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# Yield Of Sesame Varieties and Soil Properties As Influenced By Tillage And Fertilizer In Sudan Savanna Zone Of Nigeria

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## ABSTRACT
Field experiment was conducted to determine the yield of sesame varieties and soil properties as influenced by tillage and fertilizer at the Teaching and Research Farm of Federal College of Education (Tech.) Potiskum, Sudan Savanna Zone of Nigeria. The experiment consisted of three factors at three different levels. The treatments were laid out in a split-split plot in Randomized Complete Block Design (RCBD) with sesame varieties occupying the main plots; tillage practices sub-plots and fertilizer rates sub-sub plots which gave a total of 27 treatments that were replicated thrice. Soil physical and chemical analysis was carried out at the beginning and the end of experiment to see if there was a change in the soil properties after the experiment. Data collected for the yield parameters of sesame were subjected to the Analysis of Variance (ANOVA) after which significant means were separated using Least Significant Difference (LSD) at $P<0.05$. Results showed that 300 kg/ha of NPK fertilizer significantly ($P<0.05$) increased the yield parameters of sesame varieties. Significant yields were obtained from sesame planted on the ridges when compared with those on the surface or zero tillage. Application of 300 kg/ha of NPK fertilizer is recommended for optimum yield of sesame in the study area. Suggestively, sesame crop should be planted on ridges instead of on surface or zero tillage. Ridging as well as application of NPK fertilizer is hereby recommended for an enhanced increase in soil nutrients especially carbon content, CEC, N, Ca, Mg and P level in the study area.
**Keywords:** Sesame varieties; soil properties; tillage; fertilizer; Sudan Savanna Zone

## INTRODUCTION
Sesame (*Sesamum indicum* L.), also called benniseed is one of the most ancient oilseed crop known to mankind in Nigeria (Langham *et al.,* 2008). Sesame is widely grown in the Northern and Central part of Nigeria. Some of the major states involved in the production of sesame are: Adamawa, FCT Abuja, Benue, Borno, Gombe, Jigawa, Kano, Katsina, Kebbi, Kogi, Nasarawa, Plateau, Taraba and Yobe (USAID, 2002; Iorlamen *et al.,* 2014). The sesame seeds serve as ingredients in soup and a source of oil (43 %) (Biswas *et al.,* 2001). The oil is used for cooking, baking, candy making, soaps, lubricant, body message, hair treatment, food manufacture, industrial uses and alternative medicine for blood pressure, aging, stress and tension (Ahmed *et al.,* 2009).
Tillage practices have been reported to have a significant impact on sesame production especially through the improvement of soil properties with attendant provision of a suitable seedbed for good seed germination, easy emergence and good establishment of seedling through enhanced root growth by encouraging vertical and horizontal proliferation of roots through reduction in soil strength (Okeleye and Oyekanmi, 2003; Alam *et al.,* 2014).
The importance of fertilizer as agricultural input cannot be over emphasized, particularly in Nigeria where the nutrient levels of the soils are low (Agbede, 2009; Eifediyi, 2016). Fertilizer has been used to improve the yield of sesame for many years especially in the Sudan and Sahel savanna zone of Nigeria, where it is a sine- qua-non in fertility management because of the inherently low organic matter content of the soils in the region.

Unfortunately, fertilizers in Nigeria are expensive and often inaccessible by the resource poor farmers. This results in a reduction in the rates of chemical fertilization by these farmers (Ojeniyi *et al.,* 2016). In order to achieve the desired goal of the sesame producers, it therefore becomes imperative to study the effect of tillage practices as well as fertilizer rates on the yield of sesame. In order to increase the production of this crop, there is need for adoption of appropriate tillage practices as well as sound fertilizer recommendations that would ensure optimum yield of sesame varieties.

In Nigeria, optimum sowing dates, seed rates and weeding regimes have been studied in different locations within the northern guinea savanna (Ahmed *et al.,* 2009). But there is no adequate information on the optimum fertilizer rates and appropriate tillage practices for this crop in the Sudan savanna Nigeria. The recent increase in awareness, production and cultivation of sesame in the Sudan savanna Nigeria has therefore, necessitated the need to determine its yield response to tillage, soil properties and fertilizer rates in the zone.

This research therefore was undertaken to assess the yield of sesame varieties and soil properties as influenced by tillage practices and fertilizer rates with the objectives to:

1. Determine appropriate fertilizer rate that will be suitable for optimum production of sesame in the study area;
2. Establish the appropriate tillage practice(s) that will be suitable for sesame production;
3. Determine the effect of fertilizer on soil physical and chemical properties in the study area.

## MATERIAL AND METHODS

The experiment was conducted during 2018 cropping season at the Teaching and Research Farm of the Department of Agricultural Science Education, Federal College of Education (Technical), Potiskum, Sudan Savanna Zone of Nigeria to determine the yield of sesame varieties and soil properties as influenced by tillage practices and fertilizer rates in the study area.

Potiskum location falls within the Sudan Savanna Zone of Nigeria with mean rainfall of about 800 mm per annum and temperature of 39-42 0C. It is located between latitude 110 42' N to 110 43' N and longitude 110 04' E to 110 06' E (YSGN, 2008). The site had not been cultivated for about two years. The two vegetation zones in Yobe State are the Sahel in the North and the Sudan Savanna in the Southern part where Potiskum is located.

The experiment consisted of three factors at different levels. Sesame varieties were at three levels (E-8, NCRIBEN-01M and NCRIBEN-032 or Goza-25), tillage practices were also at three levels (zero tillage, surface tillage and ridges) while fertilizer rates were at three levels (0 kg/ha, 150 kg/ha and 300 kg/ha of NPK 15:15:15). The treatments were laid out in a split-split plot in Randomized Complete Block Design (RCBD) with sesame varieties occupying the main plots, tillage practices sub-plots and fertilizer rates sub-sub plots which gave a total of 27 treatments that was replicated thrice resulting to a total of 81 treatment plots/combinations on a land area of 1586m$^2$.

Planting was done on 15$^{th}$ August, 2018. E-8, NCRIBEN-01M and NCRIBEN-032 or Goza-25 varieties of sesame were sourced from National Cereals Research Institute, Badeggi-Niger State. 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 three 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. The fertilizer application was done at 2 WAP by band placement in alternate rows. Crop harvested from the net plots were used for grain yield determination. Sesame crop was harvested when about 50 % of the capsules turn yellow in colour from green.

The Pre-planting soil samples and soil samples taken from each plot according to treatments after harvest and the composite were analyzed for particle size distribution, pH, Organic Carbon, Total Nitrogen, Available phosphorus and exchangeable cations [$Mg^{2+}$, $Ca^{2+}$, $N^{a+}$ and $K^+$ as well as Cation Exchange Capacity (CEC)] at the Soil Science Departments of University of Maiduguri, Borno State and University of Agriculture, Makurdi, Benue State respectively. Data collected for the yield parameters of sesame varieties 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.

**RESULTS AND DISCUSSION**

The results of pre-planting soil analysis are presented on Table 1. The results indicate a poor soil fertility status that requires fertilizer application to replenish nutrients taken out from the soil through crop harvest and to supplement nutrients to boost yields (Olatunji and Ayuba, 2012). The values of SOM (0.95 %) falls below the average range of 2.5- 2.6 % considered for good crop growth (Prasad and Singh, 2000).

The results of physical and chemical properties of soil at the experimental site after crop harvest are presented on Table 2. The pH of the soil after crop harvest decreased in all the treatment plots but increased with the application of 300 kg/ha NPK fertilizer on zero tillage plots. The use of NPK fertilizer increased SOM. The soil organic matter was consistently low in zero tillage plots with zero application of NPK fertilizer. The total nitrogen status of the soil increased with increased application of NPK fertilizer (150 and 300 kg/ha). In the same vein, the available P was depleted in zero fertilizer treated plots. A higher build up of available P was observed on plots with the application of 300 kg/ha NPK fertilizer followed by 150 kg/ha NPK fertilizer. Similar trend was observed with the exchangeable bases. A higher build up of Mg and K was also observed on plots with the application of NPK fertilizer. The ECEC of the soil was affected by addition of inorganic fertilizer.

The results of the effects of tillage and fertilizer on yield of sesame are presented on Table 3. The ridge as a method of tillage was observed to have increased soil porosity and soil organic matter contents compared to zero tillage. Soil organic carbon content also showed slight increase in most tilled sesame plots. The results also indicated that sesame had lowest yields under zero tillage compared with those cultivated on the surface or ridges.

All the parameters studies were significantly ($P<0.05$) affected by the application of fertilizer irrespective of the varieties. This means sesame variety had no significant ($P<0.05$) effect on yield components. Higher yield components of sesame were recorded under 300 kg/ha NPK fertilizer on ridges. The number of capsules per plant, 1000 capsules weight and seed yield increased with incremental rate of NPK fertilizer application. The zero NPK treatment gave the least yield components assessed. The interaction effect of variety, tillage and fertilizer was not significant on the yield components assessed (Table 4).

The results of the pre-planting soil analysis (Table 1) thus indicated that soil amendment was required in line with earlier observation by Agboola (1975) who reported that farmers in Africa requires adequate soil amendment for good crop production as a result of low inherent soil fertility. The pH of the soil after crop harvest (Table 2) decreased in all the treatment plots but increased with the application of 300 kg/ha NPK fertilizer on zero tillage plots. The increase in soil pH can be adduced to addition of high inorganic fertilizer and also consistent with the findings of Chukwu *et al.,* (2012) who reported that application of 300 kg/ha of NPK fertilizer could lead to increase in soil pH in the south eastern Nigeria. The decrease in the pH of the tilled plots ( surface and ridges) with low application of inorganic fertilizer could be attributed to complete decomposition of organic matter as a result of enhanced activities of soil micro organisms and low level of inorganic fertilizer application (Agbede, 2009).

The use of NPK fertilizer also increased soil organic matter (Table 2). The SOM was consistently low in zero tillage plots with zero application of NPK fertilizer. This can be attributed to the absence of NPK fertilizer which would have enhanced the decomposition of organic matter in the soil. According to Plaster (1992), organic matter content of the soil can be maintained through incorporation of crop residues and NPK fertilizer. The total nitrogen status of the soil increased with increased application of NPK fertilizer (150 and 300 kg/ha). The increase in N content of the soil was observed on plots with addition of NPK fertilizer and this can be adduced to release of N from its composition which further enhanced soil microbial activities as a result of increased concentration of nutrients (Adeniyan and Ojeniyi, 2003). The depletion in total N observed on the zero tillage and zero fertilizer treatment plots may be attributed to nutrient up take by component crops and absence of fertilizer application.

In the same vein, the available P was depleted in zero fertilizer treated plots. The depletion may be attributed to uptake of the nutrients by sesame crop and probably due to fixation of the element which usually occurs at low soil pH (Brady and Weil, 2007). A higher build up of available P was observed on plots with the application of 300 kg/ha NPK fertilizer followed by 150 kg/ha NPK fertilizer. Similar trend was observed with the exchangeable bases. The release of nutrients to the soil by NPK fertilizer application most probably explains the increase in Mg and K. The increases in Mg and K upon application of NPK fertilizer have been reported by Adeniyan and Ojeniyi (2003). The ECEC of the soil was affected by addition of inorganic fertilizer (Table 2). This is an indication that soils with high organic matter content will have high ECEC as reported by Plaster (1992) and Agbede (2009). This observation is consistent with Brady and Weil (2007) who reported that inorganic fertilizer application significantly ($p<0.05$) increased ECEC of soils.

The ridge as a method of tillage was observed to have increased soil porosity and soil organic matter contents compared to zero tillage (Table 3). Fan *et al.*, (2006) reported increased in soil porosity after tillage due to increased root biomass. This may be partly attributed to the stimulatory effect of living roots on microbial activities that enhancing soil organic matter decomposition (Cheng and Coleman, 1990). Soil organic carbon content also showed slight increase in most sesame plots. These changes are considered favourable as decrease in bulk density favours aeration and water storage. Sesame crop grown on zero tillage conditions may have experienced soil compactness which impeded the acquisition of both water and nutrients and growth of roots. Soil disturbance by tillage practices increased porosity and penetrability thus allowing roots to have better access to water and nutrients (Fan *et al.,* 2006). Carlesso *et al.*, (2002) also reported that crops yield components were high when cultivated under ridge or surface tillage as a result of improved access to soil moisture than zero tillage. However, the present results indicated that sesame had lowest yields under zero tillage compared with those cultivated on the surface or ridges. It is probable that deep root growth was more enhanced by planting on a ridge or surface than on zero tillage.

Tillage methods showed significant increase in mean number of all crop parameters studied, though yield parameters were significantly lower in zero tillage than ridge tillage (Table 3). Seed yields in the zero tilled plots were also lower compared to surface and ridged tillage method. This may be partly attributed to reduced vertical root distance in no-tilled plots, which reduced the soil depth explored by crop roots. This indicated that certain stress prevailed in zero tilled plots (Scopel *et al.*, 2001) that must have led to the poor performance of crop. Scopel *et al.,* (2001) also observed significantly higher yields of crops under ridge tillage than zero tillage, and noted that the yield response to tillage methods depended on the agro-ecological zone and the rainfall pattern during crop growth. Tillage-based soil management practices usually have relatively little effects on soil water contents at planting (Unger *et al.*, 1998). Soza *et al.*, (2000) and Emerson (2003) reported that the yield level under the zero tillage and ridge tillage was dependent upon the production technologies in terms of fertilizer input use and other practices adopted. This observation is in agreement with this study where 150 and 300 kg/ha of fertilizer significantly ($P<0.05$) gave higher yield of sesame crops.

All the parameters studies were significantly ($P<0.05$) affected by the application of fertilizer irrespective of the varieties (Table 3). Higher yield components of sesame were recorded under 300 kg/ha NPK fertilizer on ridges. The number of capsules per plant, 1000 capsules weight and seed yield increased with incremental rate of NPK fertilizer application. The increased in seed yield for all the three varieties was due to the positive effects of fertilizer applications on the yield components (number of capsules per plant, 1000 capsules weight). This observation is consistent with that of Jakusko and Usman (2013) who reported that increase in grain yield of sesame is as a result of positive response of the crop to 300 kg/ha of NPK fertilizer in the North eastern Nigeria. Sesame variety had no significant ($P<0.05$) effect on most yield components. Similar reports on other oil crop like soybean have been observed by some researchers (Mandimba and Mondibaye, 1996; Osunde *et al.*, 2004). The results of the present investigation showed that sesame crop benefited more from the highest fertilizer rate (300 kg/ha) in the growing season, hence corroborate above reports. The zero NPK treatment gave the least yield components assessed. The interaction effect of variety, tillage and fertilizer was not significant on the yield components assessed (Table 4).

## CONCLUSION

A field experiment was conducted during 2018 cropping season at the Teaching and Research Farm of the Federal College of Education (Technical) Potiskum in Sudan Savanna Zone of Nigeria to determine the yield of sesame varieties and soil properties as influenced by tillage practices (zero, surface and ridge) and fertilizer rates (0, 150 and 300 kg/ha of NPK 15:15:15). From the results obtained from the study, higher yields were obtained from crops cultivated on ridges as a result of improved access to soil moisture and nutrients than on zero tillage. Application of fertilizer significantly ($P<0.05$) increased the yield of the sesame crop when compared with those plots with zero application of fertilizer. The highest sesame yields were obtained from application of 300 kg/ha.

The higher values of soil pH, organic matter, total nitrogen and exchangeable cations are an indication that soil fertility can be improved by application of NPK fertilizer for agricultural production in the study area. Tillage practices were observed to have a significant and positive impact on sesame production especially through the improvement of soil properties with attendant provision of a suitable seedbed for good seed germination and reduction in soil strength in the sub-soil. Based on the results obtained, application of 300 kg/ha of NPK fertilizer is recommended for optimum yield of sesame in the study area. Sesame crop should be grown on ridges instead of on zero tillage to improve the acquisition of both water and nutrients by the plants. Ridging as well as application of NPK fertilizer in sesame production system is a viable option for optimum yield and is hereby recommended to enhance increased soil nutrients especially carbon content, CEC, N, Ca, Mg and P level in the study area.

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**Table 1: Soil Physical and Chemical Properties of the Experimental Site before Planting at Potiskum (2018)**

| **Property** | **2018** |
|---|---|
| **Chemical Property** | |
| pH $H_2O$ (1:2.5) | 6.96 |
| pH KCl (1:1) | 6.65 |
| Organic Carbon (%) | 0.55 |
| Organic Matter (%) | 0.95 |
| Total Nitrogen (%) | 0.17 |
| Available p (mgkg$^{-1}$) | 3.15 |
| **Exchangeable Cation (Cmol Kg$^{-1}$)** | |
| $Ca^{2+}$ | 3.00 |
| $Mg^{2+}$ | 2.80 |
| $K^{+}$ | 0.24 |
| $Na^{+}$ | 0.03 |
| TEB | 6.07 |
| ECEC | 6.21 |
| EA | 0.20 |
| EC (dSm$^{-1}$) | 0.01 |
| Base Saturation (%) | 96.81 |
| **Particle size Distribution** | |
| Sand (%) | 57.10 |
| Silt (%) | 23.20 |
| Clay (%) | 19.70 |
| Textural Class | Sandy loam |

**Table 2: Physical and Chemical Properties of Soil at the Experimental Site at Potiskum after Crop Harvest (2018)**

| | Particle Size Distribution | | | | pH | | Org | Org | | Bray-1 | Exch. Cations | | (CmolKg$^{-1}$) | | | Base |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Treatments | Sand | Silt | Clay | Textural | $H_2O$ | KCl | C | M | N | P | Ca | Mg | K | Na | CEC | Saturation |
| /Plot | (%) | (%) | (%) | Class | 1:1 | 1:1 | (%) | (%) | (%) | (mgkg$^{-1}$) | | | | | | (%) |
| $T_1$ | 76.6 | 11.0 | 12.4 | Sandy Loam | 6.60 | 5.88 | 0.95 | 1.64 | 0.080 | 3.00 | 3.07 | 1.40 | 0.25 | 0.60 | 6.12 | 87.90 |
| $T_2$ | 72.3 | 12.4 | 15.3 | Sandy Loam | 6.50 | 5.70 | 0.88 | 1.90 | 0.077 | 4.20 | 3.29 | 1.51 | 0.26 | 0.65 | 6.40 | 89.10 |
| $T_3$ | 76.2 | 11.2 | 12.6 | Sandy Loam | 6.65 | 5.90 | 0.90 | 1.56 | 0.070 | 3.50 | 3.01 | 1.30 | 0.21 | 0.52 | 6.10 | 88.60 |
| $T_4$ | 77.6 | 11.2 | 11.2 | Sandy Loam | 6.45 | 5.65 | 0.74 | 1.80 | 0.091 | 3.10 | 2.96 | 1.26 | 0.21 | 0.50 | 5.80 | 87.40 |
| $T_5$ | 77.5 | 11.3 | 11.2 | Sandy Loam | 6.60 | 5.85 | 0.90 | 1.56 | 0.077 | 4.60 | 2.77 | 1.30 | 0.23 | 0.48 | 5.20 | 90.20 |
| $T_6$ | 71.8 | 11.2 | 17.0 | Sandy Loam | 6.65 | 5.90 | 0.92 | 1.75 | 0.088 | 4.00 | 3.80 | 1.60 | 0.30 | 0.71 | 6.00 | 86.70 |
| $T_7$ | 73.3 | 13.0 | 13.7 | Sandy Loam | 6.40 | 5.60 | 0.80 | 1.81 | 0.097 | 2.90 | 2.84 | 1.28 | 0.24 | 0.55 | 5.40 | 89.40 |
| $T_8$ | 72.1 | 14.0 | 13.9 | Sandy Loam | 6.70 | 5.95 | 0.87 | 1.87 | 0.091 | 3.30 | 3.57 | 1.37 | 0.26 | 0.58 | 6.22 | 88.50 |
| $T_9$ | 71.4 | 13.5 | 15.1 | Sandy Loam | 6.45 | 5.65 | 0.77 | 1.88 | 0.079 | 4.50 | 3.11 | 1.40 | 0.22 | 0.50 | 6.30 | 87.60 |
| $T_{10}$ | 72.0 | 12.4 | 15.6 | Sandy Loam | 6.75 | 5.96 | 0.91 | 1.89 | 0.070 | 3.70 | 3.46 | 1.55 | 0.24 | 0.57 | 6.50 | 89.30 |
| $T_{11}$ | 65.4 | 15.4 | 19.2 | Sandy Loam | 6.58 | 5.90 | 0.86 | 1.73 | 0.090 | 3.60 | 4.12 | 1.70 | 0.30 | 0.76 | 6.70 | 90.40 |
| $T_{12}$ | 69.6 | 13.1 | 17.3 | Sandy Loam | 6.71 | 5.94 | 0.93 | 1.72 | 0.086 | 3.10 | 3.85 | 1.54 | 0.27 | 0.69 | 6.52 | 88.80 |
| $T_{13}$ | 65.2 | 15.4 | 19.4 | Sandy Loam | 6.53 | 5.77 | 0.80 | 1.38 | 0.077 | 4.00 | 4.00 | 1.80 | 0.33 | 0.75 | 6.80 | 87.90 |
| $T_{14}$ | 73.5 | 13.0 | 13.5 | Sandy Loam | 6.48 | 5.70 | 0.73 | 1.26 | 0.088 | 3.80 | 3.08 | 1.40 | 0.24 | 0.43 | 6.27 | 89.00 |
| $T_{15}$ | 75.2 | 13.5 | 11.3 | Sandy Loam | 6.60 | 5.93 | 0.91 | 1.57 | 0.080 | 3.50 | 2.71 | 1.20 | 0.20 | 0.40 | 5.10 | 90.30 |
| $T_{16}$ | 65.1 | 15.4 | 19.5 | Sandy Loam | 6.40 | 5.70 | 0.88 | 1.69 | 0.077 | 2.90 | 4.20 | 1.86 | 0.33 | 0.75 | 6.77 | 87.80 |
| $T_{17}$ | 67.2 | 15.2 | 17.6 | Sandy Loam | 6.55 | 5.86 | 0.86 | 1.66 | 0.091 | 3.30 | 4.11 | 1.81 | 0.31 | 0.68 | 6.60 | 88.10 |
| $T_{18}$ | 72.4 | 12.6 | 15.0 | Sandy Loam | 6.59 | 5.83 | 0.83 | 1.65 | 0.070 | 3.10 | 3.75 | 1.50 | 0.29 | 0.56 | 5.90 | 86.50 |
| $T_{19}$ | 76.6 | 11.0 | 12.4 | Sandy Loam | 6.62 | 5.88 | 0.94 | 1.64 | 0.080 | 3.00 | 3.07 | 1.40 | 0.25 | 0.60 | 6.12 | 87.90 |
| $T_{20}$ | 77.6 | 11.3 | 11.2 | Sandy Loam | 6.60 | 5.85 | 0.90 | 1.56 | 0.077 | 4.60 | 2.77 | 1.30 | 0.23 | 0.48 | 5.20 | 90.20 |
| $T_{21}$ | 65.1 | 15.4 | 19.5 | Sandy Loam | 6.40 | 5.70 | 0.88 | 1.69 | 0.077 | 2.90 | 4.20 | 1.86 | 0.33 | 0.75 | 6.77 | 87.80 |
| $T_{22}$ | 76.2 | 11.2 | 12.6 | Sandy Loam | 6.65 | 5.90 | 0.90 | 1.56 | 0.070 | 3.50 | 3.01 | 1.30 | 0.21 | 0.50 | 5.80 | 87.40 |
| $T_{23}$ | 72.0 | 12.4 | 15.6 | Sandy Loam | 6.75 | 5.96 | 0.91 | 1.89 | 0.070 | 3.70 | 3.46 | 1.55 | 0.24 | 0.57 | 6.50 | 89.30 |
| $T_{24}$ | 69.6 | 13.1 | 17.3 | Sandy Loam | 6.71 | 5.94 | 0.93 | 1.72 | 0.086 | 3.10 | 3.85 | 1.54 | 0.27 | 0.69 | 6.52 | 88.80 |
| $T_{25}$ | 71.8 | 11.2 | 17.0 | Sandy Loam | 6.65 | 5.90 | 0.92 | 1.75 | 0.088 | 4.00 | 3.80 | 1.60 | 0.30 | 0.71 | 6.00 | 86.70 |
| $T_{26}$ | 72.1 | 14.0 | 13.9 | Sandy Loam | 6.70 | 5.95 | 0.87 | 1.87 | 0.091 | 3.30 | 3.57 | 1.37 | 0.26 | 0.58 | 6.22 | 88.50 |
| $T_{27}$ | 72.3 | 12.4 | 15.3 | Sandy Loam | 6.50 | 5.70 | 0.88 | 1.90 | 0.077 | 4.20 | 3.29 | 1.51 | 0.26 | 0.65 | 6.40 | 89.10 |

**$T_1$** = $V_2T_1F_0$, **$T_2$** = $V_2T_0F_1$, **$T_3$** =$V_2T_2F_1$, **$T_4$** = $V_1T_1F_2$, **$T_5$** = $V_1T_2F_0$, **$T_6$** = $V_1T_0F_1$, **$T_7$** = $V_3T_0F_0$, **$T_8$** = $V_3T_0F_1$, **$T_9$** = $V_3T_1F_0$, **$T_{10}$** = $V_1T_2F_0$, **$T_{11}$** = $V_1T_2F_1$, **$T_{12}$** = $V_1T_0F_1$, **$T_{13}$** = $V_3T_1F_0$, **$T_{14}$** = $V_3T_1F_1$, **$T_{15}$** = $V_3T_2F_0$, **$T_{16}$** = $V_2T_1$F1, **$T_{17}$** = $V_2T_0F_1$, **$T_{18}$** = $V_2T_2F_2$, **$T_{19}$** = $V_1T_2F_2$, **$T_{20}$** = $V_1T_2F_1$, **$T_{21}$** = $V_1T_1F_2$, **$T_{22}$** = $V_2T_1F_1$, **$T_{23}$** = $V_2T_1F_1$, **$T_{24}$** = $V_2T_2F_2$, **$T_{25}$** = $V_3T_2F_2$, **$T_{26}$** = $V_3T_2F_2$, **$T_{27}$** = $V_3T_1F_2$

**$V_1$** = E-8, **$V_2$** = NCRIBEN-01M, **$V_3$** = NCRIBEN-O32 (Goza-25), **$T_0$** = Zero Tillage, **$T_1$** = Surface Tillage, **$T_2$** = Ridging, **$F_0$** = 0kg/ha, **$F_1$** = 150kg/ha and **$F_2$** = 300kg/ha NPK 20:10:10

**Table 3: Main Effects of Variety, Tillage and Fertilizer on Yield of Sesame at Potiskum (2018)**

| **Variety** | Capsule Length | No. of capsules per plant | No. of seeds per capsule | Weight of 1000 capsules | Weight of 1000 seeds | Seed yield (Kg/ha) | Seed yield (t/ha) |
|---|---|---|---|---|---|---|---|
| V1 | 3.21 | 72.10 | 52.69 | 420.94 | 221.31 | 781.20 | 0.78 |
| V2 | 3.21 | 70.90 | 52.53 | 421.47 | 220.61 | 784.70 | 0.78 |
| V3 | 3.20 | 74.70 | 54.92 | 421.72 | 222.92 | 767.40 | 0.77 |
| LSD ($P \leq 0.05$) | NS | NS | 1.49 | NS | 1.63 | NS | NS |
| **Tillage** | | | | | | | |
| Surface | 3.21 | 73.00 | 53.67 | 423.33 | 220.75 | 786.50 | 0.79 |
| Ridged | 3.36 | 83.90 | 57.83 | 429.14 | 229.53 | 861.10 | 0.86 |
| Zero | 3.06 | 60.80 | 48.64 | 411.67 | 214.56 | 685.80 | 0.69 |
| LSD ($P \leq 0.05$) | 0.053 | 5.72 | 2.02 | 3.19 | 3.97 | 39.55 | 0.04 |
| **Fertilizer** | | | | | | | |
| F1 | 3.07 | 59.60 | 43.85 | 408.41 | 209.81 | 696.80 | 0.70 |
| F2 | 3.16 | 66.60 | 50.74 | 417.22 | 215.67 | 747.70 | 0.75 |
| F3 | 3.22 | 73.40 | 56.11 | 424.26 | 224.07 | 784.70 | 0.78 |
| LSD ($P \leq 0.05$) | 0.063 | 6.08 | 2.78 | 3.44 | 4.03 | 33.95 | 0.03 |

**Table 4: Interaction Effect of Variety, Tillage and Fertilizer on the Yield of Sesame at Potiskum (2018)**

| Variety | Tillage | Fertilizer | Capsule Length | No. of capsules per plant | No. of seeds per capsule | Weight of 1000 capsules | Weight of 1000 seeds | Seed yield (Kg/ha) | Seed yield (t/ha) |
|---|---|---|---|---|---|---|---|---|---|
| V1 | Surface | F1 | 3.20 | 63.30 | 42.33 | 416.67 | 206.67 | 791.70 | 0.79 |
| | | F2 | 3.17 | 75.30 | 54.33 | 417.67 | 214.67 | 750.00 | 0.75 |
| | | F3 | 3.17 | 64.30 | 55.00 | 423.67 | 221.00 | 750.00 | 0.75 |
| | Ridged | F1 | 3.27 | 63.00 | 44.67 | 420.33 | 216.00 | 791.70 | 0.79 |
| | | F2 | 3.23 | 73.30 | 54.67 | 421.00 | 218.67 | 833.30 | 0.83 |
| | | F3 | 3.40 | 86.70 | 62.67 | 431.67 | 234.33 | 895.80 | 0.90 |
| | Zero | F1 | 2.90 | 52.70 | 41.00 | 387.33 | 204.00 | 562.50 | 0.56 |
| | | F2 | 3.03 | 65.00 | 43.00 | 412.00 | 209.33 | 645.80 | 0.65 |
| | | F3 | 3.07 | 63.30 | 49.00 | 413.33 | 217.67 | 666.70 | 0.67 |
| V2 | Surface | F1 | 3.07 | 67.70 | 47.67 | 413.00 | 208.00 | 750.00 | 0.75 |
| | | F2 | 3.20 | 65.30 | 47.67 | 417.33 | 216.67 | 750.00 | 0.75 |
| | | F3 | 3.20 | 75.70 | 56.00 | 426.00 | 220.33 | 833.30 | 0.83 |
| | Ridged | F1 | 3.23 | 65.00 | 46.33 | 414.00 | 217.33 | 770.80 | 0.77 |
| | | F2 | 3.30 | 66.30 | 50.67 | 425.00 | 217.33 | 854.20 | 0.85 |
| | | F3 | 3.37 | 81.30 | 59.67 | 433.00 | 231.33 | 854.20 | 0.85 |
| | Zero | F1 | 2.83 | 51.70 | 41.33 | 396.67 | 203.33 | 541.70 | 0.54 |
| | | F2 | 3.07 | 63.00 | 47.00 | 410.33 | 213.33 | 708.30 | 0.71 |
| | | F3 | 3.10 | 64.00 | 49.67 | 417.33 | 216.33 | 708.30 | 0.71 |
| V3 | Surface | F1 | 3.17 | 60.00 | 44.33 | 415.00 | 212.00 | 750.00 | 0.75 |
| | | F2 | 3.03 | 64.30 | 48.33 | 418.00 | 215.00 | 687.50 | 0.69 |
| | | F3 | 3.17 | 81.70 | 59.67 | 425.00 | 228.67 | 770.80 | 0.77 |
| | Ridged | F1 | 3.13 | 63.30 | 47.67 | 416.00 | 211.33 | 750.00 | 0.75 |
| | | F2 | 3.33 | 68.00 | 61.67 | 424.33 | 226.67 | 812.50 | 0.81 |
| | | F3 | 3.37 | 81.70 | 58.33 | 431.67 | 226.67 | 854.20 | 0.85 |
| | Zero | F1 | 2.87 | 50.00 | 39.33 | 396.67 | 209.67 | 562.50 | 0.56 |
| | | F2 | 3.03 | 59.00 | 49.33 | 409.33 | 209.33 | 687.50 | 0.69 |
| | | F3 | 3.13 | 62.00 | 55.00 | 416.67 | 220.33 | 729.20 | 0.73 |
| | LSD ($P \leq 0.05$) | | NS | NS | NS | NS | NS | NS | NS |

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