

Evaluation of Sesame (*Sesamum indicum*) for Optimum Nitrogen Requirement Under Usual Farmers' Practice of Basal Organic Manuring in the Savanna Ecoregion of Nigeria

Peter Akintoye Babajide* and Oyeyemi Raphael Oyeleke
Department of Crop Production and Soil Science, Ladoke Akintola University of Technology,
PMB 4000, Ogbomoso, Nigeria.

* Email of Correspondence author: akinbabajide@yahoo.com / pababajide@lautech.edu.ng

Abstract

Nitrogen is a great determinant of crop growth and consequently farmers' crop yield. Hence, its roles become indispensable and cannot be substituted in crop and animal productions. Unfortunately, its availability, volatilization, leaching losses, toxic nitrate pollution etc. become a serious tropical problem, as being aggravated by improper soil management practices and incorrect nitrogen applications. However, obtaining a reliable information regarding the most suitable dosage of nitrogen required to supplement the pre-existing 'ploughed-in' or 'buried-in' organic residues (as commonly practiced by farmers), for optimum performance of sesame in the study area is reasonable. Such information is crucial, particularly in the areas of proper recommendation of nitrogen fertilizer, for efficient crop production as well as promotion of environment-friendliness in the use of chemical fertilizers. Greenhouse experiment was conducted to determine the response of sesame to eight levels (0, 20, 40, 60, 80, 100, 120 and 140 kg N ha⁻¹) of urea application. The trial was arranged in completely randomized design (CRD), replicated nine times. All the treatments were equally fortified with basal application of decaying plant residues found on the farmland, at two weeks before sesame propagation. Data collected on growth and yield parameters were analyzed using ANOVA at $p < 0.05$. Basal application of the pre-existing plant residues alone cannot successfully and sustainably enhance sesame performance in the study area. Growth significantly increased with increasing dosage of urea application till 80 kg N ha⁻¹. Moreso, uptake of nitrogen (N) did not significantly ($p < 0.05$) increase with increasing application rate of nitrogen particularly at > 80 kg N ha⁻¹. Application of 80 kg N ha⁻¹ resulted in optimum growth and yield parameters of sesame. Application of 80 kg N ha⁻¹ significantly ($p < 0.05$) enhanced uptake of most nutrients and produced the highest oil contents. Nitrogen application > 80 kg N ha⁻¹ significantly enhanced uptakes of micronutrients particularly manganese and zinc. There was a significant decline in the percentage of oil content produced as the levels urea application were above 80 kg N ha⁻¹. Application of 80 kg N ha⁻¹ is therefore adequate and recommended for improved performance of sesame and soil quality in the area investigated.

Keywords: Sesame, Nitrogen, Organic manure, Savanna ecoregion, Yield, Nutrient uptake

1. Introduction

Sesame (*Sesamum indicum*) belongs to the family Pedaliaceae. The genus consists of about thirty six species of which the most commonly recognized is *Sesamum indicum* L., popularly known as beniseed in Nigeria (Alegbejo *et al.*, 2003). It is an erect, flowering annual plant which grows 50 to 250 cm tall or more, as determined by the soil or environmental conditions and varieties (Sharma, 2005). Sesame is usually propagated by seeds and matured in 70 - 150 days after sowing, depending on the varieties (Indu and Savithri, 2003). Flowering commences 38-45 days after sowing and stops at 70-120 days after sowing (Langham and Wiermeers, 2006). Although sesame is ranked relatively amongst the drought-tolerant crops, but can die in standing water (Weiss, 2000; Ray *et al.*, 2004). The precise natural origin of species is unknown but numerous wild relatives are occurring mostly in Africa and a smaller number found in India (Ashri, 1998). It is believed to have originated from the tropical Africa where the greatest genetic diversity exists but was believed to have been introduced to India at a very early date, where a secondary center of diversity is well developed (Alegbejo *et al.*, 2003; Olaoye, 2007). Its cultivation is now extended beyond the tropical and subtropical zones to temperate and sub-temperate zones of the world (Ali *et al.*, 2000; Boureima *et al.*, 2007). It is widely naturalized in the tropical region around the world and cultivated primarily for its tiny edible seed containing 25 % protein and about 50 % oil (Weiss, 2000; Langham and Wiermeers, 2006). It is now widely cultivated in the derived, northern and southern guinea, Sudan and Sahel savannas of Nigeria (Alegbejo *et al.*, 2003). Sesame utilization includes human consumption, health treatments, beautification, livestock feeding and industrial uses (Sharma, 2005; El-Habbasa *et al.*, 2007).

Nitrogen is the most dynamic nutrient element and becomes the first limiting nutrient as land use intensifies (Tiessen *et al.*, 2003; Lafond *et al.*, 2003; Akanbi *et al.*, 2005). It is taken up in the highest amount by crops and its role in plants cannot be easily substituted (Olaniyi and Akanbi, 2008). Its supply in the soil is the most important factor limiting growth and yield (Akanbi, *et al.*, 2000; Akanbi, 2002). Increases in N supply

within limits are associated with increase in leaf area and weight, carboxylases and chlorophyll content, all of which determine the photosynthetic activities of leaf and ultimately dry matter production and allocation to the various organs of a plant (Akanbi *et al.*, 2006). Photosynthetic rate and leaf surface area increase with increase in nitrogen levels (Tiessen *et al.*, 2003; Akanbi *et al.*, 2005). Muchow and Sinclair (1994) obtained a high correlation between high saturation and leaf assimilation rate and nitrogen per unit area, and a reduction in photosynthetic rate of C₄ plants when N supply decreased. Leaf N concentrations and photosynthetic activity are positively correlated (Muchow and Sinclair, 1994). Nitrogen has been found to increase grain number and dry matter and many field experiments have shown responses in grain yield of maize to the application of N fertilizers (Akanbi, 2002). Nitrogen supply has been shown to affect both leaf area development and leaf senescence and, consequently, crop radiation interception. The duration of vegetative growth (from sowing to silking) was lengthened where no N was applied, the duration of grain filling (silking to maturity) was less sensitive to N supply (Akanbi, 2002). Application of N had been found to enhance growth and yield components in field-grown maize. Ulger *et al.*, (1997) reported an enhancement in the development of ear diameter, kernel depth, grain/stover ratio, number of ear per plant, plant height and dry matter production with increase in nitrogen rate. Furthermore, Sibale and Smith (1997) obtained a significant influence of N on number of kernels per ear. They reported increase number of kernels per ear with increased N rates. Application of N has been reported to significantly increase fruit yield of Okra (Katung *et al.*, 1996; Ali *et al.*, 2006). Apart from increasing fruit yield, N application also enhance the production of large sized fruits and improved fruit quality (Ali *et al.*, 2006; Olaniyi and Akanbi, 2008). Nitrogen also has effect on vegetative, phenological development and seed production of okra (Akanbi, 2002). Significant increase in plant height and number of leaves per plant of N fertilized maize plant was reported by Akanbi *et al.* (2001). They attributed their observations to the influence of N on production of protoplasm, cell division and its effect on size and morphology of chloroplast. All these culminated in luxuriant plant vegetative parts development (Abad *et al.*, 1997; Akanbi *et al.*, 2000). Days to 50% flowering and other fruit yield attributes could be influenced by N application. For instance, Sharma *et al* (1996) reported significant delay in fruit set with N application. This was linked to the effect of N on luxuriant vegetative growth at the expense of reproductive growth. Katung *et al* (1996) observed significant increase in percent fruit set, number of fruit plant⁻¹, fruit fresh weight plant⁻¹ and yield in okra when N level was raised from 0.0 to 100.0 kg ha⁻¹. This was attributed to the better development of vegetative parts in fertilized okra plants over non-fertilized ones. This enhanced synthesis and transportation of photosynthates from the source to the reproductive parts resulting in significant increase in number and weight of fruits (Ali *et al.*, 2006; Akanni and Ojeniyi, 2007).

It is not uncommon to observe that local farmers usually amended their soils by plant and animal residues, farmyard manure, green manure and compost, for improving crop productivity and soil physico-chemical properties (Cooperband, 2002; Babajide *et al.*, 2012). However, these organic resources which are often proposed as alternatives to inorganic or mineral fertilizers cannot solely and effectively reverse the degraded soil fertility conditions, particularly in the tropics, because of the facts that, they are; (a) rapidly 'decomposing and vanishing', due to the effects of the climatic elements such as high temperature, torrential rainfall, high solar radiation etc. (b) mostly low in nutrient concentrations (c) insufficient in quantity to meet up with the requirements of crops on most farmlands (d) labour-demanding, in terms of drudgery involved in preparation / processing and even application and (e) mostly versatile and thereby having competitive uses in the aspects of mulching, fuel, fodder, demarcation of boundaries, fencing, staking, building, medicine and erosion control (Peter *et al.*, 2000; Indu and Savithri, 2003; Chukwuka and Omotayo, 2009; Babajide *et al.*, 2012).

Nitrogen is a critical element having significant roles in crop production. Therefore, it requires proper management in the modern crop production in order to alleviate its high level of volatilization and leaching losses from farmlands, particularly in the tropics where rainfall is torrential and solar radiation is very high. In recent times, manifestation of the ill-effects of blanket application of chemical fertilizer are of great concern, particularly in the areas of toxic nitrate pollution of underground waters, eutrophication, soil acidity, poor soil moisture, poor yield, abnormally high soil temperature and harmful residual effects on beneficial soil microbes, plants and animals alike (Sobulo, 2000; Conte *et al.*, 2001; Tejada *et al.*, 2005; Olabode *et al.*, 2007). Besides, chemical fertilizers are unaffordable, particularly for the resource-poor farmers (Nziguheba *et al.*, 2002; Chukwuka and Omotayo, 2008). Amongst all the inputs required to be applied in order to enhance soil productivity, application of nitrogenous fertilizer materials is ranked first (Hansen *et al.*, 2000; Akanbi *et al.*, 2005). The base element of all biological cells starts with nitrogen and its role can't be substituted in crop production. Nitrogen contributes up to 50% of all the nutrient inputs. This contribution/requirement makes nitrogen a great determinant of farmers' crop yield (Hansen *et al.*, 2000; Akanbi, 2002). However, nitrogen is one of the most critical elements needed to be carefully managed in the modern crop production simply because of its indispensable roles in crop production as well as the high level volatilization and leaching losses from farmlands (as attributed to its defective availability and supply), particularly in the tropics where rainfall is torrent coupled with excessively intense solar radiation. In recent times, accelerated manifestation of the ill-

effects of incessant blanket application of chemical fertilizer had been reported to become a great concern and indeed a fatal threat to man, particularly in the areas of toxic nitrate pollution of underground waters, eutrophication, soil acidity, poor soil moisture, poor yield, abnormally high soil temperature and harmful residual effects on beneficial soil microbes, plants and animals alike (Allen and Gretchen, 2002; Tejada *et al.*, 2005; Olabode *et al.*, 2007). Therefore, the objective of this investigation was to determine the most efficient rate of nitrogen application required for improved sesame (*Sesamum indicum* L.) performance and enhanced environment-friendliness and soil quality in the area investigated.

2. Materials and methods

2.1 Brief Description of the Experimental Location

This research was conducted between July and October, 2008 at the Teaching and Research Farms, Ladoko Akintola University of Technology (LAUTECH), Ogbomoso, in Oyo state, Nigeria, to assess response of sesame to different rates of N-mineral fertilizer, under degraded / continuously cropped soil conditions. Ogbomoso (latitude 8° 10' N and longitude 4° 10' E), is located under the southern guinea savanna ecoregion of Nigeria. The location is well known for its attributed grassland which is extensively distributed. Also, it is characterized by bimodal rainfall distribution pattern in which the early rainy season commences in late March and ends in late July / early August, but a short dry spell in August follows immediately. After these, the late rainy season finally commences from August to November. The experimental site had been under continuous cultivation of intercropped arable crops (maize, cassava, guinea corn, yam and okra), for six years, before the commencement of experiment.

2.2 Soil Sampling and Analyses

The soil sample used was an Alfisol belonging to Egbeda soil series (Smyth and Montgomery, 1962). Collection of soil samples was carried out using soil auger at a depth of 0-15 cm, for laboratory analyses of the soil physical and chemical properties. Samples were bulked into a composite sample. The sample was then air-dried, crushed and sieved through 2mm and 0.5mm meshes for the determination of particle size, pH (H₂O), total nitrogen (N), organic carbon, available phosphorus (P), the exchangeable cations (Ca, Na, Mg, and K). The Particle size analysis was carried out according to the Bouyoucos (1951) hydrometer method using sodium hexamataphosphate as the dispersant. Soil pH was determined in a 1:1 soil: water ratio and 2:1 soil: KCl ratio (IITA, 1982). Total N was determined by the macro-Kjedahl method (Bremner, 1965) and colorimetric determination by Technicon Autoanalyser (1971). Phosphorus and exchangeable cations were determined by Mehlich 3 extraction (Mehlich, 1984). Phosphorus was determined colorimetrically using the Technicon AAII Auto-analyser, while the cations were determined using Atomic Absorption Spectrophotometer (Model Buck 200A). Olsen P was determined by extraction with sodium bicarbonate (Olsen *et al.*, 1954). Organic carbon was determined by chromic acid digestion (Heanes, 1984).

2.3 Land Clearing, Experimental Design and Filling of Pots

These were carried out manually, following farmers' conventional practice, using hoe, cutlass, mattock, rake, e. t. c. A total of Eight treatments representing different levels of urea application (0, 20, 40, 60, 80, 100, 120 and 140 kg N ha⁻¹) were introduced. The trial was arranged in completely randomized design (CRD), replicated nine times. The total number of pots used for each experiment was 8×9 = 72. Each pot was filled with 10kg soil.

2.4 Propagation, Fertilizer Application and Maintenance of Sesame

Sesame seeds of variety E8 were surface sterilized by using 95% ethanol for 10 seconds and later rinsed six (6) times with sterile water after shaking for three to five minutes in 3% hydrogen peroxide (H₂O₂). Four seeds were sown in each pot. Emerged seedlings were later thinned to one per pot, at one week after sowing (WAS). Plant residues found on the farm site were incorporated into each pot as basal manure application at two weeks before sowing. Urea fertilizer (46% N), was used as the only inorganic nitrogen (N) source, obtained from the Oyo State Agricultural Development Programme (OYSADEP), Ogbomoso. Split application of urea was done at four weeks after sowing (4 WAS) and seven weeks after sowing (7 WAS). Regular watering was maintained when necessary. Pots were manually weeded by careful hand pulling of all the emerging weed seedlings from the pots on weekly basis.

2.5 Data Collection

The growth parameters determination commenced at 6 WAS. The growth parameters measured were plant height using measuring tape placed at the base of the main stem of the plant to the tip, stem girth by using calipers, the value obtained was later converted to stem girth using a formula πD (where $\pi = 3.142$ and $D =$ diameter), number of branches was determined by direct counting of all developed branches per plant and the number of leaves was also determined by direct counting of all fully opened leaves per plant. Fully ripe capsules were carefully plucked. Number of capsules per plant was then determined by direct counting. Weight of 1000 seeds per treatment was also determined by direct counting and weighing of randomly selected 1000 seeds per treatment, followed by total seed yield converted from the seed yield obtained (from 2.5 by 2.0 m²) at spacing of

50 cm by 25cm (Fathy and Mohammed, 2009).

2.6 Post-harvesting Handlings of Plant Samples and Analyses

The experiment was terminated at 14 weeks after sowing (WAS). Plants were harvested by cutting the stem at the ground level and the roots were carefully uprooted. After harvesting, all shoots and roots were oven dried at a temperature of 80 °C to a constant weight for five days, for dry weight determination of the total biomass yield and to determine the nutrient concentrations (Akanbi *et al.*, 2005). The nutrients accumulated in plant parts were calculated as; Nutrient uptake = % Nutrient content x sample dry weight according to Ombo (1994) and Gungunla (1999).

2.7 Data Analysis

All data collected were analyzed following the procedures of analysis of variance (ANOVA) at $p < 0.05$. Significant means were separated using Duncan Multiple Range Test (DMRT), using SAS, (2008).

4. Results and Discussions

4.1 Soil Characteristics

The followings were inferred from the results of pre-cropping chemical and physical analyses of the soil samples used: The soil was mildly acidic with pH (H₂O) value of 6.40 (Table 1). The soil was texturally a sandy-loam, with sand (81.02 %), silt (10.08 %) and clay (9.00 %). Also, it was very low in terms of the concentrations of essential nutrients particularly N, and P with total N (0.08 %), extractable P Bray 1 (1.31 mgkg⁻¹) respectively. Organic carbon level was 3.96 (%), while the exchangeable bases (in cmol kg⁻¹) were K⁺ (0.22), Ca²⁺ (7.70), Mg²⁺ (2.92) and Na⁺ (0.24). Also, the values of micro nutrient levels were: Fe (11.10 mg kg⁻¹), Cu (2.39 mg kg⁻¹) and 2.71 mg kg⁻¹ for Zn (Table1). All these were in line with the findings from earlier researchers like Babajide *et al.*, (2008) and Olaniyi and Akanbi, (2008), who reported that the study area was grossly low in essential nutrient concentrations and therefore required better nutrient management approaches, for efficient crop production.

4.2 Rainfall Distribution

The results of rainfall distributions obtained from the studied location showed a strictly bimodal rainfall distribution pattern i.e. having two peaks of rainfall, suitable for two rain-fed sesame productions per year (i.e. early and late seasons). However, erratic rainfall frequencies were recorded throughout the experimental period. The highest mean of rainfall was recorded at the onset of the experiment in July (318.60mm), which later reduced to 226.30mm in the following month i.e. August (Table 2). The rainfall rose again in the month of September to 270.30mm and later fell to 224.50mm in the month of October, when the experiment was terminated (Table 2). All these results revealed that the rainfall distributions and frequencies in the area investigated were inconsistent and hence, suitable soil management practices that will ensure proper soil moisture conservation and maintenance of soil organic matter are required. Such practices encourage adequate soil moisture and nutrient conservation, in order to support general crop performance, as coined out in the research reports of Olabode *et al.*, (2007); Olaniyi and Akanbi, (2008) and Babajide *et al.*, (2012).

4.3 Growth Parameters of Sesame Under Improved Nitrogen Nutrition

Application of nitrogenous fertilizer significantly improved plant height of sesame. Plant height of sesame increased with increasing rate of N-fertilizer application (Table 3). Application of 80 kg N ha⁻¹ had significantly ($p < 0.05$) higher plant height but the values were not significantly different from those obtained from application of 100 kg N ha⁻¹, followed by 120 kg N ha⁻¹ and 140 kg N ha⁻¹ (Table 3). The control had the least values of plant height. Application of 80 kg N ha⁻¹ produced significantly higher number of leaves, compared to other fertilizer treatments tested, while the control had the least (Table 3). Significantly higher value of stem girth or circumference was observed in plants which received 120 kg N ha⁻¹ but the value obtained was not significantly different from those which received applications of 80 and 100kg N ha⁻¹ (Table 3). Although, the values of stem circumference reduced significantly ($p < 0.05$) at 140 kg N ha⁻¹, but the value recorded was significantly higher than those of the control and 20, 40 and 60 kg N ha⁻¹. Application of 80 kg N ha⁻¹ had significantly ($p < 0.05$) higher number of sesame branches, compared to all other fertilizer treatments tested (including the control which had the least value). These results are in agreement with the earlier researchers who reported increased growth parameters of crops with increased nitrogen application (Akanbi, 2002; Ali *et al.*, 2006; Olaniyi and Akanbi, 2008; Babajide *et al.*, 2012).

4.4 Yield Parameters of Sesame Under Improved Nitrogen Nutrition

Improved nitrogen nutrition significantly improved sesame yield parameters. Application of 100 kg N ha⁻¹ produced significantly higher number of capsules per plant, but the value was not significantly ($p < 0.05$) different from that of 80 kg N ha⁻¹ (Table 4). Although significant ($p < 0.05$) reduction was observed in the number of capsules per plant of sesame, at an application rate of 140 kg N ha⁻¹, but the value obtained was significantly ($p < 0.05$) higher than the control (Table 4) and other fertilizer treatment rates of below 80 kg N ha⁻¹. Application of 80 kg N ha⁻¹ produced the significantly ($p < 0.05$) higher value of 2.8g for weight of 1000 seeds, compared to all other treatments tested (Table 4). The control had the least seed weights of 2.1g (Table 4).

Urea application significantly ($p < 0.05$) improved sesame seed oil content, compared to the control. Application of 80 kg N ha^{-1} produced the highest oil contents of 46.1 %, which was not significantly different from the value obtained from application of 100 kg N ha^{-1} (Table 4). The control had the least content of sesame seed oil (Table 4).

Application of N-mineral fertilizer significantly improved sesame total seed yield (Fig. 1). The significantly ($p < 0.05$) higher total seed yield of 2.5 tons ha^{-1} was obtained from application of 80 kg N ha^{-1} , which is comparable to all other fertilizer treatments tested (Fig. 1). The total seed yield was significantly increasing from $20 - 80 \text{ kg N ha}^{-1}$, after which it declined steadily till 140 kg N ha^{-1} (Fig. 1). Application of 80 kg N ha^{-1} produced significantly higher value of total biomass production, which was not significantly different from that of 100 kg N ha^{-1} but higher than the other fertilizer treatments investigated (Fig. 2). The control had the least value of the total biomass production (Fig. 2). Nitrogen was earlier reported by many researchers to be a great determinant of crop yield. Its application significantly increased fruit quality and quantity (Katung *et al.*, 1996; Ali *et al.*, 2006; Olaniyi and Akanbi, 2008). Moreso, the significant decrease observed in sesame yield parameters particularly above nitrogen requirements limit of 80 kg N ha^{-1} has adequately corroborated the findings of Akanbi, (2002) and Akanbi *et al.* (2006), who reported that; increases in N supply within limits are only associated with increase in crops growth and yield, including the leaf area and weight, carboxylases and chlorophyll content, all of which determine the photosynthetic activities of leaf and ultimately dry matter production. These results were also in agreement with the reports of Akintunde *et al.* (1993) and Akintoye *et al.* (1998) who reported that when application of nitrogen is excessive crop growth and development may not be significant and may even diminish, thus creating a decline in the nitrogen use efficiency (NUE).

4.5 Nutrient uptakes of Sesame Under Improved Nitrogen Nutrition

Urea application significantly enhanced uptake of nutrients in sesame (Table 5). Nitrogen uptake increased with increasing levels of N-fertilizer application only from $20 - 80 \text{ kg N ha}^{-1}$, after which it declined significantly till 140 kg N ha^{-1} (Table 5). Almost similar trend was observed in P and K uptakes (except that, the significantly higher value obtained at 80 kg N ha^{-1} application level, was not significantly different from those of 100 and 120 kg N ha^{-1} for P and 100 , 120 and 140 kg N ha^{-1} for K), as indicated in Table 5. Also, Ca, Mg and Na uptakes increased with increasing levels of urea application (Table 5). Application of 80 kg N ha^{-1} had significantly ($p < 0.05$) higher values of these three basic cations (Ca, Mg and Na) but the values were not significantly different from those obtained from 100 and 120 kg N ha^{-1} for Ca and Mg, while no significant differences were observed in the treatment means of Na uptake (Table 5). Dissimilar trend of nutrient uptakes was observed in Fe and Cu. The uptakes of Fe and Cu increased with increasing dosages of urea applied till 80 kg N ha^{-1} application level, when it declined insignificantly till 120 kg N ha^{-1} (Table 5). At 140 kg N ha^{-1} , significantly lower values of Fe and Cu uptakes were observed, which were significantly higher than the control and other fertilizer treatment values lesser than 80 kg N ha^{-1} (Table 5). However, application of 140 kg N ha^{-1} had significantly higher values of Mn and Zn uptakes (Table 5). The values obtained were not significantly different from those recorded for the application of 100 and 120 kg N ha^{-1} (Table 5). Application of 80 kg N ha^{-1} had significantly lower values of Mn and Zn, uptakes, which were not significantly different from all other fertilizer treatments tested (except the control), as indicated in Table 5. These results were in agreement with the reports from the research findings of Akanbi *et al.* (2000); Dare, (2008); Gungunla, (1999), which emphasized that plant vegetative growth, development nutrient uptakes are influenced by nutrient availability particularly nitrogen, which improved as the rates of application increased. Also, these results support the findings of Akintunde *et al.* (1993) and Akintoye *et al.* (1998) who reported that, increasing nitrogen rate significantly decreased nitrogen use efficiency (NUE) and that crop performance and nutrient uptakes tend to reduce significantly when nitrogen application becomes excessive.

Table 1: Pre-cropping Chemical and Physical Properties of the Soil Sample Used

PROPERTIES	VALUES
pH (H ₂ O)	6.40
Organic C (%)	3.96
Total N (%)	0.08
Extractable P Bray 1(mg kg ⁻¹)	1.31
Fe (mg kg ⁻¹)	11.10
Cu (mg kg ⁻¹)	2.39
Zn (mg kg ⁻¹)	2.71
Exchangeable K ⁺ (cmolKg ⁻¹)	0.22
Exchangeable Na ⁺ (cmolKg ⁻¹)	0.24
Exchangeable Ca ²⁺ (cmolkg ⁻¹)	7.70
Exchangeable Mg ²⁺ (cmolkg ⁻¹)	2.92
Sand (%)	81.02
Silt (%)	10.08
Clay (%)	9.00
Textural class	Sandy loam

Table 2: Amount and Distribution of Rainfall at the Experimental Location in 2008

Months	Amounts of Rainfall (mm)
January	0.00
February	0.00
March	20.50
April	106.10
May	42.30
June	241.10
July	318.60*
August	226.30*
September	270.30*
October	224.50*
November	4.80
December	14.00
Annual Total Rainfall	1468.50

* = Months covering the growing period of sesame trial in 2008.

Sources: Nigerian Meteorological (NIMET) Station, Ilorin, Nigeria.

Table 3: Effect of Different Levels of Urea Application on Growth Parameters of Sesame Under Basal Organic Manure Application

Treatments	Plant height (cm)	No. of Leaves	Stem Girth (cm)	No. of Branches
Urea @ 0 kg Nha ⁻¹	59.2e	17.0e	2.2f	3.2d
Urea @ 20 kgN ha ⁻¹	60.2e	28.0d	2.8e	3.0d
Urea @ 40 kgN ha ⁻¹	72.1d	31.5d	3.2d	4.7c
Urea @ 60 kgN ha ⁻¹	80.2d	45.8c	3.6c	5.2c
Urea @ 80 kg Nha ⁻¹	134.2a	63.9a	7.1a	9.3a
Urea @ 100 kg Nha ⁻¹	129.3ab	58.0b	7.1a	8.0b
Urea @ 120 kg Nha ⁻¹	126.6bc	52.6b	7.2a	8.0b
Urea @ 140 kg Nha ⁻¹	110.2c	54.3b	6.8b	5.7c

Means followed by the same letters within the same column are not significantly different at p < 0.05, using DMRT.

Table 4: Effect of Different Levels of N-Mineral Fertilizer Application on Yield Parameters of Sesame Under Basal Organic Manure Application

Treatments (kg ha ⁻¹)	No of Capsules (Plant ⁻¹)	Weight of 1000 Seeds (g)	Oil Content (%)
Urea @ 0 kg Nha ⁻¹	23.7f	2.0d	42.0d
Urea @ 20 kgN ha ⁻¹	24.1f	2.0d	45.10c
Urea @ 40 kgN ha ⁻¹	31.4e	2.0d	45.60bc
Urea @ 60 kgN ha ⁻¹	41.2d	2.3c	46.0a
Urea @ 80 kg Nha ⁻¹	77.2ab	2.8a	46.1a
Urea @ 100 kg Nha ⁻¹	81.1a	2.6b	45.5ab
Urea @ 120 kg Nha ⁻¹	70.2b	2.6b	44.3bc
Urea @ 140 kg Nha ⁻¹	57.4c	2.6b	44.0bc

Means followed by the same letters within the same column are not significantly different at $p < 0.05$, using DMRT.

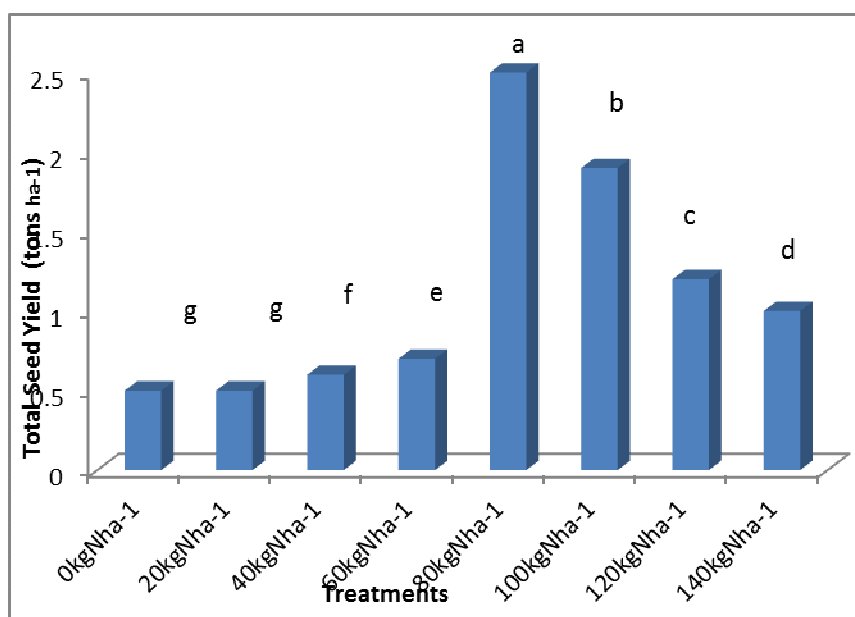


Fig 1: Influence of N-Mineral Fertilizer Levels on Total Seed Yield of Sesame Under Basal Organic Manuring

Means followed by the same letters within the same column are not significantly different at $p < 0.05$, using DMRT.

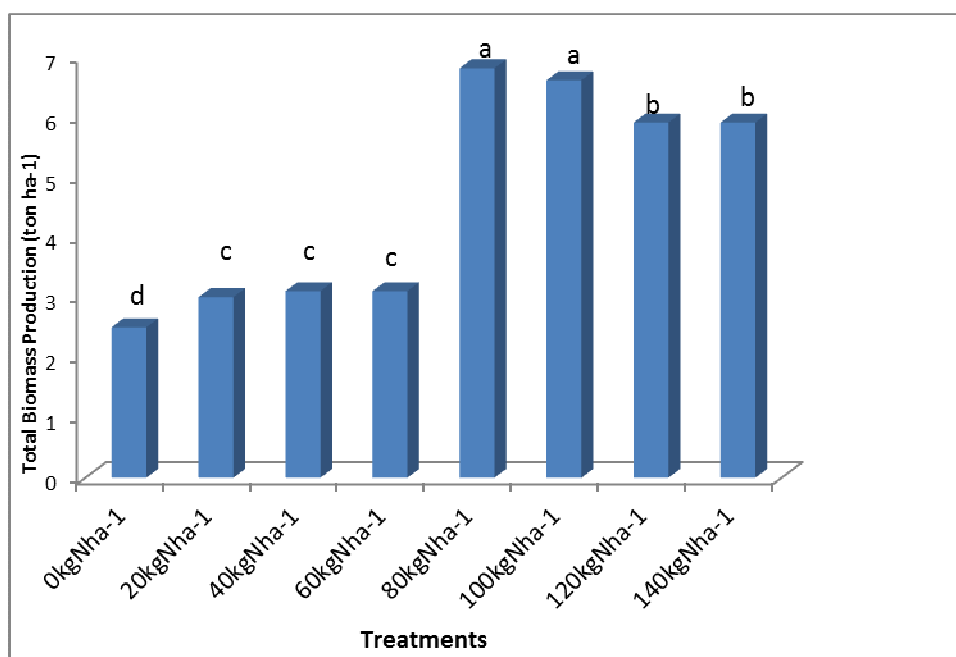


Fig 2: Effects of Different N-mineral Fertilizer Levels on Total Biomass Production of Sesame Under Basal Organic Manuring

Means followed by the same letters within the same column are not significantly different at $p < 0.05$, using DMRT.

Table 5: Effect of Different Levels of Urea Application on Nutrient Uptakes of Sesame at Ogbomosho

Treatments	N	P	K	Ca	Mg	Na	Fe	Cu	Mn	Zn
	→		(g kg ⁻¹)	←		→		(mg kg ⁻¹)	←	
0kgNha ⁻¹ Urea	5.22d	0.87e	1.47c	0.27c	0.39c	0.28b	72.00d	0.92d	32.68c	9.62c
20kgNha ⁻¹ Urea	18.76bc	1.45d	9.21b	0.67b	0.78b	0.49a	122.87c	2.41c	43.71b	14.16b
40 kgN ha ⁻¹ Urea	20.82b	3.12c	9.42b	0.68b	0.82b	0.50a	136.31b	2.73c	44.36b	15.02b
60 kgN ha ⁻¹ Urea	21.72b	4.3b	9.33b	0.72b	0.90b	0.50a	140.21b	2.79c	48.30b	15.30b
80 kg Nha ⁻¹ Urea	26.12a	6.42a	14.16a	1.92a	1.52a	0.53a	156.47a	5.01a	52.60b	15.34b
100kgNha ⁻¹ Urea	22.10b	6.10a	13.12a	1.84a	1.49a	0.50a	156.17a	4.90a	76.70a	19.23a
120kgNha ⁻¹ Urea	18.87bc	6.00a	12.98a	1.80a	1.44a	0.50a	154.05a	4.87a	79.87a	21.82a
140kgNha ⁻¹ Urea	16.19c	4.12b	12.36a	0.68b	0.78b	0.53a	138.10b	3.53b	85.20a	22.17a

Means followed by the same letters within the same column are not significantly different at $p \leq 0.05$, using DMRT.

5.0 Conclusion

Basal application of the pre-existing plant residues alone cannot successfully and sustainably enhance sesame performance in the study area, where soils are majorly marginal / highly degraded. Nitrogen is highly relevant and indispensable to crop growth and yield. Crop growth and development improved with increasing dosage of nitrogen till a desirable level which indicated optimum performance of the test crop was reached, after

which it declined. Adequate nitrogen nutrition may be beneficial to improved uptakes of other nutrients, particularly P and K, and some micronutrients. Incorrect or excessive application of inorganic nitrogenous fertilizer should be discouraged, since it may be a wasteful and uneconomical farming practice, particularly while considering the undesirable crop growth, declining yields and the likely fatal threats that may be imposed. Optimum rate of nitrogen (which will be effectively and efficiently utilized), should be applied to sesame, in order to prevent unnecessary loading of soils with chemicals and for improved crop performance and creation of environment friendliness conditions via improved soil and water quality. Since the application of 80 kg N ha⁻¹ generally improved sesame performance, it is therefore adjudged most suitable and recommended as adequate for optimum performance of sesame and improved soil / water quality in the study area. Hence, excessive application of nitrogen above the limit of 80 kg N ha⁻¹, may not benefit sesame production in the study area.

References

- Akanbi, W. B. (2002). Growth, Nutrient uptake and yield of maize and okra as influenced by compost and nitrogen fertilizer under different cropping systems. Ph. D. Thesis, Department of Crop Protection and Environmental Biology, University of Ibadan, Ibadan, Nigeria pp. 232.
- Akanbi, W. B., Akande, M. O. and Adediran, J. A. (2005). Suitability of composted maize straw and mineral nitrogen fertilizer for tomato production. *Journal of Vegetable Science* 11(1): 57-65.
- Akanbi, W. B., M. O. Akande., R. A. Baiyewu, and Akinfasoye J.O. 2000. Effect of Maize Stover Compost and Nitrogen Fertilizer on Growth, Yield and Nutrient Uptake of Amaranth. *Moor Journal of Agricultural Sciences* 1: 6-15.
- Akanbi, W. B., Togun, A. O. and Adediran, J. A. (2001). Growth and yield of maize as influenced by compost and nitrogen fertilizer. *African Crop Science Conference Proceedings*, Vol. 5: 1003 – 1006.
- Akanbi, W. B.; Oyediran., G. O., Olaniran, O. A., Adeyeye, S. A.; Akande, M. O. and Adediran, J. A. (2006). Effects of organic and inorganic fertilizers and their combination on Growth, Nutrient uptake and shoot yield of Celosia (*Celosia argentea* L.). *Science Focus* 11 (1) 84 – 90.
- Akanni, D.I. and Ojeniyi, S. O. (2007). Effect of different levels of poultry manure on soil physical properties, nutrients status, growth and yield of tomato (*Lycopersicon esculentum*). *Journal of Agronomy* 1:1-4
- Akintoye, H. A., Kling, J. G. and Lucas, E. O. (1998). Nitrogen use efficiency of single, double and synthetic maize lines grown at four N levels in three ecological zones of West Africa. *Field Crops Research* 27: 60 – 67.
- Akintunde, A. Y., Obigbesan, G. O. and Kim, S. K. (1993). Nitrogen use efficiency and grain yield as influenced by nitrogen fertilization and hybrid maize varieties in selected agroecological zones of Nigeria. In M. B. A. Fakorede *et al* (eds). *Maize improvement production and Utilization in Nigeria* published by maize Association of Nigeria. P. 119 – 124.
- Alegbejo, M. D., Iwo, G. A., Abo, M. E. and Idowu A. A. (2003). Sesame production pamphlet; A Potential Industrial and Export Oil Seed Crop in Nigeria. P. 59 – 76.
- Ali, A., Kafikafi, U., Yamaguchi, I., Sugimoto, Y. and Inanga, S. (2000). Growth, transpiration, root-boron, cytokinins and gibberellins and nutrient compositional changes in Sesame exposed to low root-zone temperature under different ratios of nitrate: Ammonium supply. *Journal of Plant Nutrition* 23: 123-140.
- Ali, M. K., Barkotulla, M. A. B., Alam, M. N. and Tawab, K. A. (2006). Effect of levels of yield and yield contribution characters of three varieties of carrot. *Pakistan Journal of Biological Sciences* 3: 553 – 557.
- Allen, V. B. and Gretchen, M. B. (2002). Bioremediation of heavy metals and organic toxicants by composting. *Mini Review; Scientific World Journal* 2: 407-420.
- Ashri, A. (1998). Sesame breeding: *Plant Breeding Reviews*, Vol.16 : 179-228.
- Babajide, P. A.; O. S. Olabode; W. B. Akanbi; O. O. Olatunji and E. A. Ewetola (2008). Influence of composted *Tithonia*-biomass and N-mineral fertilizer on soil physico-chemical properties and performance of Tomato (*Lycopersicon lycopersicum*). *Research Journal of Agronomy* 2(4): 101-106.
- Babajide, P.A.; Akanbi, W.B.; Olabode, O.S., Olaniyi, J.O. and Ajibola, A.T. (2012). Influence of pre-application handling techniques of *Tithonia diversifolia* Hemsl. A. Gray residues on growth, seed yield and oil content of sesame (*Sesamum indicum* L.), in south-western Nigeria. *Journal of Animal and Plant sciences: Biosciences*: Vol.15: 2: 2135-2146.
- Boureima, S., Diouf, M., Diop T. A., Diatta, M., Leye, E. M., Ndiaye, F. and Seck, D. (2007). Effect of arbuscular mycorrhiza inoculation on the growth and the development of Sesame (*Sesamum indicum* L.). *African Journal of Agricultural Research* Vol. 3 (3): 234-238.
- Bouyoucos, G. J. (1951). A recalibration of the hydrometer method for making mechanical analysis of soils. *Agronomy Journal* 43: 434- 438
- Bremner, J. M. (1965). Inorganic forms of nitrogen, In C. A. Blak, D. D. Evans, J. L. White, L. E. Ensminger, and F. E. Clark (ed.) *Methods of soil analysis. Part 2. Chemical and microbiological properties. 1st ed.* *Agronomy Monograph* 9. ASA, Madison, WI. pp. 1179 – 1237.

- Chukwuka, K. S. and Omotayo E. O., (2008). Effects of Tithonia green manure and water hyacinth compost application on nutrient depleted soil in South-Western Nigeria. *International Journal of Soil Science*, 3:69-74.
- Chukwuka, K. S. and Omotayo, O. E. (2009). Soil fertility restoration potentials of Tithonia green manure and water hyacinth compost on a nutrient depleted soil in south west Nigeria. *Research Journal of Soil Biology* 1(1); 20-30.
- Conte, P., Zena, A., Pilidis, G., and Piccolo, A. (2001). Increased retention of polycyclic aromatic hydrocarbons in soils induced by soil treatment with humic substances. *Environmental Pollution* 112: 27-31.
- Cooperband, L., (2002). Building soil organic matter with organic. Center for Integrated Agricultural Systems, University of Wisconsin, Madison. <http://www.cias.wisc.edu/pdf/02/03/2008>.
- Dare, M. O. (2008). Variability of yam (*Dioscorea spp.*) genotypes to Arbuscular mycorrhizal colonization and fertilizer application in yam growing regions of Nigeria. Ph D. Thesis, Department of Agronomy, University of Ibadan, Nigeria. 132p.
- El-Habbasa, S. F., Abd-El-Salam, M. S. and Kabesh, M. O. (2007). Response of two sesame varieties (*Sesamum indicum L.*) to partial replacement of chemical fertilizers by bio-organic fertilizers. *Research Journal of Agriculture and Biological Sciences* 3(6): 563-571.
- Fathy S. E. and Mohammed A. S. (2009). Response of seed yield, yield components and oil content to the sesame cultivar and nitrogen fertilizer rate diversity. *Electronic Journal of Environmental, Agricultural and Food Chemistry*. EJEAFChe 8 (4): 287 – 293.
- Gungunla, D. T. (1999). Growth and nitrogen use efficiency in maize (*Zea mays L.*) in the Southern Guinea Savannah of Nigeria. Ph D. Thesis, University of Ibadan. Pp 181.
- Hansen, B., Kristensen E. S., Grant R., Hogh, J. H., Simmels-gaard S. E. and Olsen J. E., (2000). Nitrogen leaching from conventional versus organic farming systems-a system modeling approach. *European Journal of Agronomy* 13: 65 – 82.
- Heanes. D. L. (1984). Determination of total organic carbon in the soils by an improved Chromic acid digestion and spectrophotometric procedure. *Communication in Soil Science and Plant Analysis* 15:1191-1213.
- Indu K. P. and Savithri K. E. (2003). Effect of Biofertilisers VS Perfected chemical fertilization for sesame grown in summer rice fallow. *Journal of Tropical Agriculture* 41 (2003); 47-49.
- International Institute of Tropical Agriculture (1982). Selected Methods for Soil and Plant Analysis. International Institute of Tropical Agriculture, Ibadan Nigeria. IITA Manual Series, No. 7.
- Katung, M. D. J., D. Olanrewaju, U. S. Gupta, and I. Kureh, (1996). Fruit and seed yields of Okra as influenced by farm yam manure and Nitrogen fertilizer. In Proc. 14th HORTSON Conf; Ago-Iwoye, 1-4.
- Lafond, G. P., C. A Grant, A. M. Johnston, D. W. McAndrew and W. E. May, (2003). Nitrogen and Phosphorous management of no-till flax. In *Better Crops with AgDex* 541-1982,
- Langham, R. and Wiermeers, T., (2006). Sesame Production Information. *Sesame Production in Texas*. Htm. 1-17
- Mehlich, A.(1984). Mehlich3 soil test extractant: A modification of Mehlich 2 extractant. *Communication in Soil Science and Plant Analysis* 15.12: 1409-1416
- Muchow, R. C. and Sinclair, T. R.(1994). Nitrogen response of leaf photosynthesis and canopy radiation use efficiency in field-grown maize and sorghum. *Crop Science* 34: 721-731.
- Nziguheba, G., R. Merckx, C. A. Palm A. and. Mutuo, M. (2002). Combined uses of *Tithonia diversifolia* and inorganic fertilizers for improving maize production in a phosphorus deficient soil in western Kenya. *Agroforestry System*, 55: 165-174.
- Olabode, O. S. Ogunyemi S., Akanbi W. B., Adesina G. O. and Babajide, P. A. (2007). Evaluation of *Tithonia diversifolia* (Hemsl). A Gray for soil improvement. *World Journal of Agricultural Sciences* 3 (4), 503-507.
- Olaniyi, J. O. and Akanbi, W. B (2008). Effects of cultural practices on mineral compositions cassava peel compost and its effects on the performance of cabbage (*Brassica oleraceae L.*). *Journal of Applied Biosciences* Vol.8(1): 272-279.
- Olaoye, S. F. (2007). The effects of phosphorus fertilizer application on the growth, seed yield and quality of Sesame (*Sesamum indicum*) varieties. B. Tech, Ogbomosho p. 47.
- Olsen, S. R, Cole, C. V., Watanabe, F. S. and Dean L. A. (1954). Setimation of available phosphorus in soils by extraction with sodium bicarbonate. United State Development Agency Circular 939
- Ombo, F. I. 1994. Self sufficiency in local fertilizer production for Nigeria. In Proceeding fo the 3rd African Soil Science Conference, (August 20 – 23, 1994) at University of Ibadan, Ibadan. Nigeria. p. 112 -114.
- Peter G., Francesco G. and Montague Y. (2000). Integrated Nutrient Management, Soil Fertility, and Sustainable Agriculture: Current Issues and Future Challenges. “A 2020 Vision for Food Agriculture, and the environment” International Food Policy Research Institute (IFPRI) Pp. 1- 4.
- Ray, D. L., Glenn, S., Terry, W. and Mark, W. (2004). Southwest Sesame growers pamphlet <http://www.sesaco.net>. Accessed on 06/02/2008.

- SAS (2008). Sas Institute Inc., Cary Nc., U.S.A. (Software Statistical programme). 2008
- Sharma, P. B. (2005). Fertilizer management in sesame (*Sesamum indicum*) based intercropping system in Tawab Commandarea. Journal of Oilseeds Research, 22: 63-65.
- Sharma, S. N., Prasad, R. and Singh S. (1996). Residual effects of growing mung beans and urid bean on the yield and nitrogen uptake of a succeeding wheat crop. Fertilizer Research, 44: 163 – 168.
- Sibale, E. M. and Smith, M. E. (1997). Studies in Nitrogen use efficiency in cereals. Fertilizer Research 44: 163 – 168.
- Smyth, A. J. and Montgomery, R. F. (1962). Soils and land use in Central Western Nigeria. Govt. of Western Nig. Press, Ibadan pp. 265.
- Sobulo, R. A. (2000). Fertilizer use and soil testing in Nigeria. In: Agronomy in Nigeria 2000 Edition, pp. 195-201.
- Tejada, M., Benitez, C. and Gonzatez, J. L. (2005). Effects of Application of Two Organomineral Fertilizers on Nutrient Leaching Losses and Wheat Crop. Agron. Journ. 97; 960-967
- Tiessen, K. D., Flaten, C. A., Grant, R. E. Karamanos, D. L. Burton and Entz, M.H. (2003). Efficiency of fall-banded N: Effects of application date, landscape position and inhibitors. In proc. of 2004 Manitoba Agronomist's conference, Winnipeng. 2003 pp.118-132.
- Ulger, A. C., Ibrikici, H., Cakiri, B. and Guzel, N. (1997). Influence of Nitrogen rates and row spacing on corn yield, proteins content, and other plant parameters. Journal of plant nutrient 20 (12): 1697 – 1709.
- Weiss, E. A. (2000). Oil seed crops. Blackwell Science Ltd., p.1-142. Abad, M. B., Clement, M. D., Aragan, R. P. and Camarero, A. S. 1997. The influence of soil urban waste compost and nitrogen mineral fertilizer on growth and productivity in potatoes. Commun. Soil Science Plant Anal. 28 (17 & 18): 1653-1661.

The IISTE is a pioneer in the Open-Access hosting service and academic event management. The aim of the firm is Accelerating Global Knowledge Sharing.

More information about the firm can be found on the homepage:
<http://www.iiste.org>

CALL FOR JOURNAL PAPERS

There are more than 30 peer-reviewed academic journals hosted under the hosting platform.

Prospective authors of journals can find the submission instruction on the following page: <http://www.iiste.org/journals/> All the journals articles are available online to the readers all over the world without financial, legal, or technical barriers other than those inseparable from gaining access to the internet itself. Paper version of the journals is also available upon request of readers and authors.

MORE RESOURCES

Book publication information: <http://www.iiste.org/book/>

IISTE Knowledge Sharing Partners

EBSCO, Index Copernicus, Ulrich's Periodicals Directory, JournalTOCS, PKP Open Archives Harvester, Bielefeld Academic Search Engine, Elektronische Zeitschriftenbibliothek EZB, Open J-Gate, OCLC WorldCat, Universe Digital Library, NewJour, Google Scholar

