.33a	95.17a	89.75abc
1.5	72.33a	83.33a	77.83abc
2.0	70.17a	84.67a	77.83abc
Diuron(kga.i.ha^{-1})			
0.5	93.67a	121.33a	106.42a
1.0	69.67a	79.83a	74.75abc
1.5	66.00a	77.67a	71.83bc
2.0	57.83ab	70.00a	63.92c
Hoe- Weeded	102.00a	110.83a	106.42a
Unweeded Check	17.17b	23.10b	20.13d
SE ±	14.08	15.23	10.37
Level of sign	*	*	*
Int. var x trt.	Ns	Ns	*

Mean values followed by the same letter(s) in each treatment group are not significantly different at P=0.05 (DMRT)

WAS= Weeks after Sowing

*= Significantly different at 5% level of probability

Ns= Not significant at 5% level of probability

Influence of crop variety and herbicide on grain yield.

The data on sesame grain yield is presented in the Table 5. The two varieties did not differ in grain yield in 2011 and 2012; but in the combined analysis Kenana variety gave significantly higher yield than Muva variety. In the two years and combined analysis, the hoe - weeded treatment out yielded all the herbicide treatments and the unweeded check. This was followed by Diuron at 0.5 kg a.i. ha^{-1} which produced comparable grain yield to butachlor at 1.5kg rate in the two years and the combined analysis.

However it out - yielded the remaining treatments in 2011 and the combined analysis and butachlor at 1.0 kg rate in 2011, diuron at 2.0 kg rate and unweeded check in 2012 only. All the other treatments exhibited comparable grain yield to the unweeded check in both years and the combined analysis, while diuron at the rate of 2.0 kg a.i. ha^{-1} gave the least grain yield throughout the period of the trial. There was significant interaction between variety and herbicide treatments in the two years and combined analysis.

Table 5: Effect of variety and herbicide on the grain yieldin 2011 and 2012 cropping seasons.

	Yield (kg/ha)		
Treatment	2011	2012	Combined
Variety			
Kenana	333.14	256.53	294.84a
Muva	176.24	107.77	142.00b
SE ±	51.76	51.81	36.62
Level of signif.	Ns	Ns	*
Herbicide			
Butachlor (kg a.i./ha)			

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0.5	216.39cd	166.74bcd	191.56cd
1.0	192.20cd	61.01cd	126.60cde
1.5	303.62bc	163.91bcd	233.76bc
2.0	192.31cd	135.79bcd	164.05cd
Diuron (kg a.i./ha)			
0.5	430.08b	264.18b	347.13b
1.0	190.47cd	190.75bc	190.61cd
1.5	175.92cd	147.67bcd	161.79cd
2.0	39.74d	33.29d	36.51e
Hoe-Weeded	717.43a	548.59a	630.51a
Unweeded Check	88.72d	114.58cd	101.65de
SE ±	59.91	41.90	36.56
Level of sign	*	*	*
Int.var ×trt.	*	*	*

Mean values followed by the same letter(s) in each treatment group are not significantly different at P=0.05 (DMRT)

WAS= Weeks after Sowing

*= Significantly different at 5% level of probability

Ns= Not significant at 5% level of probability

IV. DISCUSSION

Kenana variety exhibited superior performance over Muva local in number of pods per plant. This could be attributed to the better genetic composition of the improved variety (Kenana) which is probably more efficient in utilizing growth factors than the Muva local variety. This agrees with the findings of Azeez*et. al.*, (2003) who noted that improved varieties of crops exhibit superior performance of growth and yield characters over local varieties.

Plant height of sesame was significantly affected by herbicide treatment at 4, 8 and 12 WAS. Generally, plant height decreased with increasing rate in both herbicides. This could be due to the phytotoxic effect of the herbicides at higher rates, which might have caused a depressive effect on crop growth. At higher dose of butachlor and diuron there was suppressed crop growth resulting in significantly short plants. The height of plants under 0.5-1.5 kg a.i. dose of butachlor and 0.5-1.0 kg a.i. diuron were comparable to that of hoe - weeded treatment at 12 WAS. This showed that sesame plants are able to overcome the phytotoxicity effect at these rates possibly as the herbicide became degraded or leached out as observed by Imoloame*et al., (*2011).

The number of leaves per plant varied with herbicide treatments at 4 WAS. This could be as a result of the phytotoxic effect of the herbicide on the crop growth. The depressive effect of the herbicides at higher rates resulted in lower number of leaves. However at 8 WAS, with the exception of diuron at 1.5and 2.0 kg a.i. a rate in the combined analysis, the numbers of leaves from herbicide treatments were comparable to that of hoe-weeded treatment. The overcoming of the depressive effect of the herbicides agrees with the findings of Ishaya*et. al.*, (2009).

The mean performance at various growth stages showed that all herbicide treatments and hoe- weeded treatment suppressed weed infestation compared to unweeded-check up to 9 WAS. This can be attributed to efficient residual effect of these herbicides on weed control as noted by (Zimdahl and Gwynm, 1977; Rao, 2000). The ability of diuron to provide season-long effective weed control, could be due to the persistence of this herbicide in the soil (Akobundu , 1987; Beyer,1988; Imoloame, 2004).

Butachlor at 2.0 kg a.i. dose and diuron at 1.0-2.0 kg a.i / ha reduced the weed dry weight significantly in the combined analysis compared to the unweeded and gave comparable weed dry weight to the hoe- weeded check at 6 WAS. The effectiveness of these rates of butachlor and diuron in weed suppression up to 6 WAS indicates that , these herbicides at these rates can be used as an alternative weed control weed control methods to replace to hoe -weedings at 3 and 6 WAS. This agrees with findings of Ibrahim *et al*., (2009) that application of diuron at 0.960 kg a.i./ha gave excellent broad- leaved weed control in sesame in Egypt. It also agrees with Gritcher*et al.*,(2001) who reported that butachlor among all the herbicides evaluated, provided best control of weeds and least sesame injury.

The combined analysis has shown that all rates of butachlor (0.5- 2.0 kg a.i.) and 0.5- 1.0 kg a.i. rates of diuron produced appreciably higher number of pods/plant than unweeded check but comparable to hoe-weeded treatments. Since these treatments had less weeds infestation, they had less competition from weeds for growth factors such as nutrients and water. Therefore they possibly had more available assimilates for production of higher number of pods.

Throughout the two years and the combined data, it was only butachlor at 1.0 kg a.i. that produced comparable yield to the hoe-weeded treatment which gave the highest yield. This shows that butachlor at 1.0 kg a.i./ha is a promising herbicide for use in sesame. From this research, it can be recommended that butachlor at 1.0 kg a.i./ha and diuron 0.5 kg a.i./ha are possible rates for use in sesame production as alternative to first two hoe weeding for effective weed control and high yield in sesame in Mubi, Northern Guinea savanna of Nigeria.

V. SUMMARY

The experiment was conducted during 2011 and 2012 rainy seasons, to evaluate the effect of herbicides for weed control in sesame (*Sesamumindicum* L), at Food and Agriculture Organisation (FAO)/ Tree Crop Programme (TCP), Adamawa State University, Mubi, latitudes 9°30', to 11 ° 00'N and longitudes 12°00' to 13°45'E) in the northern Guinea savanna ecological zone, Nigeria.

The experiment was laid out in a split-plot design replicated three times. Two varieties of sesame (Kenana and Muva Local) were allocated to the main plots, while butachlor and diuron at each at four rates (0.5,1.0,1.5, and 2.0 kg a.i. ha^{-1}), a hoe-weeded and un-weeded checks were assigned to the sub-plots.

Kenana variety showed superior performance compared to Muva local variety in number of pods per plant, but higher fresh weed infestation in the combined analysis at 6 and 9WAS.Muva local exhibited significantly higher number of leaves per plant in both seasons and combined analysis at 12WAS and gave appreciably higher straw yield in the combined analysis.

Generally plant height decreased with increasing rates in both herbicides up to 8 WAS. The combined analysis at various growth stages showed that all herbicide treatments and hoe-weeded check suppressed weed infestation up to 9 WAS.

Throughout the two years and the combined data, it was only butachlor at 1.0 kg a.i/ha that produced comparable yield to the hoe- weeded treatment which gave the highest yield. This shows that butachlor at 1.0 kg a.i/ha is a promising herbicide for use in sesame.

VI. CONCLUSION

This research revealed that butachlor at 1.0 kg a.i./ha^{-1} rate and can be used as alternative to hoe weeding for effective weed control and higher yield of sesame.

VII. RECOMMENDATION

Potentials exist for the production of sesame using herbicides as an alternative to hoe weeding. The information thus generated in this study should further be studied for sesame production by using other herbicide rates.

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