G.J.B.B., VOL.2 (1) 2013: 12-16 ISSN 2278 – 9103

GLOBAL JOURNAL OF BIO-SCIENCE AND BIOTECHNOLOGY
© 2004 - 2013 Society For Science and Nature (SFSN). All rights reserved
www.scienceandnature.org

THE MORPHOLOGICAL, PROXIMATE AND MINERAL RESPONSES OF SESAME TO DIFFERENT NUTRIENT SOURCES

[1]Alege, G.O., [2]Mustapha, O.T., [1]Ojo, S. and [1]Awosemo, M.B. contrary
[1]Biological Sciences Dept., Kogi State University, Anyigba, Kogi State, Nigeria
[2]Plant Biology Dept., University of Ilorin, Ilorin, Kwara State, Nigeria
*Corresponding Author's address: Alege Gbenga Olorunshola, Biological Sciences Dept., Kogi State University, Anyigba, Kogi State, Nigeria. (E-mail: gbemilege7@yahoo.com, 08030815497)

ABSTRACT
The responses of morphological characteristics, proximate and mineral elements in sesame to different nutrient sources were investigated in Anyigba, Kogi State, Nigeria. Seeds of sesame (*Sesamum indicum* L.) were obtained from Ilorin, Kwara State, Nigeria and planted in 2008 and 2009 at the Research Garden of the Biological Sciences Department to eliminate variations induced by environmental differences. Top soil from the research site was separately mixed with N.P.K fertilizer, chicken dung, cow dung and no fertilizer (control). The experimental design adopted was the Complete Randomized Design (CRD). Eleven vegetative characteristics, six proximate and eight mineral elements were investigated. Mean values for five readings on each vegetative trait, three readings each on both proximate and mineral component were recorded. Data pooled on each attribute were subjected to Analysis of Variance (ANOVA) and means with significant differences were separated using the Duncan Multiple Range Test (DMRT) statistical methods. Seven morphological traits, three proximate and one mineral component did not show significant variation in their response to nutrient sources which implies that they are under strong genetic control and their expressions are not influenced by soil fertility status.

KEYWORDS: organic, inorganic, attributes, *Sesamum indicum,* N.P.K fertilizer, chicken dung, cow dung.

INTRODUCTION

The family Pedaliaceae, according to Zavareh *et al.,* (2008), consists of 16 genera and about 60 species. *Sesamum* species has a long history of cultivation, mostly for its yield of oil. United States Agency for International Development (2002) reported that the original area of domestication of sesame is obscure but it seems likely to have first been brought to cultivation in Asia especially India. However, International Plant Genetics Resources Institute (2004), emphasized that sesame was domesticated on the Indian subcontinent and was taken to Mesopotamia by the early Bronze Age. Germplasm characterization and evaluation studies on sesame indicated wide diversity in plant height, branching pattern, leaf shape, height of first capsule bearing node, number of locules per capsule, internodes length and height of first fruiting branch, weight of 100 seeds, days to maturity, oil content, seed colour, harvest index, determinate habit, resistance to pest and disease (International Plant Genetic Resources Institute, 2004). According to Ercan, *et al.,* (2002), multivariate analysis of sesame populations based on morphological characters provides genetic information that allows the breeder to improve populations by selecting from specific geographical regions. Laurentin and Karlovsky, (2006) reported genetic variability among sesame collections.

According to El-Greedly *et al.,* (2005) the increase in sesame production during the last ten years is mainly due to increase in its growing areas, especially in new reclaimed sandy soils. Sesame is majorly grown in countries such as Sudan, Nigeria, Ethiopia, Uganda, Mexico, Venezuela, India, China, Pakistan, Turkey and Myanmar (Mahajan *et al.,* 2007). India committed 2-5million hectares to the cultivation of this crop, and is the major sesame producer, accounting for 40% of the Worlds' sesame area and 27% of the world production. China is another major sesame growing country with about one million hectares under cultivation and 0.4million tonnes of seed production per year (Mahajan *et al.,* 2007). Sesame is an important oil seed crop world-wide, and it yields high quality edible and odourless oil that serve as a good source of protein and fat for humans and livestock (Adebisi *et al*., 2005). Sesame seeds are used in baking and making candy, while its oil in addition to cooking is used in the manufacture of soaps, paints, perfumes, pharmaceuticals, insecticides and ethno-botanical uses (Atungwu *et al.,* 2003; Amara *et al.,*2008). Sesame meal, a bye-product from sesame oil extraction is of excellent nutritional value to poultry and livestock. Young and succulent sesame leaves are chopped into pieces and added as vegetable to man. This preparation serves as a substitute for okra especially during scarcity of fresh okra (NAERLS, 2004). USAID, (2002) reported that dried stem may be burnt to provide fuel with the ash used for local soap making. Sesame plant according to Obiajuwa *et al., (*2005) is grown in different parts of Nigeria and the two species commonly grown for their seeds and leaves are *S indicum* and *S. radiatum*. Despite these numerous uses of sesame, Pham *et al.,* (2010) still opined that sesame production worldwide is still below expectation and the potential to increase production is considered higher. Among other factors affecting sesame production in Nigeria, lack of fertilizer response was reported by Adebisi *et al.,* (2005) as a major limitation.

Alege, *et al.,* (2009) reported that chemical fertilizers are useful for soil fertility improvement but are scarce, expensive and constitute threat to the environments. So far, studies carried out on sesame have focused on its yield, characterization of different sesame accessions and genetic diversity. There is need to study the effect of different organic and inorganic fertilizers on the morphology, proximate and mineral composition of sesame. The aims of this study therefore are to investigate the response of morphological characteristics, proximate composition and mineral elements in sesame to different nutrient source and to give the genetic implication of our findings.

MATERIALS AND METHODS

Seed Source and Planting

Black seeded sesame seeds were obtained from Ilorin, Kwara state, Nigeria in 2008.The seeds were planted in 2008 and 2009 at the research garden of the Biological sciences Department, Kogi State University, Anyigba, kogi state, Nigeria located between latitude 8^0 43′ and 9^0 5′ south of the equator and between 6^0 6′ and 7^0 45′ west of the meridian. This was done to adapt the plant to the environment where the research will be carried out (Anyigba) and to eliminate variations induced by environmental differences. Top soil was taken from the research location at the Department of Biological Sciences of Kogi State University, Anygiba. The top soil was mixed thoroughly to form composite and divided into four (4) portions. 10kg of each portion was mixed separately with NPK fertilizer, poultry dung and cow dung at the rate of 5.0 ton/ha (20g of fertilizer per pot) as recommended by Alege *et al.,* (2009) while the fourth portion was without treatment representing the control. The soils were filled into polythene bags and each treatment was replicated ten times. The organic fertilizers (poultry dropping and cow dung) were collected from the Animal Farm of the Department of Animal Science, Faculty of Agriculture, Kogi State University Anyigba. The inorganic (N.P.K 15:15:15) fertilizer was obtained from Anyigba market. Bags were labelled as follows: -

A. Bags containing (N.P.K 15:15:15 chemical fertilizer)
B. Bags containing poultry droppings
C. Bags containing cow dung
D. Bags without fertilizer (control).

Complete Randomized Design (CRD) was adopted for this study. After two weeks of planting, each stand was reduced to two seedlings per bag. Plants were watered adequately and weeding was carried out manually before harvest.

Measurement of Morphological Traits

The morphological traits were investigated at 50 % flowering stage (except final plant height and pod attributes) according to the methods outlined by Akinyele and Adigun, (2006). These traits include plant height, number of branches, stem girth, leaf area, number of leaves per plant, final plant height, pod width, pod length, number of pod per plant, number of seed per pod and weight of 100 seeds. The data pooled were subjected to Analysis of Variance (ANOVA) at $p < 0.05$. Means found significant were separated using Duncan Multiple Range Test (DMRT).

Proximate Components Studied

30g of sesame seeds from each nutrient source was ground and analyzed in triplicate for six proximate traits. Data were recorded for crude protein, crude fat/oil, fibre, mineral ash, moisture content and carbohydrate content. All analyses were done according to Official methods of Associations of Analytical Chemist (AOAC, 1990).

Mineral Components Studied

Sesame seed samples from different nutrient sources were investigated for mineral composition by using Atomic Absorption Spectrophotometer (ASS). For each element, appropriate working standard solution was prepared for leaves from each nutrient source. Readings on each mineral element was recorded in triplicate. The calibration curves were obtained for concentration versus absorbance. Eight mineral elements including Ca, Mg, K, Na, Mn, Fe, Cu and Zn were determined using the method outlined by Obiajuwa, *et. al.,* (2005). The data pooled were subjected to Analysis of Variance (ANOVA) at $p < 0.05$. Means found significant were separated using Duncan Multiple Range Test (DMRT).

RESULTS AND DISCUSSION

Figure 1 shows the photograph of sesame plants grown with different nutrient sources at 8 weeks after planting (8 WAP). The means of the various measurements taken on morphological traits are summarized in table 1 while table 2 summarized the results of the mineral element composition of sesame leaves.

Analysis of Variance (ANOVA) for the morphological traits show that only four out of eleven morphological characteristics considered show significant difference across the nutrient sources, the remaining seven morphological traits did not show significant differences across the nutrient sources (Table 1). The application of fertilizers (either organic or inorganic) significantly enhanced the performances of the sesame plants with plants grown without fertilizer (control) significantly performing less than other treatments for all the morphological traits considered except for pod length (Table1).

FIGURE 1: photograph showing *S. indicum* L grown with different nutrient sources.

Key

A = plants grown with NPK fertilizer
B = plants grown with poultry dung
C = plants grown with cow dung
D = plant grown without fertilizer.

TABLE 1: Means of measurements for the morphological traits in sesame across different nutrient sources

Nutrient sources	PHP (cm)	NBP	SGP (cm)	LAP (cm^2)	NLP	FPH (cm)	PWP (cm)	PLP (cm)	NPP	NSP	100SW
A	47.02b	6.20	96.38a	3.34	123.42a	109.38	2.84	3.82	112.98a	69.74	1.47
B	73.41a	7.71	128.61a	3.12	120.16a	106.42	2.86	3.17	101.20a	71.43	1.49
C	50.38b	6.64	101.06a	3.04	81.14 a	103.11	2.79	3.36	106.14a	70.22	1.38
D	32.26b	5.23	67.81b	2.96	76.75 b	101.13	2.78	3.55	89.16 b	69.43	1.36
LSD (0.05)	21.41	NS	19.34	NS	27.64	NS	NS	NS	9.83	NS	NS

❖ Means with the same letter are not significantly different

KEY

PHP - Plant height
NLP - Number of leaves
PWP - Pod width
NBP - Number of branches
100SW- 100 Seeds weight
B - Plant treated with chicken dung
D - Plant without treatment (control)
NPP - Number of pod per plant
SGP - Stem girth
FPH - Final plant height
PLP - Pod length
NSP - Number of seeds per pod
C- Plant treated with cow dung
NS - Not significant
LAP- Leaf Area
A- Plant treated with NPK

Analysis of Variance (ANOVA) for proximate composition in sesame leaves showed that only the ash, fat and carbohydrate content showed significant difference across the nutrient sources while moisture, crude fibre and protein content did not show significant difference (Table 2). In the case of proximate composition, the application fertilizer (organic or inorganic) suppressed the expressions of ash and fat contents, while the application of chicken dung enhanced the carbohydrate contents of sesame leaves (Table 2).

TABLE 2: Summary of means of measurements for the proximate composition of sesame leaves.

Nutrient sources	Moisture (%)	Ash (%)	Fibre (%)	Fat (%)	Protein (%)	Carbohydrate (%)
A	87.00	3.57 b	1.22	0.85 b	1.14	6.25 c
B	84.40	3.66 b	1.52	0.98 b	0.25	8.80 a
C	81.20	4.16 b	1.27	0.88 b	0.23	5.22 d
D	80.60	6.80 a	1.30	2.40 a	0.75	8.16 b
LSD (0.05)	NS	0.982	NS	0.636	NS	0.58

❖ Means with the same letter are not significantly different.

A - Plant treated with NPK
B - Plant treated with chicken dung
C - Plant treated with cow dung
D - Plant without treatment (control)

Analysis of Variance (ANOVA) for mineral element in sesame leaves showed that only Zn content did not show significant difference across the nutrient sources (Table 3). Contrary to the positive response of morphological traits in sesame to fertilizer application in table 1, the application fertilizer suppresses the expressions of Ca, Mg and Fe with varying degree of suppressions observed as a result of fertilizer application (Table 3).

TABLE 3: Summary of means of measurements for the mineral element composition of sesame leaves.

Nutrient sources	Ca (ppm)	Mg (ppm)	K (ppm)	Na (ppm)	Mn (ppm)	Fe (ppm)	Cu (ppm)	Zn (ppm)
A	20.61 b	4.10 c	34.20 b	1.41 c	0.69 a	5.76 b	0.056 a	0.281
B	20.10 b	6.50 b	35.80 a	2.29 a	0.28 c	2.55 c	0.036 b	0.306
C	21.50 b	7.20 a	4.17 d	1.56 bc	0.36 bc	1.19 d	0.058 a	0.281
D	27.00 a	7.49 a	23.33 c	1.60 b	0.31 c	8.21 a	0.056 a	0.281
LSD (0.05)	1.08	0.33	0.62	0.19	0.12	0.30	0.022	NS

❖ Means with the same letter are not significantly different.

KEY

A - Plant treated with NPK

B - Plant treated with chicken dung

C - Plant treated with cow dung

D - Plant without treatment (control)

ppm- Part per million

DISCUSSION

The factors that may bring about variation in the original genome structure of a species include geographical isolation, chromosome aberration, infection and variation in edaphic factors (Akinyele and Temikotan, 2007). Variations brought about by infections and edaphic factors result in temporary phenotypic differences and as soon as the infections and variation in soil conditions are addressed, the differences usually fade away. All the morphological characteristics studied were found to respond to nutrient sources in a way (Figure1 and Table 1). This is an indication that soil fertility condition affects morphological attributes in sesame, this finding corroborate the report of Alege *et al.* (2009). Only four out of the eleven morphological traits studied showed significant differences across nutrient sources. These attributes are plant height, stem diameter, number of leaves and number of pod per plant (Table 1). This indicates that these 4 attributes are not under strong genetic influences and soil fertility status affects the expression of these morphological traits. This further suggests that some morphological attributes in sesame are not stable. The yield of any crop according to Akinyele and Osekita (2006) is directly or indirectly a function of the interaction between the crop's genotype and the existing climatic and ecological factors. The remaining seven morphological traits viz ; number of branches, leaf area, final plant height, pod width, pod length, number of seeds per pod and weight of 100 seeds are stable to variations in soil fertility condition and are therefore under strong genetic influence. The moisture, crude fibre and protein contents did not show significant difference across the nutrient sources which indicates that these three proximate attributes are stable and their expressions are under strong genetic control because variations in soil conditions have no effect on the expression of these three traits. Proximate characteristics like fat, ash and carbohydrate contents showed significant different across nutrient sources which imply that they are not under strong genetic influence and soil fertility status can affect their expression. They are therefore not stable. The applications of fertilizer significantly reduce the fibre and fat contents of sesame leaves but the application of chicken dung increased significantly their carbohydrate contents while application of cow dung drastically reduces the carbohydrate contents of sesame leaves. Thus, application of cow dung should be discouraged if the aim is to improve the proximate composition of sesame leaves. If the utmost aim of the sesame farmer is to improve the ash and fibre contents, application of either organic or inorganic fertilizer should be discouraged, but the application of chicken dung should be encouraged if the aim is to improve the carbohydrate contents of sesame leaves. The importance of mineral elements to living organism cannot be over-emphasized. Emmanuel, *et al.* (2011) reported that seventy biological trace elements are needed by all living things for the normal function of their metabolism, reproduction and immune system. Only the Zinc (Zn) contents of sesame leaves did not show significant variation to different nutrient sources, the remaining 7 elements vary with the fertility conditions of the soil (Table 2). This is a strong indication that majority of the minerals in sesame respond to soil fertility. In case of Zn, only the mechanism controlling its uptake might be under genetic influence in sesame. The expression of minerals like Ca, Mg, K, Na, Mn, Fe and Cu show significant response to nutrient sources. This is an indication that the expressions of these seven mineral components in sesame are not under genetic influences and soil fertility status can affect them. They are therefore not stable. Murwan *et al*, (2008) reported that the composition of sesame depend on soil types. It can also be observed that application of either organic or inorganic fertilizers reduced the turnover of Ca, Mg and Fe in sesame leaf while drastic reduction in K was observed with application of cow dung (Table 2). This indicates that the type of fertilizer applied to the soil affects the turnover rate of mineral elements. This agrees with the report of Yang *et al*. (2004) that factors like soil types, temperature and precipitation can affect the synthesis and turnover rate of compounds in plants. Therefore, the findings in this study showed that the expressions of morphology, proximate and mineral elemental traits in sesame plant depend on the type of fertilizer applied.

CONCLUSION

This study revealed that mineral composition in sesame respond more to soil fertility status than morphological and proximate traits. The aim of this study, which is to investigate the response of morphological characteristics, proximate compositions and mineral elements to different nutrient sources in sesame, has been achieved.

REFERENCES

Adebisi, M.A, Ajala, M. O, Ojo, D.K and Salau, A.W. (2005) Influence of population density and season on seed yield and its components in Nigerian sesame genotypes, J. of Trop. Agric., 43 (1- 2): 13 -18.

Alege, G.O, Akinyele, B.O and Agianaku, E. (2009) Effects of nutrient sources on the vegetative and pod attributes of sesame in anyigba, Nigeria. App. Trop. Agric., 1:60 - 63.

Akinyele, B.O and Temikotan, T. (2007) Taxonomic implication of leaf epidermal characters of three Nigerian representatives of *Dipcadi medic,* J. of Res. Mgt., 1: 17-24.

Akinyele, B.O and Adigun, A.B. (2006) Soil texture and phenotypic expression of maize (*Zea mays* L.). Res. J. Bot., 1(3):139 – 143.

Akinyele, B.O and Osekita, O.S. (2006) Correlation and path coefficient analyses of seed yield attributes in okra-*Abelmoschus esculentus* (L.) Moench. Afr. J. Biotech.,5(14):1330 – 1336.

Amara, A.A, El-masry, M.H and Bogdady, H.H. (2008) Plant crude extracts could be the solution: extracts showing *in vivo* antitumorgenic activity, Pak.J.Pham.Sci., 21(2):159-171.

Atungwu, J.J, Afolabi, S.O and Afolabi, G.T. (2003) Preliminary investigation of some benniseed, *Sesamum indicum* L. genotypes for their host status to a root-knot Nematode, *Meloidogyne incognita.* Nig. J. of plant. Prot., 20:67 – 75.

El-Greedly, A, Nadia, H.M and Mekki, B.B. (2005) Growth, yield and endogenous hormones of two sesame (*Sesamum indicum* L.) cultivars as influenced by stigmasterol, J. of Appl. Sci. Res., 1(1):63 – 66.

Ercan, A.G, Taskin, M.K, Turgut, K, Bilgen, M and Firat, M.Z. (2002) Characterization of Turkish sesame (*Sesamum indicum* L.) land races using agronomic and morphologic descriptors. AKD. UNI. ZIRAAT FAK. DERGIS, 15(2):45 – 52.

Emmanuel, T.F, Omale, J, Olupinyo, O and Adah, G. (2011) Investigations on the nutritional and medicinal potentials of *Ceiba pentandra* leaf: a common vegetable in Nigeria, Int. J. of Plant Physio. And Biochem., 3(6): 95-101.

International Plant Genetic Resources Institute (2004) Descriptors for sesame (*Sesamum spp*) the International Plant Genetic Resources Institute, Rome, Italy: IPGRI.

Laurentin, H and Karlovsky, P. (2006) Genetic relationship and diversity in a sesame (*Sesamum indicum L.*) germplasm collection using amplified fragment length polymorphism (AFLP). BMC. Genet, 7(1): 1 – 10.

Mahajan, R.K, Bisht, I.S and Dhillon, B.S. (2007) Establishment of a core collection of world sesame (*Sesamum indicum* L.) germplasm accessions, SABRAO J. of Breed. and Genet., 39(1):53 – 64

Murwan, K.S.E, Khogali, E.A and Abu, E.A.Y. (2008) Chemical composition and oil characteristics of sesame seed cultivars grown in sudan. Res. J. of Agric. and Bio. Sci., 4 (6): 760 – 761.

National Agricultural Extention and Research Liaison Services (2004) Beniseed production and utilization in Nigeria. National Agricultural Extention and Research Liaison Services, Ahmadu Bello University, Zaria.

Obiajuwa, E.I, Adebiyi, F.M and Omode, P.E. (2005) Determination of essential minerals and trace elements in Nigerian sesame seeds, using TXRF techniques, Pak. J. of Nut. 4(6): 393 – 395.

Pham, T.D, Nguyen, T.T, Carlsson, A.S and Bui, T.M. (2010) Morphological evaluation of sesame (*Sesamum indicum* L.) varieties from different origins. Aus. J. of Crop Sci., 4(7): 498-504.

The United States Agency for International Development (2002) Overview of the Nigerian sesame industry. The United States Agency for International Development Nigeria, Chemonics International Inc, Washington DC:USAID

Yang, H, Duan, Y, Hu, F and Liu, J. (2004) Lack of altitudinal trends in phytochemical constituents of *Swertia francheetiana* (Gentianaceae). Biochemical Systematic and Ecology, 32: 861 – 866.

Zavareh, M., Hoogenboom, G., Mashhadi, R.H. and Arab, A. (2008) A decimal code to describe the growth stages of sesame (*Sesamum orientale* L.), Int. J. of Plant Prod., 2(3): 193 – 206.