Performance of Okra (*Abelmoschus esculentus* (L.) Moench) as Affected by Weeding Regimes and Nitrogen Fertilizer Application Rates in Mubi North, Adamawa State, Nigeria

I. D. Bake

Department of Crop Science, Faculty of Agriculture, Adamawa State University, Mubi Adamawa State

Corresponding Author: email: ibrahimdaudabake@gmail.com: 08069797877

ABSTRACT

The experiment was conducted to examine the performance of okra (Abelmoschus esculentus (L.) Moench) as affected by weeding regimes and nitrogen fertilizer application rates in Mubi North, Adamawa State, Nigeria, grown at the Teaching and Research Farm of Food and Agricultural Organization/Tree Crop Plantation (FAO/TCP), Faculty of Agriculture, Adamawa State University Mubi, during 2018rainy season. Mubi is located in the North-eastern part of Adamawa State laid between Latitude 9^0 26' and10^0 10'N and Longitude 13^0 10' and 13^0 44'E. at an Altitude of 696m above sea level. The experiments were laid out in split-plot design with the main factor consisted of four (4) levels of weeding regimes: 0 weeding, plot weeded once at 3 weeks after sowing, plot weeded twice at 3 and 6 weeks after sowing and plot weeded thrice at 3, 6 and 9 weeks after sowing ,on the other hand, the sub-plot treatment equally comprised of four (4) rates of nitrogen: 0 kg N ha^{-1}, 50kgN ha^{-1}, 100kg Nha^{-1} and 150kg Nha^{-1}replicated 3 times. Data collected on plant height, Number of leaves, stem diameter and number of branches, days to first fruit setting, fruit length, fruit diameter, number of seeds per fruit, hundred seeds weight, fresh and dried fruit yield per hectare. All the data collected were subjected to analysis of variance (ANOVA) using Statistical Analysis System (SAS), (SAS, 2010) and means that showed significant differences separated by F-test using Duncan Multiple Range Table (DMRT).The results revealed that, weeding regimes and nitrogen fertilizer application rates significantly promoted plant height (36.567 / 34.960 cm), number of leaves (23.323 / 19.796),number of branches per plant (7.575 / 6.750), stem diameter (15.808 / 15.244 mm)as the highest values at 9 weeks after sowing. On the response of phonological traits and yield components of okra, to weeding regimes and nitrogen fertilizer application rates, significant improvement were observed in days to first fruit setting (60.083 /60.333 days), fruit length (9.110 /8.584 cm),fruit diameter (10.189 /9.731 cm), number of seeds per fruit (106.168 / 102.023),100 seeds weight (5.807 /5.636 g), dried fruit yield per hectare (709.80 / 615.33 g) and fresh fruit yield per hectare (1514.69 / 1238.38 g) as the values obtained from the plot weeded thrice and received 150 kg N ha^{-i} accordingly. It is concluded that, plot weeded thrice and those received 150 kg N ha^{-}performed significantly higher than the rest of the treatments. The study therefore recommends 3 times weeding at 3, 6, and 9 weeks after sowing and application of 150kg Nha^{-1} at 3 and 6 weeks after sowing to okra farmers in Mubi and its environs for optimum fruit yield.

Keywords: Fertilizer, Nitrogen, Okra, Performance, Weeding, Rates.

INTRODUCTION

Okra (*Abelmoschus esculentus* (L.) Moench),originated from Ethiopia in Africa, but nowadays widely cultivated throughout the tropics, sub-tropics and warmer parts of the temperate regions of the world (Echo, 2003; Khalid *et al*., 2005; Farinde, *et al*., 2007). It is a flowering plant and a member in *malvaceae* family, a polyploidy crop with chromosome number as: 2 n = 130, National Research Council (NRC. 2006). Distribution of West African okra is restricted to humid and per humid climates in Africa, between 12^0 N and 12^0 S. It is

grown from Guinea to Nigeria in West Africa, Cameroon, Gabon and DR Congo in Central Africa and Uganda, in East Africa (Dhaliwal, 2017). It is one of the priority vegetable crops in Nigeria and ranks above other vegetable crops including cabbage, Amaranthus, and Lettuce (Babatunde *et al.*, 2007). The fruit are consumed immature and can be used in salads, soups and stews fresh or dried, fried or cooked (Gemede *et al*., 2013). Fresh okra fruits are the most important vegetable source of viscous fiber, an important dietary component to lower cholesterol (Arapirtsas, 2008). Seed protein is rich in tryptophan (94 mg/g N) and also contains adequate amounts of sulfur-containing amino acid (189 mg 1 g N) (Chadha, 2002).Okra fruit contain carbohydrate, protein, vitamin A, B, C and K, sodium, calcium as well as magnesium. Vitamin B_6, calcium and folic acid presence in okra could help in good vision, bone formation, growth and proper circulation of blood, and digestion (FAO, 2004).
Although, okra is a very important vegetable crop with outstanding qualities, but yields obtained from farmers' fields are often very low. Average yield per hectare in Nigeria is 2.10 t/ha, which is less than half of those in other countries like India (10.12 t/ha) and world average (7.65 t/ha). Research identified low soil fertility, weed infestation and the use of low yielding varieties as the major production constraints attributed to low yields of okra in Nigeria (Adeyemi*et al*. 2008; Iyagba*et al*. 2012). Interestingly, crops and weeds have the same basic nutrient requirements Foster (1996), the same nutrient applied to crops are generally available to weeds O'Donovan *et al.* (2001). The rate and time of nutrient application therefore, determines the relative competitiveness between crops and weeds. Despite an appreciable increase in okra fruit yield due to the application of nitrogen fertilizer, competition by weeds for light, nutrients, moisture and space reducing the total okra fruit yields (Hassan*et al*., 2003).

Early weeding is advisable to prevent weeds from setting seeds. One year seedling means seven years weeding (Thierfelder and Wall, 2018). The longer the weeds are left uncontrolled the harder their control becomes, leading to high cost of production and yield reduction. Hence strategies to increase productivity of okra in less fertile soils in order to meet the increasing demands of okra in Nigeria will have to focus on the supply of adequate nutrients for vigorous okra growth and its resistance to weed (Adeigun*et al*., 2018). Such empirical data and information is still inadequate in the study area. This study therefore, was carried out to examine the performance of okra (*Abelmoschus esculentus* (L.) Moench) as affected by weeding and rates of nitrogen fertilizer in Mubi North, Adamawa State, Nigeria.

MATERIALS AND METHODS

The experiment was conducted at the Teaching and Research Farm of Food and Agricultural Organization / Tree Crop Plantation (FAO/TCP), Faculty of Agriculture Adamawa State University. Mubi is situated between Latitude 9^0 26′ and 10^0 10′N and Longitude 13^0 10′ and13^0 44′E at an altitude of 696 m above sea level in 2018 raining season. The area has a bimodal rainfall with annual mean rainfall of 133.77 mm, the maximum and minimum average temperature of (34.42 and 22.74^{0}C) during the study year (World Whether Online, 2021),and 40 ^{0}C maximum in April (Adebayo and Tukur, 2000; Muhammad, *et al*., 2017), there are they equally identified the 2 types of seasons, viz.: the wet season which lasted from April – October and dry season covered November – March characterized by cold dry dust laden wind especially in January and February.
Prior to sowing, 5 core soil samples, randomly collected from 0 – 30 cm depth – soil using soil auger were mixed to form a composite sample. The composite soil samples were air – dried, ground, and passed through a 2 mm sieve mesh and subsequently subjected for

analysis to determine the soil textural classes, chemical properties and. exchangeable bases of soil using standard laboratory procedures. The soil pH was determined by glass electrode pH meter, total nitrogen (N) content was by micro-kjedahl method designed by (Bremner and Mulvaney, 1982), and total Phosphorus (P) was by Bray 1 method (Bray and Kurzt, 1945) while calcium (Ca) and magnesium (Mg) were determined by the Atomic Absorption Spectrophotometer (AAS) idea of (Perkin-Elmer Corp, 1969). Sodium (Na) determined using flame emission photometry profound by (Doll and Lucas, 1973). Determination of organic carbon (C) content was achieved according to Walker- Black wet oxidation method (Walkey and Black, 1934) (Table 1).

The experiment was laid out in a split-plot design with the main treatment consisted of 4 levels of weeding regimes: 0 weeding, plot weeded once at 3 weeks after sowing, plot weeded at twice at 3 and 6weeks after sowing plot weeded thrice at 3, 6 and 9 weeks after sowing while the sub-treatment equally consisted of four 4rates of nitrogen: 0 kg N ha^{-1}, 50 kg Nha^{-1}, 100 kg Nha^{-1} and 150 kg Nha^{-1}replicated 3 times. The experimental site was cleared and then ploughed with the aid of tractor mounted implement, larger soil clods were further broken down to create fine tilt soil conditions. Then, plots were manually constructed using hoe, shovel, rake and other simple farm tools. Total land area of the experimental site were 441.45 m^2 with gross plot size of 3 × 2.1 (6.3 m^2) and the net plot size of 2.25 x 1.8 m^2 (4.05 m^2).The experimental field was divided into 3 blocks and each block consisted of 16 plots given a total of 48 plots. A path way of 0.5 m between plots and 1 m between replications to allow easy passage for regular data collection was crated. Nitrogen fertilizer being the sub-treatment was applied to the field in 2 split doses (3 and 6 weeks after seedling emergence) in accordance with the experimental design as follows: 50 kg N ha^{-1}, 50 kg N ha^{-1}, 100 kg N ha^{-1} and 150 kg N ha^{-1}.

The okra seeds (variety Yar-kwadam) used for the experiment was collected from a certified local seed vendor in Mubi main market and treated with Apron Star WS (*Thia-methoxan + difenocanazole*) at 1 sachet (10 g) per 3 kg okra seeds 5 hour prior to planting on the field. Sowing was done in July, 2018. Healthy seeds were sown manually by placing the seeds in a moist soil condition at the rate of 2 – 3 seeds / hole, 2 - 3 cm depth and later thinned down to 1 seedling / stand (2 weeks after sowing). Seeds were sown at the distance of 75 x 30 cm between crop row and stand systematically. Weeding being the major determining factor was undertaken in the following sequence during the study period: 0 weeding (control),plot weeded once at 3 weeks after sowing, plot weeded twice at 3 and 6 and plot weeded thrice at 3, 6 and 9 weeks after sowing accordingly. Insecticide, Karate lambda (Lambda cyhalothrim) 5 l ha^{-1}, mixed with water was applied 4 times at 5 days intervals to guard against insect pest and it commenced when 50 % flowering was observed. Fresh okra fruits were harvested 5 times at an interval of 3 days, average taken and recorded. Growth and yield parameters determined includes: plant height, Number of leaves, stem diameter, number of branches, days to 1st fruit settings, fruit length, fruit diameter, number of seeds per fruit, 100 seeds weight, dried and fresh fruit yield per hectare. The data collected were subjected to analysis of variance (ANOVA) using Statistical Analysis System (SAS), (SAS, 2010) and means showing significant difference were separated by F-test using Duncan Multiple Range Table (DMRT).

RESULTS AND DISCUSSIONS

Soil analysis:

Physico-chemical properties of soil of the experimental site before cropping are presented in Table 1. The soil of the study site was sandy-loam, with the pH of 6.41.which is acidic in

nature. The organic carbon content (3.70 %) fall under the category of very high in accordance with the rating of Bello *et al* (2006) who classified soil organic percentages as: < 1.0, 1.0 – 1.71, 1.72 - 3. 31 – 4.29 and > 4.3 as very low, low, medium high and very high respectively. The soil of the experimental site is with medium total nitrogen (0.73 %) content in accordance with the rating of London (1991) who classified soils having total nitrogen of greater than 1.0 % as very low, 0.5 - 1 % high, 0.2 – 0.5 % medium, 0.1 – 0..2 % low and less than 0.1 % as very low in total nitrogen content. Available phosphorus of 6.67 ppm, which is medium soil according to the classification of Bray and Kurzt (1945) who also classified Available P < 5 ppm were classified as: very high, high, medium, low and very low accordingly. The experimental site has Carbon exchange capacity (CEC) of 3.25 meg/100, which is very low according to rating of the London (1991) who classified soils having CEC of > 40, 25 – 40, 15 – 25, 5 - 15 < 5 meg/100 g as very high, high, medium, low and very low.

Table 1: Physico-chemical properties of soil of the experimental site before cropping

S/No.	Particular	2018
	Physical properties	
A.		
	Particle size distribution (%	
.	Clay	14.2
	Silt	31.6
	Sand	54.2
B.	**Textural Class**	Sandy-loam
C.	**Chemical properties**	
	pH (1 – 2 soil: water solution)	6.41
	Organic carbon (kg^{-1})	3.70
	Cation exchange capacity (c mol (+) kg^{-1})	3.25
	Available nitrogen (g N kg^{-1})	0.73
	Available phosphorus (mg P kg^{-1})	6.67
	Available magnesium (c mol (+) kg^{-1})	0.47
	Available sodium (c mol (+) kg^{-1})	0.38
	Available calcium (c mol (+) kg^{-1})	1.93

Source: Laboratory experiment, 2018

Growth parameters

Results forth performance of okra to weeding regimes and nitrogen application rates on plant height, number of leaves, stem girth and numbers of branches per plant presented in Table 2 and 3. On response of these growth characters to different weeding regimes, the data collected showed significantly ($P \geq 0.001$) influenced by weeding regimes at3, 6 and 9 weeks after sowing. The finding indicated that, plot weeded thrice recorded plants with the highest mean values of: 9.438, 21.439, and 36.567 cm (plant height), 6.708, 9.383, and 23.323 (number of leaves), 2.816, 6.717 and 15.808 mm (stem girth) and also 7.575 (number of branches). While the lowest means of: 7.688, 14.702 and 26.039 cm (plant height), 5.258, 7.150 and 12.369 (number of leaves), 2.152, 4.778 and 11.728 mm (stem girth), 5.233 (number of branches) obtained from the control treatment (0 weeding). The same pattern of response was observed with regard to the performance of okra to nitrogen fertilizer application rates, where plant height, number of leaves, stem diameter and number of branches significantly ($P \geq 0.001$) increased. Greatest changes in the data collected were noticed at 150 kg N ha^{-1}: 8.907, 19.613 and 34.960 cm (plant height), 6.267, 8.883 and

19.796 (number of leaves), 2.753, 6.717 and 15.244 mm (stem diameter) as well as6.750 (number of branches) consistently. The control treatment (0 kg N ha^{-1}) showed a decreasing trend in all these parameters.

Table 2: Performance of okra as affect by weeding regimes and nitrogen fertilizer application rates on growth characters in 2018 cropping season

Treatments	Plant height at 3 WAS (cm)			Number of leaves per plant		
Weeding	**3 WAS**	**6 WAS**	**9 WAS**	**3 WAS**	**6 WAS**	**9 WAS**
0 Weeding	7.688^{d}	14.702^{d}	26.039^{d}	5.258^{d}	7.150^{b}	12.369^{c}
Weeded once	8.248^{c}	16.192^{c}	29.421^{c}	5.592^{c}	8.433^{b}	15.272^{b}
Weededtwice	8.898^{b}	17.987^{b}	35.125^{b}	5.975^{b}	8.650^{b}	17.329^{b}
Weededthrice	9.438^{a}	21.439^{a}	36.567^{a}	6.708^{a}	9.383^{a}	23.323^{a}
SE ±	0.110	0.403	0.318	0.048	0.203	0.584
Level of Sig.	***	***	***	***	***	***
Nitrogen						
0 kg N ha^{-1}	8.128^{c}	15.478^{c}	28.385^{d}	5.417^{c}	7.958^{c}	14.345^{c}
50 kg N ha^{-1}	8.478^{b}	17.216^{b}	30.942^{c}	5.783^{b}	8.208^{c}	16.335^{b}
100 kg N ha^{-1}	8.751^{a}	18.013^{b}	32.955^{b}	6.067^{a}	8.567^{b}	17.818^{b}
150 kg N ha^{-1}	8.907^{a}	19.613^{a}	34.960^{a}	6.267^{a}	8.883^{a}	19.796^{a}
SE ±	0.074	0.332	0.393	0.091	0.092	0.551
Level of Sig.	***	***	***	***	***	***
Interaction						
W * N	NS	*	NS	NS	NS	*
SE ±	0.220	0.806	0.636	0.127	0.406	1.168

Mean with the same letter (s) in each treatment group are not significantly different at 5 % level of probability using Duncan's Multiple Range Test (DMRT). **Key:** WAS = Week after Sowing, W × N = Weeding Interacted with Nitrogen, SE = Standard Error, NS = Not Significant, * = Significant at 0.05 %,*** = Significant at 0.001 %

The sequence of response showed by growth characters in this study under varying weeding regimes was in accordance with the earlier findings of Mahmoud *et al*. (2013) who reported significant increase of plant height, number of leaves per plant, number of branch per plant, leaf area per plant, number of fruits per plant, number of node, intermodal length, days to 50% flowering and fruiting, fruit yield per plant and total yield per hectare. The consistent increase in growth parameter might be attributed to the increase in the high number of weeding which was confirmed by Gogoi *et al.* (1997); Okezie (2000) and Tunku, (2006) who reported that the higher the weeding regimes, the more the performances of crop as the rate of weeding will determine the overall performances of the crop in terms of growth and yield characters. It was also reported that Nitrogen fertilizer level at the rate of 100 kg N ha^{-1}significantly improved growth development and yield of okra (Sultana, 2002).Significant increase in okra stem girth with the application of 100 kg N ha^{-1} nitrogen was equally observed (Singh*et al*., 2007).Uddin *et al.*(2014) have earlier reported significantly higher number of branches per okra plant and other related growth characters at the nitrogen application rates of 120 kg N ha^{-1}.

Table 3: Performance of okra as affect by weeding regimes and nitrogen fertilizer application rates on growth characters in 2018 cropping season

Treatments	Stem girth (mm)			Number of braches per plant
Weeding	**3 WAS**	**6 WAS**	**9 WAS**	
0 Weeding	2.152^{c}	4.778^{b}	11.728^{d}	5.233^{d}
Weeded once	2.418^{b}	5.311^{b}	12.850^{c}	5.967^{c}
Weededtwice	2.609^{b}	6.305^{a}	14.603^{b}	6.542^{b}
Weededthrice	2.816^{a}	6.717^{a}	15.808^{a}	7.575^{a}
SE ±	0.055	0.155	0.262	0.107
Level of Sig.	***	***	***	***
Nitrogen				
0 kg N ha^{-1}	2.238^{c}	5.098^{c}	12.408^{c}	5.850^{c}
50 kg N ha^{-1}	2.460^{b}	5.662^{b}	13.309^{b}	6.200^{b}
100 kg N ha^{-1}	2.543^{b}	5.937^{b}	14.028^{b}	6.517^{b}
150 kg N ha^{-1}	2.753^{a}	6.413^{a}	15.244^{a}	6.750^{a}
SE ±	0.046	0.095	0.273	0.102
Level of Sig.	***	***	***	***
Interaction				
W × N	NS	NS	NS	NS
SE ±	0.109	0.311	0.525	0.214

Mean with the same letter (s) in each treatment group are not significantly different at 5 % level of probability using Duncan's Multiple Range Test (DMRT). **Key:** WAS = Week after Sowing, W × N = Weeding Interacted with Nitrogen, SE = Standard Error, NS = Not Significant, *** = Significant at 0.001

Phonological traits

Phenological traits of okra such as days to firstfruit setting, fruit lengthand fruit diameter exertedsignificant ($P \geq 0.001$) increase by weeding regimes and nitrogen application rates (Table 4). Plot weeded thrice obviously influenced okra to sets first fruit within the minimum60.083 days and the maximum sets at 61.917 days. Fruit length and fruit diameter were recorded greater mean values of: 9.110 and 10.189 cm in the plot weeded thrice whereas, the minimum 6.981 and 8.160 cm obtained from the control (zero weeding). With regard to the nitrogen application rate, significant ($P \leq 0.05$) difference was observed on days to firstfruit setting, the shortest 60.333 and the longest 61.333days recorded fromthe plot that received 150 N kg ha^{-1} and the control (0 N kg ha^{-1}) accordingly. However, fruit length and diameter weresignificant ($P \geq 0.001$) with the longest and thickest fruits (8.584 and 9.731 cm) fruit recorded at 150 N kg ha^{-1}and 0 N kg ha^{-1}while the shortest and thinnest (7.633 and 8.560 mm) fruits obtained at 150 kg N ha^{-1} the control (0 kg N ha^{-1}) treatment.

The observed pattern of significant progressive performance of days to first fruit setting, fruit length and diameter at the various weeding regimes and nitrogen levels is similar to the previous findings of Bamipe (2006); Osundare (2009); Mahmoud *et al*., (2013) and Shah *et al*. (2017) who reported significantly higher mean values of these phonological traits on different soil under the varying weeding regimes. In another study, Smith and Ojo (2007); Mahmoud *et al*. (2013) revealed significant reduction in days to first fruit setting when weeding was done frequently. Furthermore, linear increase in fruit length and diameter of okra with the application of nitrogen at the rates of 125 kg N ha^{-1} and 145 kg N ha^{-1} were early revealed by (Mani and Ramanathan 1980; Mjambu *et al*. 1985, and Singh *et al.* 1998). Imoloame (2013) attributed these remarkable performances to a reduced competition for various growth resources such as nutrients, water and light. This implied that, the time interval adopted for weeding and nitrogen application rates in this study was able to break the period required by various weeds species to freely compete and cause substantial damage

rather the competition went in favor of the main crop, as such it made armful and efficiently utilization of the available nutrients which resulted to these tremendous performances.

Table 4: Performance of okra as affect by weeding regimes and nitrogen fertilizer application rates on somephonological traits in 2018 cropping season

Treatments	Days to first fruit setting	Fruit length (cm)	Fruit diameter (cm)
Weeding			
0 Weeding	61.917[a]	6.981[c]	8.160[d]
Weeded once	60.667[b]	7.697[b]	8.791[c]
Weeded twice	60.583[b]	8.731[a]	9.583[b]
Weeded thrice	60.083[b]	9.110[a]	10.189[a]
SE ±	0.268	0.168	0.119
Level of Sig.	**	***	***
Nitrogen			
0 kg N ha^{-1}	61.333[a]	7.633[d]	8.560[d]
0 kg N ha^{-1}	61.083[ab]	8.003[c]	9.041[c]
0 kg N ha^{-1}	60.500[ab]	8.298[b]	9.392[b]
0 kg N ha^{-1}	60.333[b]	8.584[a]	9.731[a]
SE ±	0.306	0.091	0.089
Level of Sig.	*	***	***
Interaction			
W × N	NS	NS	NS
SE ±	0.536	0.336	0.239

Mean with the same letter (s) in each treatment group are not significantly different at 5 % level of probability using Duncan's Multiple Range Test (DMRT). **Key:** W × N = Weeding Interacted with Nitrogen, SE = Standard Error, NS = Not Significant, **= Significant at 0.01 %, *** = Significant at 0.001 %

Yield characters

Okra yield characters such as number of seeds per fruits, hundred seeds weight, dried fruit and fresh fruit yield per hectare performed significantly ($P \geq 0.001$) well under varying weeding regimes and nitrogen fertilizer application rates (Table 5). Number of seeds per fruits and hundred seeds weight were higher (106.168 and 5.807 g) at plot weeded thrice whereas, the lowest mean values (86.992 and 4.663 g) obtained from the control (0 weeding). With regard to the rates of nitrogen fertilizer, the greatest yield of 102.023 and 5.636 g recorded from the application of 150 kg N ha^{-1} while the lowest mean values (88.932 and 5.048 g) obtained from the control treatment (0 kg N ha^{-1}). In the same vein, dried and fresh fruit yield per hectare recorded significantly highest yields of 709.80 and 1514.69 g when weeding was done thrice whereas, the control treatment (0 weeding) gave the least yield values of 365.14 and 766.90 g being the lowest performance. Furthermore, the response of dried fruit yield and fresh fruit yield per hectare to the rates nitrogen fertilizer was very impressive. At the highest rates of 150 kg N ha^{-1}maximum yields of 615.33 g and 1238.38 g)were recorded with the lowest 464.39 and 1032.73 g being least values obtained from the control treatment (0 kg N ha^{-1}).

Table 5: Performance of okra as affect by weeding regimes and nitrogen application rates on some yield and yield attributing characters in 2018 cropping season

Treatments	Number of seeds per fruit	Hundred seeds weight (g)	Dried fruit yield per hectare (g)	Fresh fruit yield Per hectare (g)
Weeding				
0 Weeding	86.992[b]	4.663[c]	365.14[d]	766.90[d]
Weeded once	92.293[b]	5.268[b]	464.24[c]	989.04[c]
Weeded twice	98.167[b]	5.668[a]	635.54[b]	1249.58[b]
Weeded thrice	106.168[a]	5.807[a]	709.80[a]	1514.69[a]
SE ±	2.193	0.085	10.869	27.568
Level of Sig.	***	***	***	***
Nitrogen				
0 kg N ha^{-1}	88.932[c]	5.048[c]	464.39[c]	1032.73[c]
50 kg N ha^{-1}	94.364[b]	5.289[b]	518.32[c]	1084.81[c]
100 kg N ha^{-1}	97.291[b]	5.433[b]	576.69[b]	1162.30[b]
150 kg N ha^{-1}	102.023[a]	5.636[a]	615.33[a]	1238.38[a]
SE ±	1.271	0.059	14.333	23.933
Level of Sig.	***	***	***	***
Interaction				
W × N	NS	NS	NS	NS
SE ±	4.386	0.169	21.738	55.136

Mean with the same letter (s) in each treatment group are not significantly different at 5 % level of probability using Duncan's Multiple Range Test (DMRT). **Key:** W × N = Weeding Interacted with Nitrogen, SE = Standard Error, NS = Not Significant, *** = Significant at 0.001 %

The highest mean values of okra fruit yield consistently recorded at various weeding regimes implies that timely weeding after seedling establishment is indispensable in determining okra yield. Studies by Iyagba *et al*. (2012) revealed that, better weed control will reduce competition from the weeds leading to higher fruit yield. Increase in fresh fruit yields of okra due to weeding regimes was reported by Iyagba and Ibe (2013). Similarly, Dada and Fayinminnu (2007) recorded higher okra fruit yield (t/ha^{-1}) when weeding was done 3 - 6 weeks after the crops were established. This implied that, most of assimilates were partitioned in to economic yield principally because weed interference at this weeding regimes did not confer any adverse effect on the source and sink metabolic process of crop. Furthermore, studies revealed that, all vital processes in plants are associated with protein, of which nitrogen is an important constituent (Shan *et al*., 2017). Gates (1998) and Chandler (1999) recorded significant improvement in okra seeds numbers at 120 kg ha^{-1}. This means that seed weight is associated with adequate supply of nitrogen. Navdeep and Daljeet (2016) equally reported significantly higher number of fruits/plot and yield ha^{-1} when nitrogen was applied at the rate of 100 kg ha^{-1}. Olasatan (2001); Babatola *et al*. (2002) opined that, growth and yield of okra fruits depends on available soil nitrogen and amount of nitrogen applied.

CONCLUSION

The results of this study showed that, weeding regimes and nitrogen application rates significantly promoted the growth, yield and yield attributing characters of okra. Prominent treatment among weeding regimes is plot weeded thrice (3, 6 and 9 weeks after sowing) while nitrogen at the highest rate of 150 kg N ha^{-1} was the best. However, okra is an indeterminate crop by its nature, the more the weeding frequency the higher the productivity. Three times weeding at 3, 6 and 9weeks after sowing complemented with the addition of nitrogen at 150 kg N ha^{-1} (in 2 split doses i.e. 3 and 6 weeks after sowing is therefore recommended to farmers for adoption in order to encourage rapid growth, increase okra fruit yields and subsequently income.

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