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Effects of varieties and tillage practices on soil properties and yield of sesame in Makurdi, Southern Guinea Savanna zone of Nigeria

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Abstract

This study was conducted in 2018 and 2019 cropping seasons to evaluate the effects of sesame varieties and tillage practices on the yield of sesame at the Teaching and Research Farm, Federal University of Agriculture, Makurdi, Nigeria. Treatments consisted of three sesame varieties (Jigida, NCRIBEN-01M and NCRIBEN-032) and three levels of tillage practices (zero tillage, flatbeds and ridges). The experiments were laid out in a randomized complete block design (RCBD) and replicated thrice. Composite surface (0-15 cm) soil samples were collected prior to planting and after harvest. Data collected include several capsules per plant, seeds per capsule, length of the capsule (cm), 1000 seeds capsule weight (g), 1000 seeds weight (g) and seed yield (t ha^{-1}). The data were subjected to ANOVA using Genstat Release 10.3 DE and significant means were separated using Least Significant Difference (LSD) at a 5% level of probability. Results indicated that improved varieties performed better than local varieties in terms of yield in both cropping seasons. Ridges produced higher yields than flatbeds and zero tillage in both seasons. The effect of varieties on soil properties did not differ significantly however, improved varieties left lower essential nutrients in soil compared with the local variety. Zero tillage retained higher nutrients and organic matter in the soil while ridges gave lower values for essential nutrients and organic matter. It is recommended that sesame should be grown on ridges for sustainable production. For the conservation of essential nutrients and organic matter in the soil, zero tillage is recommended for the study area.

Keywords: Sesame varieties, Tillage, Yield, Southern Guinea Savanna, Nigeria

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1.0 Introduction

Sesame is one of the most ancient oilseed crops known to mankind (Langham *et al.,* 2008). Sesame is cultivated in almost all tropical and subtropical Asian and African countries for its highly nutritious and edible seeds (Iwo *et al.*, 2002). The oil is used for cooking, baking, candy making, soaps, lubricant, body massage, hair treatment, food manufacture, industrial uses and alternative medicine for blood pressure, ageing, stress and tension (Ahmed *et al.,* 2009). The sesame seeds serve as ingredients in soup and a source of oil (Biswas *et al.,* 2001). It is widely cultivated in the Northern and Central parts of Nigeria (USAID, 2002; Iorlamen *et al.,* 2014). The demand for sesame and its products is growing both at the National and International levels. Thus huge market potential exists for sesame. However, owing to its previous status as a minor crop, there has been little research efforts towards improved production of the crop (NCRI, 2002).

Tillage practices have been reported to have a significant impact on sesame production especially through the improvement of soil properties with the attendant provision of a suitable seedbed for good seed germination, easy emergence and good establishment of seedling by way of enhanced root growth thereby encouraging the vertical and horizontal proliferation of roots through a reduction in soil strength (Ali *et al.,* 2006; Okeleye and Oyekanmi, 2003; Alam *et al.,* 2014).

In Nigeria, farmers commonly till the soil to improve its physical, chemical, and biological characteristics that alter plant growth and yield (Agber *et al.,* 2017). Crops grown without tillage are stunted and show symptoms of water and nutrient deficiencies because of high surface bulk density, low porosity, retarded infiltration, and low water holding capacity of the soil (Ali *et al.,* 2015). However, the conventional tillage methods have negative effects on soil life and increase the mineralization of organic matter. A zero tillage system, on the other hand, is a conservation method that involves the use of crop residues that aid water infiltration, prevent erosion, and increase organic matter content and agricultural productivity (Ali *et al.,* 2015).

Survey reports by various researchers in the savanna areas revealed that the yield of the sesame crop is low, probably due to a lack of improved varieties and poor tillage practices. According to Eifediyi *et al.,* (2018), cultivating the crop early in the season predisposes it to vegetative growth and pest invasion. In addition, traditional sesame growers rarely use improved varieties to increase their yields. Studies have shown that the crop performs well with the appropriate tillage practices (Eifediyi *et al.,* 2016 and Eifediyi *et al.,* 2018) and improved varieties.

However, for sustainable production of sesame, there is a need for the adoption of improved practices and varieties that would ensure optimum yield. The recent increase in awareness, production and cultivation of sesame across the savanna zones has, therefore, necessitated the need to determine its response to tillage practices. The objective of the study was to assess the soil properties and the yield of sesame as influenced by varieties and tillage practices to establish appropriate tillage practices that will be suitable for sesame production in the study area.

2.0 Materials and Methods

2.1 Experimental Site

A study was conducted in 2018 and 2019 cropping seasons to evaluate the effects of varieties and tillage practices on soil properties and the yield of sesame at the Teaching and Research Farm, Federal University of Agriculture, Makurdi-Nigeria. The study location falls within the Southern Guinea Savanna Zone of Nigeria with a mean rainfall of about 1, 250 mm per annum and a temperature of 25-30 ^{0}C. It is located between latitude 7^{0}41' N to 7^{0}42' N and longitude 8^{0}37' E to 8^{0}38' E. The treatments consisted of three sesame varieties (Jigida, NCRIBEN-01M and NCRIBEN-032) and three levels of tillage practices (zero tillage, flatbeds and ridges). The experiments were laid out in an RCBD with sesame varieties occupying the main plots and tillage practices at the subplots and were replicated thrice.

2.2 Land Preparation and Planting

The experimental area was cleared manually using cutlass and demarcated into experimental units. Thereafter flatbeds and ridges were made using a hoe. NCRIBEN-01M and NCRIBEN-032 (improved varieties) of sesame were sourced from National Cereals Research Institute, Badeggi-Niger State and Jigida (local variety) was sourced from the local farmers. The local variety served as a check.

Sesame seeds were sown at an inter and intra-row spacing of 75 x 5 cm. Sesame seeds were drilled along the ridges (or straight lines on flat land) and thinned to have two plants per stand along the row two weeks after planting (WAP) to give a plant population of 133,333 plants ha^{-1} (Jakusko and Usman, 2013). This permits maintenance of appropriate plant density and also alleviates the attendant problems associated with high-density planting.

2.3 Cultural Practices

Two hoe weedings at 3 and 9 weeks after planting (WAP) were done during the period of the experiments. Soil mounds were built around the plant stands at each weeding. The fertilizer application was done at 2 WAP by band placement in alternate rows.

2.4 Harvesting

Crop harvested from the net plots were used for grain yield determination. Sesame crop was harvested when about 50 % of the capsules turn yellow from green. Harvesting was not delayed to prevent seed loss through shattering. Harvesting was done by cutting the stems with sickles. Harvesting by pulling the plants from the root was avoided to prevent contamination of seeds with sand. After harvesting, the plants were tied with a rope into bundles and positioned in an erected form on a tarpaulin for the capsules to be fully dried.

2.5 Soil Data Collection and Analysis

Before planting, surface (0-15 cm) soil samples were collected from eight points and bulked; post-harvest composite soil samples were also collected based on treatments. The soil samples taken from each plot according to treatment were air-dried; crushed and sieved using a 2 mm sieve and analyzed using standard soil analytical procedures at the Advanced Soil Science Laboratory of the Federal University of Agriculture, Makurdi. Particle size distribution was determined by the Hydrometer method (Bouyocous, 1951). Soil pH was measured with the glass electrode pH meter in soil solution ratio 1: 2 in 0.01 M $CaCl_2$. Soil organic carbon (OC) was determined by the Walkey and Black method. Total N by the macro-Kjeldahl digestion method (Bremner and Mulraney, 1982), Available P was determined by Bray and Kurtz (1945) extraction method. Exchangeable cations were extracted using NH_4OAC solution, K and Na were read using a flame photometer, while Ca and Mg was determined using the Atomic Absorption Spectrophotometer (AAS). Effective cation exchange capacity (ECEC) was established as the summation of the exchangeable cations (K, Na, Ca, Mg) and exchange acidity.

2.6 Crop Data Collection and Analysis

Data were collected for the yield parameters of sesame for both cropping seasons as follows:-

The lengths of ten capsules from each net plot were measured from the bottom of the sesame capsule to the capsule apex using a meter rule and the average value recorded. Five plants in the net plot were sampled, the number of capsules on each plant counted and the average value determined and recorded. 1000 capsules were taken from ten sampled plants per plot and weighed also on a sensitive Mettler top-loading electronic balance (Model P. 1200) the mean weights were then recorded. Ten dry capsules were sampled randomly from each net plot. They were split open and the number of seeds in each capsule counted and average values were recorded. A total of 1000 sesame seeds from each plot were counted and weighed on an electronic top-loading Mettler balance to obtain the weight of 1000 seeds. From the seed yield per plot, seed yield per hectare for each plot was computed by converting it into kilogram per hectare by extrapolation.

Data collected for the yield parameters of sesame for both cropping seasons were subjected to the Analysis of Variance (ANOVA) using Genstat Release 10.3 DE after which significant means were separated using Least Significant Difference (LSD) at 5 % level of probability.

3.0 Results and Discussion

3.1 Soil Physical and Chemical Properties of the Experimental Site before Planting

Selected soil physical and chemical properties of the experimental site before planting are shown in Table 1. The results indicated that soils for both cropping seasons were sandy loam in texture. This texture is ideal for sesame production as sesame require soils that are well-drained for optimum growth and yield. The high sand content of the soils (71.8 and 75.50 %) for 2018 and 2019 respectively was indicative of the low clay content which could be attributed to the soil separates sorting activities by organisms, clay eluviation, and surface soil erosion, parent material or a combination of

these factors (Odunze *et al.,* 2006; Malgwi *et al.,* 2008; Adamu *et al.,* 2010).
The slightly acidic pH of the soils (6.08 – 6.05) also indicates that the soils are suitable for sesame production as this pH range is the optimum pH for most crops and microbial activities in the soil. Bennet (2011) reported that sesame is intolerant of very acidic or saline soils hence the pH obtained from this soil is ideal for optimum sesame production. Very low pH values have a drastic effect on growth, whereas some varieties can tolerate a pH value up to 8 (Naturland, 2002; Akinoso *et al.,* 2010).

The soils were low in essential plant nutrients and organic carbon with the exception of sodium which was moderate when compared with soil fertility ratings by Esu (1991). The poor nutrient status of this soil is characteristic of many tropical soils where the slash and burn practice coupled with high insolation and rainfall prevents the build-up of organic matter which is the storehouse of most nutrients (Anjembe, 2004). This is in line with earlier observations by Aduayi *et al.* (2002) and Senjobi *et al.* (2013) who reported that Nigeria soils are deficient in most nutrients.

3.2 Main Effects of Varieties and Tillage Practices on Selected Soil Properties

The main effects of variety and tillage practices on selected soil properties are presented in Tables 2, 3 and 4. The varieties did not have a significant difference in their effect on most of the soil properties after harvest in 2018 and 2019. The effects of tillage on soil properties also show no significant difference in most of the parameters studied.
Tillage operations are known to influence both the release and conservation of soil nutrients. The effects of tillage practices on nutrients indicated that the zero tilled plots had higher nutrients followed by the flatbeds while the ridged plots had the least available in both years. The higher nutrient status of zero tillage can be attributed to the presence of mulch on the surface due to decomposed plant residues, which led to enhanced soil organic matter status and the associated availability of nutrients (Agbede, 2008). Tillage systems that reduce soil disturbance and residue incorporation have generally been observed to increase soil organic matter content (Mrabet *et al*., 2001). Ismail *et al.* (1994) concluded that conservation tillage systems result in significant and positive effects on several chemical soil properties. Soil organic matter largely contributes to nutrient cycling and thus supplies N, S and other elements as well (Saleque *et al.,* 2009). Several researchers observed an increase of soil organic matter and carbon with conservation tillage practices in the topsoil layer (Bronick and Lal, 2005; Vogeler *et al.,* 2009; Powlson *et al.,* 2012; Schjonning and Tomsen, 2013).

Table 1: Selected Soil Physical and Chemical Properties of the Experimental Site before Planting in Makurdi

Property	**2018**	**2019**
Chemical Property		
pH	6.08	6.50
Organic Carbon (%)	0.52	0.53
Organic Matter (%)	0.90	0.91
Total Nitrogen (%)	0.11	0.12
Available P ($mgkg^{-1}$)	3.90	4.35
Exchangeable Cation ($Cmol\ kg^{-1}$)		
Ca	3.00	2.30
Mg	2.80	2.10
K	0.27	0.31
Na	0.24	0.20
EB	6.31	4.91
EA	1.10	0.90
CEC	7.41	5.81
Base Saturation (%)	85.20	84.51
Particle Size Distribution		
Sand (%)	71.8	75.50
Silt (%)	10.00	9.50
Clay (%)	18.20	15.00
Textural Class	Sandy loam	Sandy loam

In general, tillage improves the decomposition of crop residues by facilitating contact between plant tissue and soil aggregate surfaces, the primary biome of soil microorganisms (Bronick and Lal, 2005). In addition, tillage and organic matter in the soil and improve the availability of nutrients for plant growth through the formation of clay humus complexes and the increase of charged surfaces for nutrient binding. Accumulation of considerable amounts of total nitrogen, phosphorus (P), and potassium with conservation tillage was observed (Calegari *et al.,* 2013; Spiegel *et al.,* 2007). This may be because the land was not disturbed which increased the buildup of soil organic matter, resulting in high organic carbon which reflects a reduced rate of leaching in the soil profile in the soil studied. Tillage systems (zero tillage) that reduce soil disturbance and residue incorporation have generally been observed to increase organic C. Zero tillage have been reported to have resulted in an increase in organic C content which in turn enhances soil quality and resilience (Abid and Lal, 2008). Differences in available N among tillage systems observed in the current study are in agreement with those of other studies (Martin-Rueda *et al.,* 2007). Available N was significantly higher in zero tillage treatment than in the other tillage systems.
Similarly, in a study on Mollisols in Nebraska, available N was significantly greater under zero tillage than conventional tillage (Martin-Rueda *et al.,* 2007). In another study, soil available N content was also significantly increased under

zero or minimum tillage (Martin-Rueda *et al.,* 2007). Higher Nitrogen in the zero tilled soils may be attributed to less loss through immobilization, volatilization, denitrification, and leaching (Malhi *et al.,* 2001). Available P and K as well as other essential nutrient elements were higher under zero treatment probably due to higher soil organic C levels. Zibilske *et al.* (2002) reported that improvement of soil available P was due to redistribution or mining of P at lower soil depths. Also, work done by Redel *et al.* (2007) showed a high amount of P under zero tillage treatment compared to the conventional tillage and have attributed this to an increase in contact time between P and soil particles.

Cultivation also stimulates soil carbon losses due to accelerated oxidation of soil carbon by microbial action. Hence when organic matter is lost the associated nutrients are also lost. Yin and Vyn (2002) also observed more soil nutrients in the case of no-tillage as compared to deep tillage. The least values of essential nutrients recorded by the ridged plots compared with the zero tilled plots could be due to inversion of topsoil during soil preparation, which brought less fertile

Table 2: Main Effects of Varieties and Tillage Practices on Selected Soil Properties in Makurdi

Varieties	BS (%)		CEC (cmol kg^{-1})		Ca (cmol kg^{-1})		EA (cmol kg^{-1})		EB (cmol kg^{-1})		K (cmol kg^{-1})	
	2018	2019	2018	2019	2018	2019	2018	2019	2018	2019	2018	2019
V1	85.26	84.26	7.81	7.74	3.14	3.13	1.15	1.22	6.63	6.52	0.28	0.28
V2	85.38	84.28	7.86	7.61	3.14	3.07	1.15	1.19	6.71	6.41	0.30	0.28
V3	85.33	84.20	7.73	7.74	3.07	3.14	1.13	1.22	6.60	6.52	0.27	0.29
LSD ($P \le 0.05$)	0.73	NS	0.49	NS	0.30	NS	NS	NS	NS	NS	NS	NS
Tillage												
Flat	85.42	84.02	7.86	7.61	3.14	3.07	1.15	1.21	6.72	6.39	0.28	0.29
Ridged	85.32	84.41	7.78	7.84	3.10	3.17	1.14	1.22	6.64	6.62	0.28	0.28
Zero	85.23	84.31	7.75	7.64	3.11	3.08	1.14	1.20	6.58	6.44	0.29	0.28
LSD ($P \le 0.05$)	0.73	NS	0.49	NS	0.30	NS	NS	NS	NS	NS	NS	NS

NS= Not significant, V1 = jigida, V2 = NCRIBEN-01M, V3 = NCRIBEN-032

Table 3: Main Effects of Varieties and Tillage Practices on Selected Soil Properties in Makurdi

Varieties	Mg (cmol kg^{-1})		N (%)		Na (cmol kg^{-1})		OC (%)		OM (%)	
	2018	2019	2018	2019	2018	2019	2018	2019	2018	2019
V1	2.99	2.87	0.077	0.077	0.33	0.24	0.75	0.62	1.29	1.07
V2	3.03	2.83	0.082	0.073	0.48	0.24	0.76	0.57	1.31	0.98
V3	3.02	2.87	0.080	0.077	0.39	0.24	0.69	0.62	1.18	1.06
LSD ($P \le 0.05$)	NS	NS	0.02	NS	NS	NS	0.06	NS	NS	NS
Tillage										
Flat	3.06	2.81	0.079	0.075	0.47	0.23	0.71	0.56	1.23	0.97
Ridged	2.97	2.93	0.076	0.075	0.48	0.24	0.70	0.70	1.21	1.21
Zero	3.01	2.84	0.081	0.076	0.25	0.24	0.78	0.55	1.34	0.94
LSD ($P \le 0.05$)	NS	NS	NS	NS	0.08	NS	0.06	0.05	0.15	0.11

NS= Not significant, V1 = jigida, V2 = NCRIBEN-01M, V3 = NCRIBEN-032

Table 4: Main Effects of Varieties and Tillage Practices on Selected Soil Properties in Makurdi

Varieties	pH		Sand (%)		Clay (%)		Silt (%)	
	2018	2019	2018	2019	2018	2019	2018	2019
V1	6.13	6.32	69.16	69.48	19.08	18.99	11.76	11.81
V2	6.15	6.30	68.47	69.30	19.41	18.56	12.12	12.14
V3	6.14	6.32	68.68	69.23	18.70	18.69	12.51	12.08
LSD ($P \le 0.05$)	NS	NS	NS	NS	NS	NS	NS	NS
Tillage								
Flat	6.14	6.30	68.94	70.00	19.00	18.19	12.04	12.08
Ridged	6.13	6.34	68.72	68.38	18.92	19.84	12.00	11.78
Zero	6.15	6.30	68.65	69.64	19.28	18.20	12.35	12.16
LSD ($P \le 0.05$)	NS	NS	NS	NS	NS	0.67	NS	NS

NS= Not significant, V1 = jigida, V2 = NCRIBEN-01M, V3 = NCRIBEN-032 subsoil to the surface in addition to possible leaching (Ali *et al.,* 2006) as well as rapid mineralization and uptake of nutrients by the crops (Adekiya *et al.,* 2009).

Similarly, Alam *et al.,* (2014) reported that tillage practices showed a positive effect on soil properties and crop yields, Bulk and particles densities were decreased due to tillage practices having the highest reduction of these properties and the highest increase of porosity and field capacity in zero tillage. The highest total N, P, K and S in their available forms was recorded in zero tillage. Therefore, zero tillage was found to be suitable for soil health and achieving the optimum yield of crops.

3.3 Main Effects of Varieties and Tillage Practices on the Yield of Sesame

The main effects of the varieties and tillage practices on the yield of sesame in the 2018 and 2019 cropping seasons are shown in Table 5. Results indicated that the varieties had a significant difference on all the parameters measured except capsule length and number of seeds per capsule and weight of 1000 seeds. There were significant differences in the varieties concerning some of the yield attributes such as the number of capsules per plant, weight of 1000 capsules and 1000 seeds as well as grain yield as a result of the differences in the varieties and apart from the local variety (jigida), the other varieties have been bred for higher yield and other desirable qualities. The number of capsules and yield of the crop were higher in the improved varieties (NCRIBEN-01M and NCRIBEN-032) than in the local variety. NCRIBEN-032 gave a significantly higher yield than the other varieties in the 2018 and 2019 cropping seasons. Chude *et al.* (2012) reported that under farmers' conditions beniseed yield is between 200 and 450 kg ha^{-1} of dry seed. However, up to 500 – 800 kg, ha^{-1} can be obtained by adopting improved practices with a plant population of 25 - 40,000 plants ha^{-1}. The yield obtained in the current study in 2018 was in the range of that reported by Chude *et al.* (2012) and the yield of 700 kilograms per hectare reported by Nigeria's Harvest (2009) but in 2019, the yields were higher than those reported here.

However, the yields obtained in this study in both years were lower than the 2000 kg ha^{-1} reported by Adebowale *et al.* (2010) and Hassen (2011). The variability in yield and yield attributes as influenced by tillage practices in both seasons (Table 5) could be attributed to differences conferred on the soil properties by the different tillage practices. Numbers of capsules per plant, number of seeds per capsule, weights of 1000 seeds and capsules as well as yield were all higher in the ridged plots followed by flatbeds and then the zero tilled plots. The higher yield in ridged plots could be attributed to the fact that tillage greatly affected soil moisture and temperature, which in turn affected plant nutrient dynamics in soil (Ahmed *et al.,* 2009). In improving soil condition, tillage is a key factor and plays a significant role in improving crop growth and yield (Wasaya *et al.,* 2011).

The success or failure of crop production systems depends on the seedbed environment. Generally, tillage improves soil bulk density, water storage capacity and soil penetration. Halvorson *et al.* (2001) and Dinnes *et al.* (2002) reported that tillage operations and soil disturbance can generally cause an increase in soil aeration and nutrient mineralization for crop use. In 2019, results indicated that the performances of the varieties were largely influenced by the type of tillage practice they were grown on. Zero tilled soils gave the least yield of all the tillage practices in both cropping seasons. Zero tilled soils are usually compacted and a compacted soil layer, because of its high bulk density and low porosity confines the crop roots in the upper layer thereby reducing the volume of soil that can be explored by the crop for nutrients and water (Lipiec *et al.,* 2003). The zero tilled plots having the least yield (0.40 t ha^{-1}) could be due to restricted oxygen supply, restricted root hair growth and high concentration of CO_2 in the soil which may be toxic to the roots. The critical limit of CO_2 for most species is between 10 to 20 % (Prohar *et al.,* 2000). Gajri and Majumdar (2002), listed disadvantages of zero tillage to include difficulty in sowing operations, slow rate of organic matter decomposition and pollution problems associated with continuous use of chemical pollution in fields with problematic weeds.

Uzun *et al.,* (2012) reported that the lowest yield of post wheat second crop sesame was recorded for zero-till with a value of 413.0 kg ha^{-1}. This is similar to results obtained in this study where zero tilled plots gave the lowest yields. Senjobi *et al.* (2013) also reported that there was a significant difference in soil parameters among the tillage practices. Their result conforms with the present study where the ridged tillage system resulted in the most favourable soil environment, for crop growth and best performance of crop

Table 5: Main Effect of Varieties and Tillage Practices on the Yield of Sesame in Makurdi

Varieties	**Capsule Length (cm)**		**No. of capsules per plant**		**No. of seeds per capsule**		**Weight of 1000 capsules (g)**		**Weight of 1000 seeds (g)**		**Seed yield (t ha^{-1})**	
	2018	2019	2018	2019	2018	2019	2018	2019	2018	2019	2018	2019
V1	3.01	2.99	13.92	14.47	48.42	68	337.4	370.1	137.19	135.42	0.34	0.43
V2	3.03	3.01	17.89	14.67	59.58	67	379.9	372.0	136.94	138.81	0.54	0.44
V3	3.03	3.02	24.11	14.92	54.94	228	382.5	375.0	139.69	140.67	0.48	0.44
LSD ($P \leq 0.05$)	NS	0.034	3.20	0.93	NS	NS	17.19	6.32	NS	5.023	0.10	NS
Tillage												
Flat	3.98	2.98	18.64	14.06	54.42	67	381.3	363.9	133.17	133.06	0.43	0.45
Ridged	3.03	3.00	23.81	14.67	55.39	68	387.6	372.1	138.53	138.89	0.45	0.48
Zero	2.98	3.05	14.47	15.33	57.14	229	371.8	381.1	122.14	142.94	0.42	0.40
LSD ($P \leq 0.05$)	NS	0.029	4.21	0.80	1.27	NS	7.47	5.48	3.90	4.350	0.014	0.014

NS= Not significant, V1 = jigida, V2 = NCRIBEN-01M, V3 = NCRIBEN-032 followed by flatbed and no-tillage practice in the area studied. The significant difference in yields was adduced to lower bulk density, higher water holding capacity and porosity which increased plant root proliferation and optimal utilization of soil nutrients under ridged plots. Hence ridges can increase production while zero-till is better for sustainable and improved soil properties. The report by Ali *et al.* (2015) was also similar to the results obtained in this study. They reported that tillage practices significantly increased the mean values of crop parameters studied. Yield components were significantly lower in no-tillage than ridge tillage. Grain yields in the no-tillage plots were also lower compared to other tillage methods. This they attributed to reduced vertical root distribution in no-tilled plots, which reduced the soil depth explored by their roots. Similarly, Agber *et al.* (2017) reported that tillage methods significantly affected maize growth and yield and that the lowest yield values were observed in no-tillage plots as compared to ridged and flatbeds.

5.0 Conclusion and Recommendations

Results indicated that the improved varieties performed better than the local variety in terms of yield in both cropping seasons. Ridges produced higher yields followed by flatbeds and then zero tillage in both cropping seasons. The effects of variety on soil properties did not differ significantly however, the improved varieties left lower essential nutrients in soil when compared with the local variety. Zero tillage retained higher nutrients and organic matter in the soil while ridges gave lower values for essential nutrients and organic matter. It can be recommended that sesame should be grown on ridges for sustainable production. For conservation/ retention of essential nutrients and organic matter in the soil, zero tillage is recommended in the study area.

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