East African Scholars Journal of Agriculture and Life Sciences
Abbreviated Key Title: East African Scholars J Agri Life Sci
ISSN 2617-4472 (Print) | ISSN 2617-7277 (Online) |
Published By East African Scholars Publisher, Kenya

OPEN ACCESS

Volume-2 | Issue-6 | Jun-2019 |

Research Article

Response of Sesame (*Sesamum indicum* L) to Sowing Methods and Fertilizer Types on Degraded Soil of Southern Guinea Savanna Agroecological Zone, Nigeria

E. Ndor[1] and I.U.Nasir[1]

[1]Department of Crop Production Technology, College of Agriculture, Lafia Nasarawa, State, Nigeria

*Corresponding Author
E. Ndor

Abstract: The experiments were conducted during 2015 and 2016 rainy seasons; to determine the effect of sowing methods, NPK fertilizer and poultry manure on the performances of sesame (SesamumindicumL) in degraded soil of southern guinea savanna agroecological zone, Nigeria. The treatments consisted of two planting methods: (dibbling and broadcasting) three levels of NPK fertilizer: (0, 60 and 120 kg ha^{-1}) and three levels of poultry manure :(0, 2.5 and 5 t ha^{-1}) which were factorially combined and laid in a Randomized Complete Block Design (RCBD) and replicated three. The results showed that dibbling produced sesame plants that are significantly higher in number of leaves (68.34, 78.53); higher number of branches (17.46, 19.23) and also the tallest plants of 86.84cm and 97.46cm in both 2015 and 2016 cropping seasons. Application of 120 kg ha^{-1} of NPK fertilizer significantly gave rise to plants with highest number of leaves (72.68 and 80.48); tallest plants (103.42cm and 115.23cm) and highest number of branches (15.05 and 15.96), in both years of cropping. Also, application of 5 t ha^{-1} of poultry manure significantly produced the highest number of branches (75.63 and 89.24); tallest plant (112.34cm and 118.56cm) and highest number of branches (15.08 and 16.26). Dibbling produced significantly higher number of 65.12 and 69.58 flowers per plant and highest number of capsules (62.24 and 65.21) per plant. Also, seed yield of 896.45 kg ha^{-1} and 923.34 kg ha^{-1} of sesame in both cropping seasons. Application of 120 kg ha^{-1} of NPK fertilizer produced the highest number of 62.45 and 63.21 sesame flowers per plant; 59.42 and 60.12 higher number of capsule per plant and highest seed yield of 891.24 and 898.78 kg ha^{-1} compared to other fertilizer rates in 2014 and 2015 cropping season. Also, application of 5 t ha^{-1} of poultry manure produced significantly higher grain yield of 948.45 and 992.28 kg ha^{-1}compared with other level of applied manure. Interaction between NPK fertilizer and poultry manure did not produced any significant effect on all the growth and yield parameters of sesame assessed in both years of cropping.

Keywords: Response, Sesame, fertilizer, poultry manure, degraded soil.

INTRODUCTION

Sesame (*Sesamum indicum*L) is a crop grown in many parts of the world for its quality oil, insecticidal and medicinal properties as well as for its cosmetic and ornamental values. In Nigeria, sesame is widely grown in the middle belt. This area accounts for about 90% annual 00export of sesame in Nigeria (Anon., 2002).In most African countries especially Nigeria, sesame is usually sown after a main crop, on relatively poor soils, resulting in low yields of about 300 kg ha^{-1} (Okpara et. al., 2007) compared with 1960 kg ha^{-1} in Venezuela; 1083 kg ha^{-1} in Saudi Arabia and 517 kg ha^{-1} in Ivory Coast (Abubuakar *et al.*, 1998).

In modern agronomic practices of crop production, sowing method and fertilizer applications are imperative for boosting the growth and production of crops especially under rain fed conditions. Most of the peasant small holder sesame farmers generally use the broadcast method of sowing for sesame production, because of the ease of planting and absence of proper equipment for planting. This method is bedeviled with uneven distributions of seeds, and seed lying scattered in the open surface which can be picked up by birds. Also Sevgi *et al.*, (2004) reported that broadcast sowing obstruct mechanization during further management practices. Planting technique not only ensures proper

Quick Response Code

Journal homepage:
http://www.easpublisher.com/easjals/

Article History
Received: 15.04.2019
Accepted: 28.05.2019
Published: 16.06.2019

DOI: 10.36349/easjals.2019.v02i06.004

adjustment and optimum plant population in the field, but also enables the plants to utilize the land and other inputs more efficiently and resolutely towards growth and yield. Improved planting method has a great role to play in increasing sesame yield.

Sesame yields in Nigeria remained very low compared to other countries of the world (Abubakar *et al.,* 1998). This is because in Nigeria, sesame is cultivated on marginal and sub-marginal lands with poor fertility, under rainfed conditions and most cases without any nutrients supplement. Rapid depletion of soil nutrients and poor physical condition of the savanna soils constitute a strong limitation to crop production (Salako, 2003). Therefore, these soils must be supplemented with adequate macronutrients in other to keep them productive (Ndor *et al.,*; 2012).However, the shortage and high cost of inorganic fertilizers have limited their use for crop production among the peasant farmers in Nigeria. Also, chemical fertilizers alone generate several deleterious effects to the environment. This is because; the synthetic fertilizer is rapidly lost by either evaporation or by leaching in drainage water which causes serious environmental pollution (Aisha et el., 2009). Hence, organic manures can serve as alternative to mineral fertilizers for improving soils structure (Dauda *et al.,* 2008). Therefore, there is the need for increased dependence on the use of organic waste such as farmyard manure, crop residues and poultry manure for crop production. Survey reports have shown that fertilizers are not applied to sesame even in major sesame growing areas of Nigeria. This view is also upheld by these scientists (Shehu *et al.,* 2009; Haruna, 2011; Haruna and Abimiku, 2012; Jakusko, 2013; Jakusko and Usman, 2013 and Iorlamen *et al.,* 2014) who recently x-rayed the contributions of both organic and inorganic fertilization on growth and yield of sesame in Nigeria. However, out of these research works only few were conducted on degraded soils of southern guinea savanna agroecological zone which is one of the sesame producing area. Therefore, this study is aimed at evaluating the effect of sowing methods and different fertilizer types and rates on growth and yield of sesame on degraded soil of Lafia.

MATERIALS AND METHODS

Climate Conditions

The experiment was conducted during 2015 and 2016 rainy season at the research and teaching farm of the college of agriculture, Lafia, Nasarawa state, Nigeria. The study area fallswithin southern guinea savanna agroecological zone of Nigeria, and is located between Latitude08.33 N and Longitude 08.32 E. Rainfall usually starts from Aprils – October and the average monthly rainfall figures ranges from 40 mm-350mm. The months of July and August usually records heavy rainfall. The daily maximum temperature ranges from 20.0ºC – 38.5ºC and daily minimum ranges from 18.7ºC – 28.2ºC. The months of February to early April are the months that have the highest maximum temperature while the lowest maximum temperature months are recorded in December and January because of the prevailing cold harmattan wind from the northern part of the country at this period. The relative humidity rises as from April to a maximum of about 75- 90 percent in July (NIMET, 2016).

Soil and Vegetation Conditions

The soil type of the study area composed of highly leached Altisols with low base saturation. The soil is strongly acidic and has high content of iron and Aluminum oxides hence reddish brown in colour with very low organic matter content and low total nitrogen and available phosphate. The vegetation of the study area is that of the southern Guinea Savanna with interspersion of thicket, grassland, trees, fringing woodlands or gallery forest along the streams. The natural vegetation of the area is made up of grasses and some traces of scattered wild and economic trees like *Vittellaria paradoxa* (Shear butter tree); *Parkia*s pp (locust bean tree); *Gmelina* arborea (beechwood); *Anacadium* spp (Cashew trees); *Magnifera indica* (Mango). These trees usually shed off their leaves in the long dry season to conserve the available water.

Experimental Design and Data Collection

The treatments consisted of two sowing methods (broadcasting and dibbling),three levels of 0NPK (0, 60 and 120Kgha$^{-1)}$ and three levels of poultry manure (0, 2.5 and 5t ha^{-1}) which were factorially combined and laid in a Randomized Complete Block Design (RCBD) and replicated three times to form fifty four plots. The plot size was 3 m by 4 m plots and 1 m between replicates. The soil data for this study were collected from soil samples at the depth of 15 cm from experimental plots before planting for analysis. The land was cleared, ploughed and harrowed. Poultry manure was incorporated and allowed for two weeks before Yandev 55 sesame seed variety was sown by broadcasting and dibbling at a spacing of 70cm X15cm inter and intra row spacing on the field. Four weeks after sowing (4WASs) NPK fertilizer was applied. Weeds were control by hand hoeing and insect pest were controlled using sprayed with karate 5EC. The following parameters [number of leaves, number of branches, plant height (cm), number of pods/plant, fresh pod weight/plant, seed weight/plant, seed weight/plot and seed weight/ha were assessed in both years.

Data Analysis

The data collected were subjected to analysis of variance using GENSTAT, and where there is a significant difference; the means were separated using F-LSD at 5% probability level

RESULTS

Soil and Manure Analysis

The soil of the experimental site was low in most of the plant nutrient elements, implying that the soil is low infertility. In 2016, however there was an improvement which may be attributed to the residual

effect of the manure applied in the previous year. The soil was very low in nitrogen, phosphorus, potassium, organic carbon and the same with cation exchange capacity (Table 1). Also, the soil was slightly acidic in nature (6.08, 6.10); high in sand fraction (85.00, 84.00) and also very high in base saturation (87.00, 90.39) in both 2015 and 2016 cropping seasons. The chemical analysis of the poultry manure used in both cropping season (Table 2) showed that the manure used in 2016 was superior in nutrients compared to the one used in 2015.

Table1. Laboratory analysis of soils at 0-30cm before cropping in both years

Properties	2015	2016
Mech. Composition		
Clay (%)	11.6	12.6
Silt	3.4	3.4
Sand	85.0	84.0
TCL (USD)	SL	SL
Chemical composition		
pH(H2O)	6.08	6.10
pH(0.01MKCl2)	6.00	5.44
T N%	0.04	0.07
% OC	0.64	0.86
% O M	1.10	1.48
Avail. P(ppm)	4.57	12.29
K($mgkg^{-1}$)	0.31	0.38
Mg($cmolkg^{-1}$)	1.78	1.28
Ca($cmolkg^{-1}$)	3.41	4.83
Na($cmolkg^{-1}$)	0.67	0.42
Al + H(acidity)	0.83	0.76
CEC($cmolkg^{-1}$)	6.17	7.91
%Base Saturation	87.00	90.39

Table2. Chemical composition of the poultry manure used during the study

% Chemical properties	2015	2016
N	3.14	3.89
P	0.48	0.59
K	4.95	5.34
Ca	5.52	5.65
Mg	0.45	0.56
Na	0.32	0.30
OC	45.90	49.23

Growth Parameters of Sesame

Sowing methods, NPK fertilizer and Poultry manure significantly increased all the growth parameters of sesame assessed in both years of cropping (Table 3). Dibbling produced sesame plants that have higher number of leaves (68.34, 78.53); higher number of branches (17.46, 19.23) and also the tallest plants of 86.84cm and 97.46cm respectively compare to broadcast method of seed sowing in both 2014 and 2015 cropping seasons. Application of 120 kg $ha^{-1}$of NPK fertilizer gave rise to highest number leaves (72.68 and 80.48); tallest plants (103.42cm and 115.23cm) and highest number of branches (15.05 and 15.96), which are statistically at par with application of 60 $kgha^{-1}$ of NPK fertilizer in both years of cropping. Also, application of 5 t ha^{-1} of poultry manure produced the highest number of branches (75.63 and 89.24); tallest plant (112.34cm and 118.56cm) and highest number of branches (15.08 and 16.26), which are also statistically the same with application of 2.5 t ha^{-1} of poultry manure in 2015 and 2016 cropping seasons.

Table 3: Effect of sowing methods and fertilizer types on growth parameters of sesame at five weeks after sowing (WAS)

Treatments	Number of leaves	Number of leaves	Plant height (cm)	Plant height (cm)	Number of branches	Number of branches
	2015	2016	2015	2016	2015	2016
Sowing methods						
Broadcasting	51.23	62.54	79.32	85.45	15.85	17.95
Dibbling	68.34	78.53	86.84	97.72	17.46	19.23
LSD(0.05)	2.34	3.21	3.56	3.78	1.21	1.23
NPK (kg)						
0	46.38	54.32	68.75	72.85	13.22	13.34
60	58.21	68.29	84.34	97.46	14.89	15.25
120	72.68	80.48	103.42	115.23	15.56	15.96
Poultry manure(t)						
0	43.64	52.47	72.45	73.32	13.02	13.08
2.5	59.52	67.35	91.34	97.45	14.45	14.95
5	75.63	89.24	112.34	118.56	15.08	16.26
LSD(0.05)	10.12	11.56	15.87	1.23	1.05	1.45
Interaction						
NPK X PM	NS	NS	NS	NS	NS	NS

Yield Parameters of Sesame

The result showed that sowing methods, NPK fertilizer and poultry manure had a significant increased on all the yield parameters of sesame assessed in both years of cropping (Table 4). Dibbling produced significantly higher number of 65.12 and 69.58 flowers per plant, 62.24 and 65.21 highest numbers of capsules per plant. Also, seed yield of 896.45 kg ha^{-1} and 923.34 kg ha^{-1} of sesame in both cropping seasons. Application of 120 kg ha^{-1} of NPK fertilizer produced the highest

number of 62.45 and 63.21 sesame flowers per plant; 59.42 and 60.12 higher number of capsule per plant and highest seed yield of 891.24 and 898.78 kg ha^{-1}compared to other fertilizer rates in 2015 and 2016 cropping season. Also, application of 5 t ha^{-1} of poultry manure produced significantly higher grain yield of 948.45 and 992.28kg ha^{-1}compared with other level of applied manure in all the years of cropping.

Table 04: Effect of sowing methods and fertilizer types on yield parameters of sesame at harvest

Treatments	No. of flower/plant	No. of flower/plant	No. of capsule/plant	No. of capsule/plant	Seed yield/ha (kg/ha)	Seed yield/ha (kg/ha)
	2015	2016	2015	2016	2015	2016
SM						
Broadcasting	56.24	60.34	51.45	54.42	726.24	785.65
Dibbling	65.12	69.58	62.24	65.21	896.45	923.34
LSD(0.05)	4.56	5.48	3.78	4.43	45.68	56.22
NPK (kg)						
0	49.56	48.87	45.68	46.69	623.56	642.14
60	56.98	58.12	52.54	56.47	755.34	786.89
120	62.45	63.21	59.42	60.12	891.24	898.78
PM(t)						
0	50.68	50.32	48.78	49.56	654.43	682.75
2.5	60.42	64.65	56.34	60.22	874.25	915.43
5	65.68	69.73	63.75	66.85	948.45	992.82
LSD(0.05)	2.24	3.01	3.65	3.11	43.21	48.54
Interaction						
NPK X PM	NS	NS	NS	NS	NS	NS

SM=Sowing Method; PM= Poultry Manure

DISCUSSION

The soil of the experimental site was low in most of the plant nutrient element examined (Table 01). This means that the soil is already exhausted due to intensive and continuous cultivation without adequate application of replenishment measures to sustain it productivity. This finding is in tandem with the results obtained by Ndor and Iorkua (2013).The superior performance of dibbling sowing method in both growth and yield of sesame may be attributed to even distribution of plant in the field that enhances the efficient utilization of the soil nutrients and moisture with minimal tendency for competition by the plants. This result agrees with the finding of Sevgi *et al.*, (2004) who reported higher seed yield of sesame when planted in row compare to broadcasting method. This result also corroborated the findings of Husain *et al.*, (1989) who reported that wider spacing produced more healthy plant because each plant had enough space for nutrients, soil moisture and light interception; whereas, at broadcast planting, the distance between two plants may be very close. However, a contrary results was reported by Goranchand *et al.*, (1990) who observed that maximum yield was obtained in close spacing of crops. The positive response of sesame to NPK fertilizer application may be attributed to the state of the soil (i.e degraded soil). Therefore, when NPK fertilizer is applied there was a spontaneous response by the crop. This agrees with the earlier findings of Ogbonna and Obi(2000).Poultry manure significantly improved both growth and yield of sesame, because apart from supplying plant nutrient elements to the soil, poultry manure also improves the soil physical properties which enhanced crop growth and development (Ndor *et al.*, 2013). This results is in consonant with the finding of (Haruna 2011).There is presently the advocacy for organic farming which provides quality and safe products as an alternative to conventional practices involving use of inorganic fertilizers and other agrochemicals which are implicated for a number of environmental degradation problems.

CONCLUSSION

From this study, it can be concluded that dibbling planting method, could be the best planting method for sesame and 120kgha^{-1}NPK fertilizer and 5tha^{-1} of poultry manure the optimal fertilizer levels for a good growth and environmentally friendly production of sesame in degraded soil of southern guinea savanna agroecological zone, Nigeria. However, further locational trials should be conducted within the zone to confirm this result.

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