Journal of Agriculture and Environment Vol. 7 No. 2, Dec. 2011: 133-143
ISSN 1595465X

GROWTH PARAMETERS OF SESAME (*Sesamum indicum* L.) AS AFFECTED BY CHEMICAL AND MANUAL WEED CONTROL METHODS IN SUDAN SAVANNAH ZONE OF NIGERIA

A. I. Take-tsaba[1], A. I. Yakubu[2], N. D. Ibrahim[3] and B. L. Aliero[4]

[1] Department of Agricultural Education, School of Vocational Education, Federal College of Education (Technical), Gusau, Nigeria

[2] Department of Crop Science, Faculty of Agriculture, Kebbi State University of Science and Technology, Aliero, Birnin Kebbi, Nigeria

[3] Department of Crop Science, Faculty of Agriculture, Usmanu Danfodiyo University, Sokoto, Nigeria

[4] Department of Biological Sciences, Faculty of Science, Usmanu Danfodiyo University, Sokoto, Nigeria

ABSTRACT

Two field experiments were carried out during 2007 and 2008 rainy seasons at the Dry Land Teaching and Research Farm of Usmanu Danfodiyo University, Sokoto (latitude 13^0 01'N, longitude 5^0 15'E and 350m above sea level) in the Sudan Savanna agro-ecological zone of Nigeria, to study the effect of chemical and manual weed control methods on the growth performance of sesame (*Sesamum indicum* L.). Three herbicides: *butachlor*, *glyphosate* and *pendimethalin* were used at three rates each (butachlor at 0.75, 1.00, 1.25 kg a.i. ha^{-1}, glyphosate at 0.82, 1.23, 1.64 kg a.i. ha^{-1}, and pendimethalin at 0.50 0.75 and 1.00 kg a.i. ha^{-1}) and three manual weeding regimes (weedy check, weeding at 6 weeks after sowing (WAS) and weed free throughout the crop life cycle) laid out in randomized complete block design (RCBD) and replicated three times. The results revealed that plant height, crop vigour score, number of leaves and branches per plant were significantly and positively affected by the chemical weed control. Growth attributes of sesame were equally positively affected by manual weed control. Chemical weed control with pendimethalin at 0.50 kg a. i. ha^{-1} produced maximum effect in plant height, while pendimethalin at 1.00 kg ha^{-1} significantly produced more branches per plant in 2007 season.

Keywords: Weed control; Sesame; Growth parameters

INTRODUCTION

Sesame (*Sesamum indicum* L.) commonly known as beniseed in Nigeria is one of the cultivated oil seed crops in the world (Onyibe *et al*., 2002). It has been grown since the beginning of arable cultivation and originates from the dry savannah of tropical Africa and

where it spread to India and China where it is still widely cultivated (Augstbuger *et al.*, 2002). The total world crop area under beniseed cultivation is about 6 million hectares. The leading world's producers are India, China, Mexico and Sudan. Total annual consumption is about 65% for oil and 35% for food. The food segment includes about 42% roasted, 12% ground, 36% washed and processed and 10% roasted and salted (RMRDC, 2004).

In Nigeria, the crop is cultivated either as sole crop or in mixture with other crops like groundnut or cotton (Katung, 1987). The major producing areas in Nigeria are Nasarawa, Jigawa and Benue States. Other important areas are Yobe, Kano, Katsina, Kogi, Gombe and Plateau States (USAID, 2002). The crop is gaining significance in Nigerian agriculture because of the economic importance of its seeds in the world market (Olowe *et al.*, 2003) as well as the nutritional value of the leaves when use as vegetable.

Despite these immense benefits, seed yield is generally low in Nigeria (90-250 kg ha^{-1}) due to prevalence of weed infestation which is the major agronomic reason for the low seed yield of sesame (Van Rheeman, 1983). Yield loss of over 70% could be caused by uncontrolled or poorly controlled weeds (Busari and Bature, 1993). Fadayomi (1991) found that the traditional manual hoe-weeding is the prevailing method of weed control. However, the method is not only expensive, but labour for doing it is also scarce, thereby making timely weeding unfeasible. The use of herbicides to control weeds has been known to man for centuries and they have played, and will continue to play important role in world agriculture (Akobundu, 1987). Manual weeding is probably the oldest method of weed control and consists of hand-pulling, hand-slashing, hand-hoeing and mowing of weeds. This study was therefore conducted to evaluate the most suitable weed control method for sesame production, optimum rate of herbicide application and suitable combination of chemical and manual weed control for the growth performance of sesame in the Sudan Savannah zone of Nigeria.

MATERIALS AND METHODS

Study Area

The experiment was conducted at the Dry Land Teaching and Research Farm of Usmanu Danfodiyo University, Sokoto, (Latitude 13°01' N, Longitude 5°15'E, 300M above sea level) in the Sudan Savanna agro-ecological zone of Nigeria, during 2007 and 2008 rainy seasons. The climate of the area is semi-arid, characterized by a long dry season with cool dry air during harmattan from November to February and hot season from March to May, followed by short rainy season from May to October. The soil of the experimental area was sandy with pH range of 4.85 (in $CaCl_2$) to 5.55 (in H_2O), organic carbon 8.6g kg ha^{-1}, total nitrogen 0.33kg^{-1} and available phosphorus of 3.8 mg kg^{-1}. The total annual rainfall received during the cropping seasons was 452.12 and 667.60 mm in 2007 and 2008, respectively.

Treatment and Experimental Design

The treatments consisted of three herbicides tested at three rates of each (butachlor at 0.75, 1.00, 1.25 kg a.i. ha^{-1}, glyphosate at 0.82, 1.23, 1.64 kg a.i. ha^{-1} and pendimethnalin at 0.50, 0.75, 1.00 kg a.i. ha^{-1}) and three manual weedings (weedy check, hoe-weeding at 6 weeks after sowing (WAS) and weed free) arranged in all possible factorial combinations. The experiment was laid out in a Randomized Complete Block Design with three replications. Individual plot size was 2.1 m x 3 m with 3.6 m^2 as the net plot size. A pinch

of sesame seeds variety Ex-Sudan, obtained from Zamfara Comprehensive Agricultural Revolution Programme (ZACAREP) were sown per hill by dibbling method at a spacing of 30 cm x 30 cm and later thinned to three plants per stand at 4 weeks after sowing (WAS). The seeds were dressed with Apron Star 42WS at the rate of one sachet (10g) per 4 kg of sesame seeds before planting, to guard against pests and pathogens.

Herbicide application was done after sowing. Glyphosate was applied on the weed foliages immediately after sowing, while butachlor and pendimethalin were applied pre-emergence after rainfall within the first three days after sowing using a CP3 Knapsack sprayer in 250 L ha^{-1} spray volume at a pressure of 2.1 kg/cm^{-2}. Manual weeding was done with hand hoe according to treatments. NPK fertilizer 20:10:10 was used to supply 45 kg N, 22.5 Kg P_2O_5 and 22.5 kg K_2O per hectare at 4 WAS, followed by 45 kg N per hectare at 6 WAS using area (46% N). All fertilizers were uniformly broadcasted. Data collected was that on plant height, number of leaves per plant, crop vigour score and number of branches per plant from randomly selected and tagged plants.

Data Analysis

The data generated were subjected to analysis of variance (ANOVA) procedure of Randomized Complete Block Design (RCBD) using Statistical Analysis System (SAS). Treatment means found to be statistically different were compared using Duncan's Multiple Range Test (DMRT) at 5% level of probability.

RESULTS AND DISCUSSION

Plant Height

Mean values of sesame plant height (cm) at 4, 8 and 12 WAS as affected by chemical weeding during 2007 and 2008 rainy seasons are presented in Table 1. Result indicated that chemical weeding had significant effect on plant height at different growing stages of the crop in both seasons, except at 8 and 12 WAS in 2008. At 4 WAS in 2007, butachlor 0.75 kg a.i. ha^{-1} recorded the tallest plants (13.0 cm) which was statistically similar to butachlor 1.00 kg a.i. ha^{-1}. The three levels of butachlor produced taller plants than each level of glyphosate and pendimethalin, except the latter at 0.50 kg a.i. ha^{-1}, which was similar to butachlor at 1.00 and 1.25 kg a.i. ha^{-1} . At 8 and 12 WAS, all the levels of butachlor and pendimethalin resulted in taller plants than the three levels of glyphosate, except at 8 WAS when pendimethalin at 1.00 kg a.i. ha^{-1} was at par with the glyphosate levels.

In the 2008 season, butachlor 1.00 kg a.i. ha^{-1} recorded the tallest plants at 4 WAS, (10.9 cm), which were statistically similar to butachlor at 0.75, 1.25 and glyphosate at 0.82-1.64 kg a.i. ha^{-1} , and statistically higher than pendimethalin at 0.50 – 1.00 kg a.i. ha^{-1} . The occurrence of shorter plants on the different rates of pendimethalin applied plots could be attributed to its adverse effect (injury) on the young sesame seedlings. This observation agrees with the earlier reports by Grichar *et al*. (2001) who reported that pendimethalin at 1.12 kg a.i. ha^{-1} reduced plant height by up to 66% when compared with the untreated check.

Manual weed control showed no significant effect on plant height in both seasons, except at 12 WAS in both trials, where there was significant ($P<0.05$) effect (Table 1). At 12 WAS in 2007 cropping season, manual weed free treatment produced the tallest sesame plants (82.1) than manual weeding at 6 WAS, which was in turn superior to the least (57.6) by the weedy check. A different trend was observed in 2008 when manual weeding at 6

WAS produced the tallest plants (134.6 cm) though statistically similar to weed free and higher than weedy check. The shortest plants (57.6 cm and 121.5 cm) produced by weedy check at 12 WAS in both seasons was as a results of the effect of inter specific competition between the crop and weeds for light and other resources in the weedy check. This was buttressed by Harper (1999) who reported that the longer the duration of competition between crop and weeds the greater the reduction in the growth of that crop.

The interaction of chemical and manual weed control on plant height was found to be significant ($P<0.05$) at 8 and 12 WAS in 2007 (Table 4).

Table 1: Plant height (cm) of Sesame at 4, 8 and 12 WAS as affected by chemical and manual weed Control during 2007 and 2008 rainy seasons

Treatments		Plant Height (cm)					
		----------2007----------			----------2008----------		
		4 WAS	8 WAS	12 WAS	4 WAS	8 WAS	12 WAS
Chemical weeding (C)	(kg a.i. ha^{-1})						
Butachlor	0.75	13.0^{a}	60.2^{ab}	86.9^{ab}	10.6^{a}	68.4	129.4
Butachlor	1.00	11.4^{ab}	50.6^{ab}	77.6^{b}	10.9^{a}	70.9	135.6
Butachlor	1.25	10.5^{b}	48.2^{ab}	78.1^{ab}	10.7^{a}	71.8	136.2
Glyphosate	0.82	6.6^{c}	22.3^{c}	43.3^{c}	8.9^{ab}	56.4	119.1
Glyphosate	1.23	7.5^{c}	21.5^{c}	37.4^{c}	8.9^{ab}	60.2	119.7
Glyphosate	1.64	7.5^{c}	24.0^{c}	43.1^{c}	9.4^{a}	66.0	132.2
Pendimethalin	0.50	9.5^{b}	62.4^{a}	93.2^{a}	8.0^{b}	63.4	129.0
Pendimethalin	0.75	7.6^{c}	45.4^{b}	82.2^{ab}	8.0^{b}	63.6	133.0
Pendimethalin	1.00	6.3^{c}	28.9^{c}	75.8^{b}	8.1^{b}	61.6	134.2
SE ±		0.60	5.30	4.90	0.60	4.90	4.90
Significance level		**	**	**	**	Ns	Ns
Manual weeding (M)							
Weedy check		8.9	37.9	57.6^{c}	9.0	60.1	121.5^{b}
Weeding 6 WAS		9.0	37.9	66.1^{b}	9.3	68.0	134.6^{a}
Weed free		8.7	45.5	82.1^{a}	9.4	66.1	133.3^{a}
SE ±		0.30	3.10	2.80	0.30	2.80	2.80
Significance level		Ns	Ns	**	Ns	Ns	**
Interaction							
C x M		Ns	*	**	Ns	Ns	Ns

Means in columns followed by the same letter(s) within the same treatment group are not statistically different at either 1% or 5% level of significance using DMRT; * and **= significant at 1% and 5% levels of probability; Ns = not significant; WAS= weeks after sowing

The results showed that at 8 WAS, the tallest plants (74 cm) were obtained from plots which received butachlor 0.75 kg a.i. ha^{-1} and kept un-weeded throughout the crop life cycle followed by those that received pendimethalin at 0.50 kg a.i. ha^{-1} under the weedy check (66.5 cm). The shortest plants (6.7 cm) were obtained from plots applied with glyphosate at 0.82 kg a.i. ha^{-1} which was comparable to glyphosate at 1.23, 1.64, kg a.i. ha^{-1} and pendimethalin at 1.00 kg a.i. ha^{-1} under this weed control treatment. Manual weeding at 6 WAS in combination with butachlor at 0.75-1.25 kg a.i. ha^{-1} and pendimethalin at 0.50 kg a.i. ha^{-1} resulted in taller plants than all the treatments with glyphosate; with the weed free control, pendimethalin at 0.50 and 0.75 kg a.i. ha^{-1} having taller plants than the highest rate

of 1.00 kg a.i. ha^{-1}. At 12 WAS, the three rates, each of butachlor and pendimethalin gave taller plants than the three rates of glyphosate when the crop was left weedy and when it was manually weeded at 6 WAS. However, with the weed free control, all the herbicides treatments were statistically at par with respect to plant height. The reason for the shortest (6.7 cm and 3.4 cm) plants from glyphosate 0.82 kg a.i. ha^{-1} plus weedy check at 8 and 12 WAS could be due to the fact that weeds were not controlled at the initial stage of crop growth on these treatments and provided a suitable environment for weed growth. This agrees with the observations of Mathews (1979) who reported that weed competition at the initial stages of crop growth can be so severe that plants remain stunted.

Number of Leaves

The number leaves per plant were significantly ($P<0.05$) affected at all stages of crop growth in both seasons, except at 8 and 12 WAS in 2008 cropping season (Table 3). In 2007 butachlor at 0.75-1.25 kg a.i. ha^{-1} had statistically more number of leaves at 4 WAS than glyphosate 0.82 – 1.64 kg a.i. ha^{-1} and pendimethalin 0.50-1.00 kg a.i. ha^{-1} which were statistically at par with each other except glyphosate 1.64 kg a.i. ha^{-1} which was superior to pendimethalin at 1.00 kg a.i. ha^{-1}. At 8 WAS pendimethalin at 0.50 – 0.75 kg a.i. ha^{-1} and butachlor at the three rates produced more number of leaves per plant than each of the three rates of glyphosate. At 12 WAS, pendimethalin at 0.50 – 1.00 kg a.i. ha^{-1} produced the highest number of leaves per plant, which were statistically the same and significantly higher than butachlor at 1.25 kg a.i. ha^{-1}. Butachlor at 0.75 and 1.00 kg a.i. ha^{-1} were in turn superior to glyphosate at 0.82 – 1.64 kg a.i. ha^{-1}, which was the least in the trial. In 2008, butachlor at 0.75 kg a.i. ha^{-1} and glyphosate at 1.23 and 1.64 kg a.i. ha^{-1} produced more number of leaves per plant at 4 WAS than each of the three levels of pendimethalin. At 8 and 12 WAS, there was no significant effect of chemical weed control on the number of leaves per plant. The reason for the pendimethalin treated plots to have recorded lower number of leaves at 4 WAS could be due to the injury caused to sesame plants by the former at the early stage of crop growth. This is in conformity with the results of Grichar *et al.* (2001) and Dotray *et al.* (2008) who observed that pendimethalin damaged sesame plants at early stage of crop growth.

Crop Vigour

Manual weed control had a significant ($P<0.05$) effect on number of leaves per plant at 4 WAS in 2007 and at 12 WAS in both trials (Table 2). Weed free plots and weeding at 6 WAS produced significantly higher number of leaves than the weedy check throughout the period of investigation. The lower number of leaves recorded on the weedy check could be due to serious struggle for the scarce growth resources, notably, solar radiation, moisture and nutrients by the plants on the weedy check plots. This agrees with the observation of Bissdorf and Weber (2007) who reported that weeds compete with crops for nutrients, moisture and sunlight, which decreases crop growth.

Crop vigour score was also significantly ($P<0.05$) affected by chemical weed control in both seasons (Table 3). In 2007 season, more vigorous crop growth (3.8 - 4.3) was observed with pendimethalin at 0.50 – 1.00 kg a.i. ha^{-1} and butachlor at 75 -1. 25 kg a.i. ha^{-1} than the least (1.7) by glyphosate at 0.82-1.23 kg a.i. ha^{-1}. While in 2008 season, butachlor at 1.25 kg a.i. ha^{-1} produced the highest (4.1) crop vigour score, which was superior to the ones recorded by glyphosate at 0.82-1.64 kg a.i. ha^{-1}. Also, butachlor at 0.75 and 1.00 kg a.i. ha^{-1} and pendimethalin at 0.75 kg a.i. ha^{-1} produced more vigorous plants than

glyphosate at 0.82 kg a.i. ha^{-1}. The reason for less vigorous plants from glyphosate treated plots might be attributed to the zero tillage adopted on these plots treated with the different rate of this herbicide. This agrees with the observations of Akobundu (1987) who reported that tillage provides a good seed bed for seed germination and seedling growth.

Manual weed control had a significant ($P<0.05$) effect on crop vigour score of sesame during 2007 and 2008 cropping seasons (Table 3). The weed free control recorded the most vigorous plants in both trials (3.7 and 4.1) which was superior to the weedy check and manual weeding at 6 WAS. Manual weeding in turn produced more crop vigour than the weedy check in 2007 and was at par with it in 2008. The most vigorous plants observed on weed free treatments could be due to the conducive environment created for plant growth. This agrees with the observations of Akobundu (1987) who reported manual hand hoeing provides a clear seed bed and loosen the soil, hereby making plant nutrients available to crop plants.

Table 2: Number of leaves per plant of Sesame at 4, 8 and 12 WAS as affected by chemical and manual weed control during 2007 and 2008 rainy seasons

Treatments		Number of leaves per plant					
		2007			2008		
		4 WAS	8 WAS	12 WAS	4 WAS	8 WAS	12 WAS
Chemical weeding (C) (kg a. i. ha^{-1})							
Butachlor	0.75	7.2^{a}	31.5^{ab}	59.3^{bc}	6.8^{ab}	27.2	60.6
Butachlor	1.00	7.4^{a}	33.2^{a}	60.3^{bc}	7.0^{a}	29.3	72.0
Butachlor	1.25	7.0^{a}	26.4^{ab}	45.1^{cd}	7.0^{a}	29.8	68.7
Glyphosate	0.82	5.1^{bc}	13.8^{c}	32.7^{d}	6.0^{bc}	21.6	55.6
Glyphosate	1.23	4.9^{bc}	13.5^{c}	28.0^{d}	6.3^{ab}	23.7	55.6
Glyphosate	1.64	5.7^{b}	13.8^{c}	27.1^{d}	6.3^{ab}	25.9	60.3
Pendimethalin	0.50	5.2^{bc}	34.7^{a}	75.2^{ab}	5.3^{c}	24.8	67.2
Pendimethalin	0.75	5.1^{bc}	31.4^{ab}	82.2^{ab}	5.2^{c}	25,2	68.8
Pendimethalin	1.00	4.5^{c}	22.5^{bc}	89.7^{a}	5.3^{c}	24.5	72.4
SE±		0.32	3.15	8.57	0.26	2.26	6.03
Significance level		**	**	**	**	Ns	Ns
Manual weeding (M)							
Weedy check		5.3^{b}	21.6	41.8^{b}	6.0	23.1	55.7^{b}
Weeding 6 WAS		5.9^{a}	24.4	58.6^{a}	6.2	27.2	70.2^{a}
Weed free		6.1^{a}	27.7	66.1^{a}	6.2	26.4	67.5^{a}
SE±		0.18	1.18	4.94	0.15	1.31	3.48
Significance level		**	Ns	**	Ns	Ns	*
Interaction							
C x M		Ns	Ns	Ns	Ns	Ns	Ns

Means in columns followed by the same letter(s) within the same treatment group are not statistically different at either 1% or 5% level of significance using DMRT; * and **=significant at 1% and 5% level of probability; Ns = not significant; WAS=weeks after sowing

An interaction of chemical and manual weed control on crop vigour score was found to be significant (P<0.05) in 2007 but not significant in 2008 (Table 5). The result revealed that with the weedy check, butachlor at 0.75 kg a.i. ha^{-1} and pendimethalin at 0.50 kg a.i. ha^{-1} produced the most vigorous plants which were superior to those on glyphosate at 0.82-1.64 kg a.i. ha^{-1}. The other treatments of butachlor and pendimethalin were superior to treatments with glyphosate. With manual weeding, butachlor at the three levels, and pendimethalin at 0.50 and 1.00 kg a.i. ha^{-1} resulted in more vigorous crop plants than treatments with glyphosate. However, with the weed free control, only pendimethalin at 0.5 and 0.75 kg a.i. ha^{-1} produced greater crop vigour than glyphosate at 1.23 kg a.i. ha^{-1}. The highest crop vigour score (4.6) observed on the treatment combination involving butachlor at 1.00 kg a.i. ha^{-1} and manual weeding at 6 WAS might be attributed to initial weed control by butachlor, and subsequent control by hoe-weeding at 6 WAS, which provided a weed free environment during the critical period of weed competition which is generally between 3 and 6 WAS for most annual crops.

Table 3: Crop vigour score of Sesame at 9 WAS and number of branches per plant at 12 WAS as affected by chemical and manual weed control during 2007 and 2008 rainy seasons

Treatment		Crop vigour score		Number of branches per plant	
		2007	2008	2007	2008
Chemical weeding (C) (kg a.i. ha^{-1})					
Butachlor	0.75	4.1^{a}	3.8^{ab}	1.9^{abc}	1.6
Butachlor	1.00	3.9^{ab}	3.9^{ab}	2.2^{ab}	2.0
Butachlor	1.25	4.0^{ab}	4.1^{a}	1.0^{bc}	2.1
Glyphosate	0.82	2.0^{c}	2.9^{c}	1.1^{bc}	1.3
Glyphosate	1.23	1.7^{c}	3.2^{bc}	0.8^{c}	1.5
Glyphosate	1.64	2.1^{c}	3.2^{bc}	0.9^{bc}	1.4
Pendimethalin	0.50	4.3^{a}	3.7^{abc}	1.9^{abc}	1.9
Pendimethalin	0.75	3.8^{ab}	4.0^{ab}	2.8^{a}	1.3
Pendimethalin	1.00	3.2^{b}	3.6^{abc}	2.9^{a}	2.2
SE±		0.25	0.26	0.41	0.32
Significance level	**	**	**	**	Ns
Manual weeding (M)					
Weedy check		2.7^{c}	3.3^{b}	1.2^{b}	1.3
Weeding 6 WAS		3.3^{b}	3.4^{b}	1.9^{a}	1.8
Weed free		3.7^{a}	4.1^{a}	2.1^{a}	2.0
SE±		0.14	0.15	0.23	0.18
Significance level		**	**	*	Ns
Interaction					
C x M		**	Ns	Ns	Ns

Means in columns followed by the same letter(s) within the same treatment group are not statistically different at either 1% or 5% level of significance using DMRT;* and **=significant at 1% and 5% level of probability ; Ns =not significant ; WAS=weeks after sowing

Number of Branches

The number of sesame branches per plant was significantly (P<0.05) affected by chemical and manual weed control in 2007 season, but was not significantly affected in 2008 season (Table 3). Pendimethalin at 0.75 and 1.00 kg a.i. ha^{-1} produced the highest number of branches per plant, which was statistically higher than those produced by butachlor at 1.25 kg a.i. ha^{-1} and glyphosate at 0.82, 1.23 and 1.64 kg a.i. ha^{-1} and statistically similar to butachlor at 0.75 and 1.00 kg a.i. ha^{-1} and pendimethalin 0.50 kg a.i. ha^{-1}. The highest number of branches produced by pendimethalin at 1.00 kg a.i. ha^{-1} could be attributed to the reduction in plant stands by pendimethalin which resulted in less intra-specific competition compared to treatments with glyphosate in which there was no stand reduction and plants produced less number of branches. This finding is in conformity with that of Dotray *et* al. (2008) who found that some pre-emergence herbicides reduced stands as the rate increased, but sesame compensates by branching.

Table 4: Plant height (cm) of Sesame at 8 and 12 WAS as affected by interaction of chemical and manual weed control during 2007 and 2008 rainy seasons

Treatment		**Manual weeding**		
		Weedy check	Weeding 6 WAS	Weed free
Chemical weeding (C) **(**kg a.i. ha^{-1})				
		Plant height (cm) 8 WAS		
Butachlor	0.75	74.2^{a}	52.7^{a-d}	53.9^{a-d}
Butachlor	1.00	46.3^{a-e}	62.8^{abc}	42.9^{a-g}
Butachlor	1.25	50.0^{a-d}	50.7^{a-d}	44.1^{a-f}
Glyphosate	0.82	6.7^{i}	13.2^{f-i}	47.1^{a-d}
Glyphosate	1.23	11.9^{ghi}	10.6^{hi}	42.2^{b-g}
Glyphosate	1.64	15.3^{ei}	15.3^{e-i}	41.5^{b-gh}
Pendimethalin	0.50	66.5^{ab}	62.6^{abc}	58.4^{abc}
Pendimethalin	0.75	47.5^{a-d}	31.9^{c-i}	56.9^{abc}
Pendimethalin	1.00	22.9^{d-i}	41.5^{b-h}	22.5^{d-h}
SE±		9.30		
		Plant height (cm) 12 WAS		
Butachlor	0.75	95.6^{ab}	82.5^{ab}	82.6^{ab}
Butachlor	1.00	73.9^{ab}	82.9^{ab}	76.2^{ab}
Butachlor	1.25	81.2^{ab}	70.2^{ab}	74.1^{ab}
Glyphosate	0.82	3.4^{e}	41.8^{c}	84.7^{ab}
Glyphosate	1.23	5.9^{de}	42.3^{cde}	80.9^{ab}
Glyphosate	1.64	24.1^{cde}	32.1^{cd}	73.3^{ab}
Pendimethalin	0.50	88.6^{ab}	96.3^{ab}	94.9^{ab}
Pendimethalin	0.75	79.4^{ab}	69.0^{abc}	98.3^{a}
Pendimethalin	1.00	67.1^{b}	87.5^{ab}	72.9^{ab}
SE±		8.53		

Means within rows and columns followed by the same letter(s) in superscript are not statistically different (P>0.05) WAS= weeks after sowing

Table 5: Crop vigour score of Sesame at 9 WAS as affected by interaction of chemical and manual weed control during 2007 and 2008 rainy seasons

Treatment		Manual weeding		
		Weedy check	Weeding 6 WAS	Weed free
Chemical weeding (C) (Kg a.i. ha^{-1})				
Butachlor	0.75	4.3^{a}	4.0^{a}	4.0^{ab}
Butachlor	1.00	3.6^{abc}	4.6^{a}	3.3^{a-d}
Butachlor	1.25	3.6^{abc}	4.3^{a}	4.0^{ab}
Glyphosate	0.82	0.6^{g}	1.3^{efg}	4.0^{ab}
Glyphosate	1.23	1.0^{fg}	1.3^{efg}	2.6^{b-e}
Glyphosate	1.64	1.0^{fg}	2.0^{d-g}	3.3^{d-d}
Pendimethalin	0.50	4.3^{a}	4.3^{a}	4.3^{a}
Pendimethalin	0.75	3.3^{a-d}	3.3^{a-d}	4.6^{a-}
Pendimethalin	1.00	2.3^{c-f}	4.0^{ab}	3.3^{a-d}
SE±			0.44	

Means within rows and columns followed by the same letter(s) in superscript are not statistically different (P>0.05) WAS= weeks after sowing

Manual weed control had a significant (P<0.05) effect on number of branches per plant in 2007 season (Table 3). More number of branches (2.1) were recorded in weed free than in non-weeded control (1.2). This could be due to a conducive environment in the weed free plots which provided more nutrients and moisture. This agrees with the observations of Kafiriti and Deckers (2001) who reported that the degree of branches in sesame is influenced by the environment.

CONCLUSION

From the results of this study, it may be concluded that chemical weed control had a significant effect on growth parameters of sesame with pendimethalin at 0.50 kg a.i. ha^{-1} producing maximum effect in plant height and number of leaves per plant at 8 and 12 WAS, crop vigour score and number of branches per plant. Also manual weeding at 6 WAS produced maximum effects in plant height and number of leaves per plant. Similarly, keeping the crop free from weeds produced maximum effect in crop vigour score and number of branches per plant. Thus, for better performance of sesame in Sokoto, the crop should be chemically weeded with pendimethalin at 0.50 kg a.i. ha^{-1} and manually weeded at 6 WAS. Future researche should be geared towards finding the herbicide rate that can effectively control weeds so as to produce maximum growth of sesame in Sokoto.

ACKNOWLEDGEMENT

The authors thank the management of Federal College of Education (Technical), Gusau, Zamfara State, Nigeria for the opportunity, financial and other assistance given to Mal. A. I. Take-tsaba to undertake his M. Sc. Studies on which this project was carried out. We also thank Dr. Ajit Singh of Crop Science Department, Usmanu Danfodiyo University,

Sokoto, for assisting with the statistical analysis and Mal. Ahmed Modi of the Soil Science Laboratory, Usmanu Danfodiyo University, Sokoto, for conducting the soil analysis.

REFERENCES

Akobundu, I. O. (1987). *Weed Science in the Tropics: Principles and Practices*. A Wiley-Inter-science Publication Chichester, New York, Brisbane, Toronto, Singapore 522pp.

Augstburger, F. J. Berger and U. Censkowesky (2002). Organic farming in the tropics and subtropics. Exemplary Description of 20 Crops Sesame Natureland www.Naturland.de 15/3/2009

Bissdort, J. K. and C. Weber (2007). Field guide to non-chemical pest management in sesame production. Pesticide Action Network (PAN). Hamburge, Germany. www.pan-germany.oisat.org 12/2/2009.

Busari, L. D. and G. Bature (1993). Evaluation of selected herbicides for weed control in sesame in the southern guinea savanna of Nigeria. *Nigerian Journal of Weed Science* 6: 7-12.

Dotray, P., J. Grichar and C. Godsey (2008). Pre-emergence herbicide testing on sesame in 2007. American Sesame Growers Association (ASGA), 5p.

Dudley, T. S. W. S. Grichar and A. A. McCallum (2000). Crop Profile for sesame in United States http://www./pmcenters.org/cropprofiles//docs/ussesame. htmApril,2000

Fadayomi, O. (1991). Weed management in Nigerian agriculture in the 90s. The chemical weed control option. *Nigerian Journal of Weed Science* 4: 79-85.

Grichar, W. J., D. C. Sestak, K. D. Brewer, B. A. Besler, C. R. Stichler and T. S. Dudley (2001). Sesame (*Sesamun indicum* L.) tolerance and weed control with soil-applied herbicides. *Crop Protection* 20 (5): 389-394.

Harper, F. (1999). *Principles of Arable Crop Production.* Second edition, Blackwell Science Ltd. U. K. 335p.

Kafiriti, E. M. and J. Deckers (2001). Oilseed crops, In: Raemaekers R. H. (ed.) Crop *Production in Tropical Africa* C. I. P Royal Library I. Brussels, 1540p.

Katung, P. D. (1987). Effect of sowing date and plant population on yield and yield components of sesame. M. Sc Thesis, Department of Agronomy, Ahmadu Bello University, Zaria.

Matthews, G. A. (1979). *Pesticide Application Methods* Longman Inc. New York 334p.

Olowe, V. I., O. Okeleye, K. A., Durojaiye, S. A., Elegbede, S. Oyekanmi, and P. O. Akintoku (2003). Optimum plant densities for soybean *(Glycine max (L) Merril)* and sesame (*Sesamum indicum L.)* in maize based intercropping system in south-western Nigeria. *Journal of Agricultural Science, Environment and Technology.* Series A3 (3): 79-89.

Onyibe, J. E., E. B. Tologbonshe and E. O. Ubi (2002). Beniseed production and utilization in Nigeria. *Extension Bulletin No. 154 Horticulture Series No.5.* National Agricultural Extension and Research Liaison Services (NAERLS), Ahmadu Bello University, Zaria. 25p.

Oplinger, E. S., D. H. Putman, A. R. Kaminshi, C. V. Hanson, E. A. Oelke, E. E. Schutte and J. D. Doll (1990). *Alternative Field Crops Manual: Sesame* http//www.hort.purdue.edu/newcrop/afem/sesame:html.

RMRDC (2004). Survey Report of ten selected agro raw materials in Nigeria. Raw Materials Research and Development Council, Federal Ministry of Science and Technology, Abuja Pp. 1-31

USAID (2002). *Overview of the Nigerian Sesame, Industry*. United States Agency for International Development.Chemonics International Inc. Washington DC.

Van Rheeman, H. R. (1983). Major problems of growing sesame in Nigeria. *Communication on Agriculture of the University of Wageningen*, Netherlands, pp 1-30.