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Morphological evaluation of selected sesame (*Sesamum indicum* L.) genotypes from five states in Northern Nigeria

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The morphological characteristics of 12 selected sesame (*Sesamum indicum* L.) genotypes, from five states in northern part of Nigeria (Kaduna, Niger, Nassarawa, Kogi, and Benue), were evaluated during the 2012 cropping season at the Department of Biological Sciences experimental field, Federal University of Technology, Minna, Nigeria using a randomized block design. The objective of the experiment was to assess the performances of all the selected genotypes based on morphological parameters such as plant height, petiole length, number of leaves/plant, number of branches per plant and leaf surface area per plant. While NG01 had the tallest plants 2 weeks after planting, KG01 and NA01 had the shortest plants. Seven genotypes; (KD, NG-01, NG-02, NA-01, BE-01, KG-01 and KG-02 had positive characteristics (such as higher number of leaves and high number of branches) which could bring about high yield. These findings suggest that some of the genotypes could be potential parents for inclusion in future breeding programmes aimed at improving *S. indicum* in northern Nigeria.

Key words: *Sesamum indicum* L., morphological characteristics, genotypes.

INTRODUCTION

Sesame (*Sesamum indicum* L.; Pedaliaceae family) is an annual plant that is considered to be one of the most important and oldest oil crops (Noorka et al., 2011) that has been under cultivation in Asia for over 5000 years (Bisht et al., 1998). The crop originates predominantly from East Africa, with fewer germplasms from India (Nayar and Mehra, 1970; Baydar, 1999; Bedigian, 2003).

Sesame is an important source of high quality oil and protein (IPGRI and NBPGR, 2004). The oil has an excellent stability due to the presence of natural antioxidants such as sesamolin and sesamin (Brar and Ahuja, 1979; Kamal-Eldin, 1993). The fatty acid composition of its oil varies considerably among different cultivars worldwide (Yermanos et al., 1972). After oil

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extraction, the remaining meal contains 35 to 50% protein, and is rich in tryptophan and methionine. Sesame seed coats are rich in calcium (1.3%) and provide a valuable source of minerals (Johnson et al., 1979). The addition of sesame to the high lysine meal of soybean produces a well-balanced animal feed.

India and China are currently the world's largest producers of sesame, followed by Myanmar, Sudan, Uganda, Nigeria, Pakistan, Tanzania, Ethiopia, Guatemala and Turkey. World production of sesame fluctuates due to disturbances in local economies, crop production and weather conditions. Nigeria is the third largest producer of Sesame in Africa, after Sudan and Uganda with about 165.1 ha (harvested area) that produced 83 tons (FAO, 2005) numerous wild relatives occur in Africa (Baydar, 1999). In Nigeria, sesame is often referred to as benniseed and is widely used and very popular in parts of the north, where it is commonly grown. The local names are *riddi* in Hausa, *ishwa* in Tiv, *yamati* or *eeku* in Yoruba, *igorigo* in Igbira, *anufi* in Gbagi, and *esso* in Nupe (Falusi and Salako, 2001). The seeds, which yield half of their weight in oil, are most commonly used in soups while the young leaves are used in a soup vegetable, while the stem and oil extracts are used in making local soups. Traditionally, the seeds are roasted and mixed together with roasted groundnut or used as a soup thickening condiment in Nigeria (Falusi and Salako, 2001). According to Kobayashi et al. (1990), 36 species have been identified of which 22 species have been found in Africa, 5 in Asia, 7 in both Africa and Asia, and one species each in Crete and Brazil.

Variation is a necessary criterion for any selection programme aimed at improving desirable characters. Adeyemo and Ojo (1993) reported some morphological characters such as plant height, height of first capsule, days to flowering, number of Capsule as important characters to be considered for evaluation in sesame. Despite the visible presence of a wide range of variability in morphological characters in sesame, no selection within local genotypes or hybridization has resulted in the improvement of the crop.

The objective of this study was therefore to study such variability in morphological traits that would allow suitable germplasm to be identified as potential parents for future sesame breeding programmes.

MATERIALS AND METHODS

Twelve sesame genotypes used in this study were collected from local farmers in sesame-growing regions in collaboration with Nigeria's Agricultural Development Project (ADP) of the states of the North central zones, namely Kaduna, Niger, Kogi, Benue, and Nassarawa.

A factorial experiment was adopted using a total of 12 combinations in a randomized block design, and each genotype was replicated three times. Two plants were remained in each pot after planting for three weeks with an inter-pot distance of 40 cm. Pots were placed in open sunlight (that is, no shading). The soil type used for the experiment was a sandy-loamy soil (sand, silt, clay = 83.52, 7.28 and 7.20%, respectively) collected from the experimental site with a pH of 6.34. The average temperature in the cropping season was 26.7 to 35.3°C. The experiment was conducted at the Department of Biological Sciences Experimental Garden, Federal University of Technology, Minna, Nigeria. Plants were watered twice daily. The most common pests recorded were *Helicoverpa* sp. caterpillars, which penetrate into the fruit of the sesame plant and destroy them, and fungal attack by *Cercospora sesame*, which usually destroys the plant's leaves. Plants were sprayed with pesticides and insecticides (pyrethroids cypermethrin) at a rate of 10 to 15 L/ha with controlled droplet application using spinning disc sprayers.

The following data was obtained: 1) Plant height at 2 and 4 weeks after planting (WAP) and at maturity, which was measured from the ground level up to the terminal bud on the main axis of each plant using a ruler. 2) Number of branches/plant. 3) Length of petiole (cm) using a ruler. 4) Leaf surface area (cm^2). 5) Survival percentage at 3 WAP.

Data was separated by analysis of variance (ANOVA) and significant differences among the means of morphological and yield parameters were assessed by Duncan's multiple range test. Survival was represented as simple percentages.

RESULTS

Significant differences were detected among the 12 sesame genotypes for seed colour, flower colour and seed length (Table 1). All genotypes showed wide ranges of variation for morphological characters such as plant height, number of leaves per plant, number of branches per plant, petiole length and leaf surface area (Tables 2 and 3). For example, while NG01 had the tallest plants at 2 WAP, KG-01 and NA-01 were shortest (Table 2). NA-01 and KD, on the other hand, had the highest number of branches, while NG-04 had the least. Also, while NA-01 had the highest number of leaves, genotype NG-01 had the longest petioles. KG-02 had the highest leaf surface area while NG-04 had the least. While NG-01 had the highest percentage survival at 3 WAP, NA-02 and NG-04 had the lowest survival percentages (Figure 1). NA-02 did not survive after 3 WAP.

DISCUSSION

The present study indicates that significant genetic variability exists among 12 sesame genotypes from the northern part of Nigeria. These genotypes are available and fundamental for the development of the species in Nigeria. Yahaya et al. (2014) stated that it is common to find similar genotypes with different registrations in germplasm collections. Likewise also it is possible that, in genotypes of distinct origin, genotypes which are the same can be found, even though they are phenotypically different. Alege and Mustapha (2013) reported that morphological attributes such as plant height, number of leaves, stem diameter and number of pods/plant are not under a strong genetic influence.

Nevertheless, the variability that was observed in the

Table 1. Description and sources of the 12 collected sesame genotypes.

Accession number	Local name	Source	Seed colour	Colour of flowers	Seed length (mm)
KD	Riddi	Kafanchan, Kaduna	White	White	3-3.5
NG-01	Anufi	Paiko, Niger	Light brown	White	2-2.5
NG-02	Ishwa	Saminaka, Niger	Light brown	White	3
NG-03	Esso	Katcha, Niger	Light brown	White	2-3
NG-04	Anufi	Mayaki, Niger	Creamy white	White	2-3
NA-01	Riddi	Nassarawa	Black	Purple	2-3
NA-02	Riddi	Nassarawa	Brown	White	2-3
NA-03	Riddi	Nassarawa	White	White	2-3
BE-01	Ishwa	Benue	White	White	2
BE-02	Ishwa	Benue	Creamy white	White	3-3.5
KG-01	Gogori	Kogi	Creamy white	Purple	3
KG-02	Gogorigo	Kogi	Light brown	White	2-3

Table 2. Mean plant height (cm) of the 12 collected sesame genotypes.

Accession number	2 WAP	4 WAP	6 WAP
KD	4.41 ± 1.05^{ab}	17.89 ± 4.75^{a}	59.13 ± 16.34^{cd}
NG-01	4.71 ± 1.49^{a}	16.97 ± 5.44^{ab}	56.16 ± 15.73^{cd}
NG-02	2.50 ± 0.69^{ef}	16.74 ± 4.99^{ab}	63.40 ± 21.84^{bc}
NG-03	4.11 ± 0.77^{ab}	13.76 ± 4.40^{bc}	54.37 ± 16.62^{cd}
NG-04	2.32 ± 0.79^{f}	7.65 ± 3.63^{f}	46.40 ± 13.72^{e}
NA-01	1.94 ± 1.13^{f}	8.30 ± 2.70^{ef}	73.27 ± 4.86^{ab}
NA-03	3.75 ± 0.84^{bc}	11.90 ± 6.68^{cd}	48.90 ± 14.49^{cd}
BE-01	3.13 ± 0.74^{de}	12.67 ± 4.09^{cd}	75.10 ± 9.56^{a}
BE-02	3.49 ± 1.01^{cd}	11.54 ± 3.96^{cd}	48.90 ± 10.94^{de}
KG-01	2.09 ± 0.70^{ef}	11.02 ± 2.79^{de}	61.50 ± 15.36^{c}
KG-02	3.45 ± 0.92^{cd}	14.67 ± 3.41^{ab}	58.27 ± 17.78^{cd}

Values are mean ± SD. Values followed by the same letter(s) within a column do not differ statistically ($P \leq 0.05$) according to DMRT. WAP = weeks after planting.

Table 3. Mean of several morphological characteristics of the 12 collected sesame genotypes.

Accession number	Petiole length (cm)	No. leaves/plant	No. branches/plant	Leaf surface area (cm^2)
KD	1.42 ± 0.56^{ab}	59.00 ± 29.35^{bc}	4.00 ± 1.89^{a}	20.33 ± 6.01^{ab}
NG-01	1.54 ± 0.57^{a}	52.00 ± 16.34^{bc}	3.00 ± 1.16^{ab}	18.77 ± 4.12^{ab}
NG-02	1.32 ± 0.56^{ab}	65.00 ± 31.04^{b}	2.00 ± 0.98^{bc}	19.43 ± 6.42^{ab}
NG-03	1.24 ± 0.33^{ab}	52.00 ± 25.45^{bc}	3.00 ± 1.57^{ab}	17.67 ± 6.42^{ab}
NG-04	1.12 ± 0.27^{b}	34.00 ± 17.95^{d}	1.00 ± 1.26^{d}	13.40 ± 4.97^{d}
NA-01	1.24 ± 0.42^{ab}	96.00 ± 32.88^{a}	4.00 ± 1.38^{a}	16.83 ± 5.39^{ab}
NA-03	1.13 ± 0.40^{b}	40.00 ± 16.45^{cd}	1.47 ± 1.59^{cd}	15.53 ± 8.53^{bc}
BE-01	1.17 ± 0.47^{a}	51.00 ± 16.62^{bc}	2.00 ± 0.79^{bc}	14.40 ± 5.72^{cd}
BE-02	1.48 ± 0.60^{ab}	39.00 ± 15.84^{d}	1.93 ± 1.48^{c}	15.22 ± 6.99^{cd}
KG-01	1.20 ± 0.51^{a}	52.00 ± 26.30^{bc}	2.18 ± 1.19^{bc}	18.17 ± 5.31^{ab}
KG-02	1.21 ± 0.41^{ab}	52.00 ± 17.50^{bc}	2.00 ± 1.00^{bc}	20.67 ± 7.06^{a}

Values are mean ± SD. Values followed by the same letter(s) within a column do not differ statistically ($P \leq 0.05$) according to DMRT.

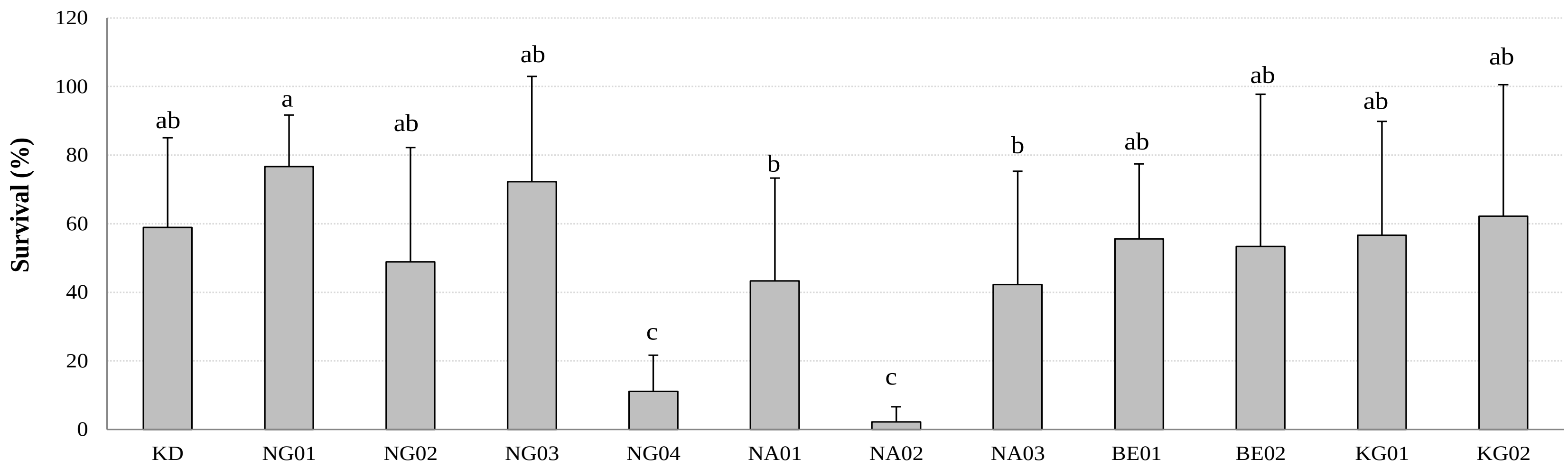

Figure 1. Survival percentages of 12 sesame genotypes collected from the North of Nigeria. Error bars indicate SD. Values followed by the same letter(s) do not differ statistically (*P*≤0.05) according to DMRT.

present study will be further characterized and studied for the identification of duplicates and to select parents for breeding programs. Falusi et al. (2014) characterized Roselle germplasm based on information derived from both morphological and agronomic traits to maximize the germplasm's genetic potential. Plant height, for instance, is one important characteristic that could help to differentiate sesame genotypes into short, medium and tall forms. The high number of branches observed in some of the genotypes, such as KD, NG-01, NG-03, NA-01, may ultimately determine the pod-bearing ability of a plant which in turn may contribute to yield.

Thus, identification and selection of genotypes with more branching ability is necessary. Variation in branch number among sesame varieties has been previously reported (Suhasini, 2006; Seymus and Bulent, 2010). Branching habit is affected by environmental conditions, sowing season, seed rate and spacing (Weiss, 1971). Number of branches in sesame is highly heritable and is influenced by the genetic content of the genotype (Shadakshari et al., 1995; Pham et al., 2010). The number of leaves per plant and leaf surface area also plays important roles in the yield ability as leaves are the site of nutrient synthesis of plants. Several genotypes, such as KD, NG-01, NG-02, NA-01, BE-01, KG-01 and KG-02, which had positive characteristics such as a high number of leaves and number of branches which could bring about high yield, are potential parents for inclusion in future breeding programmes aimed at improving the agronomic aspects of sesame in the north of Nigeria.

Conflict of Interest

The author(s) have not declared any conflicts of interest.

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