

Full Length Research Paper

Characteristics of three Nigerian species of sesame in taxonomic importance of the vegetative and pod

G. O. Alege¹, B. O. Akinyele^{2*}, S. M. Ayodele¹ and A. V. Ogbode¹

¹Department of Biological Sciences, Kogi State University, Anyigba, Kogi State, Nigeria.

²Department of Crop, Soil and Pest Management, the Federal University of Technology, Akure, Nigeria.

Accepted 14 May, 2021

The relevance of the vegetative and the pod characteristics to the taxonomy of three Nigerian species of sesame was investigated. The plant materials used are *Sesame alatum*, *Sesame radiatum* and *Sesame indicum*. After growing the plants for two years in the same environment, the seeds of each species were harvested and broadcast in a separate perforated 5 L plastic bucket filled with sandy loam soil. The buckets were kept at the nursery and watering carried out until seedlings were fully established. Two seedlings of each species were then transplanted to a 5 L plastic bucket filled with sandy loam soil and each bucket was replicated 20 times. The experimental design used was the completely randomized design (CRD). Each plant stand was thinned to one seedling two weeks after transplanting. Ten vegetative and five pod characteristics were investigated at flowering and harvest respectively. Mean values for each species were calculated and recorded from five plants randomly selected. Data were subjected to analysis of variance (ANOVA) and means separated using the least significant difference (LSD). Results revealed that the majority of the vegetative, pod and quantitative characteristics investigated show significant differences among the three species. These characteristics were used to construct a taxonomic key that facilitates the identification of the three sesame species.

Key words: Sesame, Nigeria, characteristics, taxonomy, sandy loam soil.

INTRODUCTION

Sesamum indicum L., a member of the family Pedaliaceae, and one of the medicinal plants widely used throughout the world (Bedigan, 2003; Sofowora, 1984) is one of the oldest cultivated plants in the world. According to Muhamman and Gungula (2008), the plant is gaining significance in the Nigerian agriculture because of the economic importance of its seeds as well as the nutritional value of the leaves when used as a vegetable. Sesame originated from Tropical Africa and was taken, at an early stage, to India where it was domesticated and became a crop of the new world (Falusi, 2007). Prabakeran (1996) observed that the nature of sesame leaf varies from one species to another. According to him, the leaves are ovate to wavy entire in *S. indicum*, penta-lobed entire in *Sesamum alatum*, heteromorphit linear to

three lobed entire leathery in *Sesamum malabaricum*, deeply dissected coarse in *Sesamum laciniatum*, coarse leathery with serrated margin in *Sesamum occidentale* and coarse broad in *Sesamum radiatum*.

Sesame plant is grown in different parts of Nigeria. In the Tiv and Idoma tribes of Benue State, Nigeria, two breeds of sesame, namely *S. indicum* and *S. radiatum* are cultivated mainly for their seeds and leaves (Obiajunwa et al., 2005). Falusi and Salako (2001) reported that the seeds yield a quantity of oil that is half their weight. The oil is commonly used in making soup while the young leaves are used as a soup vegetable. Various parts of the plant are also used in native medicine (Falusi and Salako, 2001). The stems are usually burned to provide fuel where firewood is scarce and the ash is commonly used for local soap production. The pressed cake that is formed after the oil is removed is a rich source of protein for animals (Alege et al., 2009a).

*Corresponding author. E-mail: yele174@yahoo.co.uk.

Though variation in climatic and edaphic conditions, according to Muhamman and Gungula (2008), affect sesame yields and performance, the major constraints identified in growing sesame in most countries are instability in yield, lack of wider adaptability, drought, non-synchronous maturity, poor stand establishment, lack of response to fertilizer application, profuse branching, lack of seed retention, low harvest index and susceptibility to insect pests and pathogens (Mahajan et al., 2007). Laurentin and Karlovsky (2006) reported that *S. indicum* has a large genetic variability. This attribute should be taken into account when planning conservation strategies or when sesame variability is being used in breeding programs. According to IPGRI (2004), germplasm characterization and evaluation studies revealed that sesame exhibits wide diversity in plant height, branching pattern, leaf shape, height of first capsule – bearing node, number of capsules per axil, capsule length and width, number of seeds per capsule, number of locules per capsule, internode length and height at first fruiting. In their own investigation, Mahajan et al. (2007) observed that sesame varieties selected from local landraces generally are adapted only to the environments from which they were derived. Contrary to this finding, Ercan et al. (2002) observed that numerous modern varieties and ecotypes of sesame adapt to various ecological conditions. However, the cultivation of these modern varieties is limited due to insufficient genetic information on them. This is supported by Laurentin and Karlovsky (2006).

The wide diversity in a sizeable number of sesame characteristics as revealed by IPGRI (2004), no doubt poses a problem in the identification of the plant's taxa. Hence, the focus of this study is to address this problem by identifying the vegetative and the pod characteristics of the sesame plants that are species specific. Such characteristics, because of their high taxonomic importance, could be used in constructing a taxonomic key for the purpose of easy and quick identification of the three sesame species irrespective of their growth environments.

MATERIALS AND METHODS

Three sesame species, namely *S. alatum*, *S. radiatum* and *S. indicum* were used in this study. Seeds of *S. alatum* ("gorigo" in Yoruba – a Nigerian language) were obtained from Anyigba market in Dekina Local Government Area of Kogi State, Nigeria while the seeds of *S. radiatum* ("ekuku pete" in Yoruba) and *S. indicum* ("ekuku gogoro" in Yoruba) were obtained from Oja Oba market in Ilorin, Kwara State, Nigeria. Seeds of the three species were planted and grown under the same soil and climatic conditions in 2007 and 2008 to eliminate variations that may have been induced by environmental differences. In 2009, seeds of each species were broadcast in a separate perforated plastic bucket of 5 L size filled with sandy loam soil. The buckets were kept at the Nursery of the Research Garden of the Department of Biological Sciences, Kogi State University (KSU), Anyigba, Nigeria. Watering was carried out regularly until seedlings were fully established. Two seedlings of each species were then transplanted to a 5 L size plastic bucket

filled with sandy loam soil and each bucket was replicated twenty times such that there were sixty buckets in all. The experimental design used for the study was the completely randomized design (CRD). The buckets were arranged and labeled appropriately as follows:

Buckets containing *S. alatum* - A
Buckets containing *S. radiatum* - B
Buckets containing *S. indicum* - C

Two weeks after transplanting, each plant stand was thinned to one seedling. Plants were watered adequately and weeding was carried out regularly using hands. The vegetative and the pod characteristics were investigated at flowering and harvest respectively. Each of these features was classified either as a qualitative trait or as a quantitative trait. The qualitative traits studied are habit of the plant, seed shape and color, flower color, leaf shape and stem texture. The quantitative (vegetative) traits investigated are plant height, stem circumference, number of nodes per plant, number of primary branches per plant, number of secondary branches per plant, final plant height, number of leaves per plant, leaf length, leaf width and leaf area. The quantitative (pod) characteristics studied are number of pods per plant, pod length, pod circumference, number of seeds per pod and weight of hundred (100) seeds. Mean values for each species were calculated and recorded from five plants randomly selected. All the linear measurements were carried out according to the method of Akinyele (2005) as modified by Akinyele and Adigun (2006). Weighing was carried out according to Alege et al. (2009a). Data were then subjected to analysis of variance (ANOVA) and means were separated using the least significant difference (LSD).

RESULTS

The descriptions of the nature of the qualitative characters are shown in Table 1 while the means of measurements of the vegetative and the pod characteristics are shown in Tables 2 and 3 respectively. Figure 1 shows the pods and the seeds of the three sesame species.

DISCUSSION

The differences that occur among organisms are caused by two factors: (i) variation in their genetic make-up and (ii) variation due to environmental influence (Elrod and Stansfield, 2003). Elmund et al. (2004) stated that the phenotype of members of the same species may vary continuously while their genotype is relatively stable throughout the life of the organisms. For taxonomic purposes, therefore, variation based on the genetic make-up of the organisms is more reliable than variation induced by changes in environmental factors (Akinyele and Temikotan, 2005). The fact that the seeds of the three sesame species used for this study were obtained from different places points to another fact that they must have been harvested from environments with different climatic and edaphic factors. The initial level of differences among the three sesame plants, therefore, may have been exaggerated by variation in the conditions of their places of cultivation. This will, no doubt, make some of

Table 1. Description of the qualitative characters of the three sesame species.

Species	Habit	Seed texture and color	Flower color	Leaf shape	Stem texture
<i>S. alatum</i>	Erect, moderately branched	Smooth brown	White	Linear with entire margin	Smooth
<i>S. radiatum</i>	Erect, highly branched	Rough black	Light purple	Heart shape with serrated margin	Hairy
<i>S. indicum</i>	Erect, moderately branched	Rough black	Dark purple	Linear with entire margin	Hairy

Table 2. Means of measurements of the vegetative attributes of the three species of sesame.

Species	Plant height (cm)	Stem circumference (cm)	No. of nodes per plant	No. of primary branches per plant	No. of secondary branches per plant	Final plant height (cm)	No of leaves per plant	Leaf length (cm)	Leaf breadth (cm)	Leaf area (cm ²)
A	71.74	2.68	19.60	6.60	4.60	111.18	124.80	11.52	4.26	50.56
B	42.68	3.26	13.20	16.20	114.80	72.90	1045.80	5.58	4.12	23.40
C	88.82	3.34	21.40	18.20	37.20	121.54	510.20	9.84	4.78	46.99
LSD value	22.6212	NS	5.4747	7.6019	78.8372	30.8499	511.7840	2.9871	NS	18.8533

Table 3. Means of measurements of the pod characteristics of the three sesame species.

Species	Number of pods per plant	Pod length (cm)	Pod circumference (cm)	No. of seeds per pod	Weight of 100 seeds (g)
A	60.60	2.86	2.94	66.20	0.38
B	407.80	1.30	1.96	37.00	0.18
C	153.40	2.84	2.60	76.80	0.33
LSD value	229.4975	0.2135	0.2652	20.5414	0.0872

these differences to be of no taxonomic value. Since this study has eliminated the environmentally induced variation by bringing the three sesame plants into cultivation under the same environmental factors, any character that now shows significant variation is most likely to have a taxonomic value. The results obtained from the study carried out on the qualitative characters show that there are sharp differences (discontinuous variation) among the three sesame

species used for this investigation (Table 1). The differences are particularly more pronounced in the flower color which is specific for each species. This indicates that each of the three species is of a distinct genotype. Out of the ten quantitative (vegetative) characteristics studied, eight showed significant differences among the three sesame species (Table 2). These characteristics are plant height, number of nodes per plant, number of primary branches per plant, number of secondary

branches per plant, final plant height, number of leaves per plant, leaf length and leaf area. The fact that the three species showed significant differences in these attributes is an indication that they have diverged from their common ancestral stock. Hence, the significant differences observed are largely a legacy of the interaction between the sesame species and their new local environments. This report is in consonance with the finding of Mahajan et al. (2007) that varieties



S. ALATUM

S. RADIATUM *S. INDICUM*

Figure 1. The pods and the seeds of the three sesame species.

selected from local landraces generally are adapted to the environments from which they were derived. The two characteristics that show no significant differences are the stem circumference and the leaf width. That the two characteristics are still retained in spite of the divergence is clearly an indication that they are under a strong influence of the genotype. This agrees with the finding of Alege et al. (2009b). Hence, as also reported by Akinyele (2005), they are so stable that the new environments have very little or no effect on them.

The yield of any crop, as expressed by Caliskan et al. (2004) and Polat et al., (2006), is, directly or indirectly, a function of its phenotypic expression which, in turn, is a reflection of the interaction between the crop's genotype and the existing climatic and ecological factors (Akinyele and Osekita, 2006). All the five pod characteristics studied show significant differences among the three sesame species (Table 3). This is a further evidence that, although they may have had the same origin; their evolution has been along different trends. Having identified those characteristics of the sesame plants that are species specific, they can now be used to construct a taxonomic key that will assist in identifying the three species. The following taxonomic key is, therefore, an attempt to achieve this goal.

1a. Leaf linear with entire margin, about 10.0 - 12.0 cm long and 4.0 - 4.5 cm broad:

- 2a. Seed brown and smooth, 100 weighing about 0.38 g.....*S. alatum*
- 2b. Seed black and rough, 100 weighing about 0.33 g.....*S. indicum*
- 1b. Leaf heart-shape with serrated margin; about 5.4 - 6.0 cm long and 3.8 - 4.3 cm broad:*S. radiatum*

Conclusion

The aim of this study, which is to identify sesame characteristics that are species specific, has been achieved. These characteristics have also been used to construct a taxonomic key that will make identification of the three sesame species easy and quick. The vegetative and the pod characteristics investigated in the study are therefore relevant to the taxonomy of Nigerian sesame.

REFERENCES

Akinyele BO (2005). The bearing of vegetative morphology on the taxonomy of four Nigerian species of Aleo Linn. App. Trop. Agric. 10(2): 8-12.
 Akinyele BO, Adigun AB (2006). Soil texture and the phenotypic expression of maize (*Zea mays* L.). Res. J. Bot. 1(3): 139-143.
 Akinyele BO, Osekita OS (2006). Correlation and path coefficient analyses of seed yield attributes in okra – *Abelmoschus esculentus* (L.)

- Moench. *Afr. J. Biotechnol.* 5(14): 1330-1336.
- Akinyele BO, Temitokan T (2005). Taxonomic implication of leaf epidermal characters of three Nigerian representatives of *Dipcadi*. *J. Res. Sci. Manag.* (3)1: 17-24.
- Alege GO, Akinyele BO, Agianaku E (2009a). Effects of nutrient source on the vegetative and pod attributes of sesame in Anyigba, Nigeria. *App. Trop. Agric.* 2(14): 60-63.
- Alege GO, Akinyele BO, Bodunde MO (2009b). Effect of nutrient source on the phenotypic expression and gall formation in okra – *Abelmoschus esculentus* (L.) Moench. *App. Trop. Agric.* 14(1): 54-59.
- Bedigan D (2003). Evolution of sesame revisited. Domestication, diversity and prospects. *Genet. Resour. Crop Evol.* (7): 773-778.
- Caliskan S, Arslan M, Arioglu H, Isler N (2004). Effect of planting method and plant population on growth and yield of sesame (*Sesamum indicum* L.) in a mediterranean type of environment. *Asian J. Plant Sci.*, 3: 610-613.
- Elmund WS, Dunn LC, Theodosius D (2004). Principles of Genetics TaTa McGraw-Hill Edition, New York, p 459.
- Elrod SL, Stansfield WD (2003). Genetics: Tata McGraw- Hill Publication, New Delhi. India, p. 500.
- Ercan AG, Taskin KM, Turgut K, Bilgen M, Firat MZ (2002). Characterization of Turkish sesame (*Sesamum indicum* L.) Landraces using agronomic and morphologic descriptors. *Akdeniz Universitesi Ziraat Fakultesi, Dergisi.* 15(2): 45- 52.
- Falusi AO, Salako EA (2001). Assemblage of sesame germplasm for conservation and genetic improvement in Nigeria. *Plant Genetic Resour. Newslett.*, 127: 25- 38.
- Falusi OA (2007). Segregation of genes controlling seed color in sesame (*Sesamum indicum* Linn.) from Nigeria. *Afr. J. Biotechnol.* 6(24): 2780- 2783.
- International Plant Genetic Resources Institute (IPGRI) (2004). Descriptors for Sesame (*Sesamum* spp), Rome, Italy. p. 63.
- Laurentin HE, Karlovsky P (2006). Genetic relationship and diversity in Sesame (*Sesamum indicum* L) germplasm collection using amplified fragment length polymorphism (AFLP). *GMC Genet.*, 7: 1-10.
- Mahajan RK, Bisht IS, Dhillon BS (2007). Establishment of a core collection of World Sesame (*Sesamum indicum* L) germplasm accessions. *SABRAO J. Breed. Genet.* 39(1): 53-64.
- Muhamman MA, Gungula DT (2008). Growth Parameters of Sesame (*Sesamum indicum* L.) as affected by Nitrogen and Phosphorus level in Mubi. *Nig. J. Sustainable Dev. Agric. Environ.* 3(2): 80- 86.
- Obiajunwa EI, Adebisi FM, Omode PE (2005). Determination of Essential Minerals and Trace TXRF Technnique. *Pak. J. Nutr.*, 4(6): 393 -395.
- Polat R, Saglam R, Aydemir S, Cikman A (2006). Effects of different tillage methods on soil physical properties under second crop sesame in the harran plain, Southeast Turkey. *Asian J. Plant Sci.*, 5: 613-618.
- Prabakeran AJ (1996). Genetic Diversity of wild Sesame from Southern India. *J. Plant Genetic Resour. Newslett.* 106: 36- 39.
- Sofowora A (1984). Medicinal plants and traditional medicine in Africa. John Wiley and Sons Ltd. New York, p. 256.