

Evaluation of M₃ lines of sesame (*Sesamum indicum* L.) for vegetative parameters

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Abstract

Vegetative parameters of eight M₃ (third mutant generation) lines of sesame were evaluated under rain fed condition. The seeds of the lines were sown alongside their respective controls using a randomized complete block design. The eight lines were generated from three parental stocks: NCRIBEN-04E (V₁), NCRIBEN-01M (V₂) and NCRIBEN-03L (V₃). The three parental stocks were exposed to different doses of gamma irradiation from cobalt-60 source. 04E-550-G2-3 had the highest plant height (57.40) at the 6th week which was significantly different (P<0.05) from the three checks. 03L-450-G2-2 had the highest petiole length (12.45cm) which was significantly different (P<0.05) from the checks except check three (12.25cm) which was not significantly different (P>0.05). 03L-450-G1-2 had the highest number of leaves (91) and consequently highest number of branches (5.60). Although the number of leaves were significantly different (P<0.05) from Check three (54.60), there was no significant difference (P>0.05) between the number of branches and check three (5.40). The results obtained for vegetative parameters of M₃ lines of sesame suggests that some of the genotypes could be used as potential parents for future breeding programmes aimed at improving sesame lines.

Keywords: doses; gamma irradiation; parental stocks; vegetative

Introduction

Sesame (*Sesamum indicum* L.) also called benni seed is a self-pollinating flowering plant belonging to the family Pedaliaceae (Ghandi, 2009). Sesame, being the first tamed oil crop is also among the best oil crops in the world (Ashri, 2007). Sesame is popularly called the king of oil seeds due to its high oil content of between 50% - 60% (Toan *et al.*, 2010). Sesame seed contains excellent amounts of nutrients such as phosphorus, oxalic acid and excellent qualities of seed oil and meal (Prasad, 2002). India and China presently produce the highest quantity currently of sesame followed by Myanmar, Sudan, Ethiopia, Uganda, Nigeria, Pakistan, Tanzania and Paraguay (Sharma *et al.*, 2014).

In Nigeria, sesame is often called Benni seed and it is cultivated in large scale in many parts of the north. The local names are 'Riddi' in Hausa, 'Ishwa' in Tiv, 'Eeku' in Yoruba, 'Igorigo' in Igbira, 'Esso' in Nupe and 'Anufi' in Gbagi (Falusi and Salako, 2001). Sesame oil is used in cooking and also used in Salad and confectionary products. The young leaves are used in vegetable soup and the stem and oil extracts are used in making local soaps (Falusi and Salako, 2003). The seeds are roasted traditionally and mixed together with roasted groundnut or used as a soup thickening condiment in Nigeria (Falusi and Salako, 2001).

Sesame is highly tolerant to drought due to its extensive root system and grows in areas where other crops may not thrive. However, it requires adequate moisture for germination and growth (FAO, 2012; Jayakumar *et al.*, 2015). Sesame seeds are utilized as major constituents in several consumables, a large component of the seeds is utilized as oil and meal (Morris, 2009; Muhammad *et al.*, 2013). Sesame oil has shown great prospects in the lowering of blood pressure, blood cholesterol and also act in alleviating atherosclerosis, heart disease and cancers due to its high level of polyunsaturated fatty acids (Hibasami *et al.*, 2000; Miyahara *et al.*, 2001).

Several studies have shown that mutation breeding greatly improves genetic variant of crop plants. Genetic diversity of plants has been overstretched as a result of fast eroding genetic resources and high decline in genetic resources, hence the need for mutation breeding which have proven to greatly improve the genetic variant of crop plants. Many evidences have portrayed mutation breeding to highly enhance genetic variant of crop plants as the variability of crop plants at species level have reached its limit due to high breeding intensity and rapid erosion of genetic resources (Poornananda and Hosakatte, 2009). Research has shown that irradiated seeds enhance mutation frequency, promote gene recombination and broaden the mutation spectrum (Micke *et al.*, 1996). They are effective in improving growth and quality of plants, through their high mutation frequency; and can interact with atoms and molecules, thus producing free radicals in cells that affect the morphology, anatomy, biochemistry and physiology of the plants (Chahal and Gosal, 2002, El-Khateeb *et al.*, 2016).

Variation is an inevitable criterion for any selection programme aimed at improving desirable characters. Adeyamo and Ojo (1993) reported some morphological characters such as plant height, height of first capsule, days to flowering and number of capsules as important traits to be considered for evaluation in sesame (Figure 1).

The objective of this study was therefore to evaluate variability in morphological characters that would allow for selection of germplasm with desirable traits which will be beneficial for future breeding programmes of sesame as shown in Figure 1 (high number of multicarpillate capsules, long petioles, high plant heights) and Figure 2 (high number of leaves and branches).



Figure 1. Sesame plant with fruits (Source: field source)



Figure 2. Sesame plant with flowers (Source: field source)

Materials and Methods

Description of the study area

The experiment was conducted at the experimental garden of Federal University of Technology Minna, Niger State, Nigeria. Minna is located in the North Central Zone of Nigeria, within longitude 6° 33' East and latitude 9° 37' North.

Seed collection

Eight M₃ (mutant seeds) lines of sesame with three controls were obtained from the department of Plant Biology, Federal University of Technology, Minna, Nigeria for further evaluation to M₄ lines. The description of the lines is shown in the Table 1 below.

Table 1. Parental stock and main characters of M₃ lines

Mutant lines	Dose (Gy)	Major feature
NCRIBEN 04E 04E-550-G1-3	550	3 carpels/capsule, single capsule/leaf axil
04E-550-G2-3	550	2 carpels/capsule, 2-3 capsules/leaf axil
04E-550-G3-3	550	2 carpels/capsule, Single capsule/leaf axil
Check One	0	2 carpels/capsule, Single capsule/leaf axil
NCRIBEN 01M 01M-350-G1-2	350	3 carpels/capsule, single capsule/leaf axil
01M-350-G2-2	350	2 carpels/capsule, Single capsule/leaf axil
Check Two	0	2 carpels/capsule, Single capsule/leaf axil
NCRIBEN 03L 03L-250-G1-1	250	2 carpels/capsule, Single capsule/leaf axil
03L-450-G1-2	450	2 carpels/capsule, Single capsule/leaf axil
03L-450-G2-2	450	3 carpels/capsule, single capsule/leaf axil
Check Three	0	2 carpels/capsule, Single capsule/leaf axil

Source: Muhammad *et al.* (2018).

Experimental design

The experiment was conducted using a Complete Randomized Block Design (CRBD). It consisted of thirty Plants per block with three replications for each of the eight lines (8) and their respective controls. Three seeds were sown per hole and thinned down to two at three weeks after planting. The plants were sown alongside their respective controls during the 2018 cropping season.

Collection of data

Agro-morphological parameters such as plant height, length of petiole, number of leaves and number of branches were taken between May and August, 2018 according to Falusi *et al.* (2015) and Yahya *et al.* (2015).

Results

The evaluation of M₃ lines of Sesame (*Sesamum indicum* L.) for vegetative parameters was presented in Table 1. The highest plant height at week three (3), four (4) and five (5) was observed in the check three (9.70 cm, 22.50 cm and 33.80 cm). This was significantly different ($P < 0.05$) from the plant heights of other lines. The highest plant height at week six (57.40) was observed in 04E-550-G1-3 which was significantly different ($P < 0.05$) from the plant heights of other lines. Check one had the lowest plant height (36.60 cm) at week six (6) while 01M-350-G1-2 had the lowest plant height (5.08 cm) at week three (3) which were both significantly different from the plant heights of other lines.

03L-450-G2-2 had the highest petiole length (12.45 cm) which was statistically the sesame ($P > 0.05$) with check three (12.25 cm) but statistically different ($P < 0.05$) from petiole length of all other lines. Check one from had the lowest petiole length (5.50 cm).

The highest number of leaves was observed in 03L-450-G1-2 (91.00) was significantly different from the number of leaves in other lines while check one had the least number of leaves (51.60) which was significantly different from the number of leaves of other lines.

A similar trend was observed in the number of branches where 03L-450-G1-2 had the highest number of branches (5.80) which was statistically similar ($P > 0.05$) to check three (5.40) but significantly different from other lines.

Table 2. Vegetative parameters of three varieties of sesame lines at different irradiation doses

Mutant Lines	PH at wk3	PH at wk4	PH at wk5	PH at wk6	LPat wk6	NL at wk6	NB at wk6
NCRIBEN04E (V1)							
04E-550-G1-3	6.46±0.70 ^{ab}	15.20±1.07 ^{abc}	23.40±2.73 ^a	47.80±3.02 ^{abcd}	10.48±1.36 ^b	61.20±4.68 ^a	3.00±0.71 ^{ab}
04E-550-G2-3	7.70±1.87 ^{ab}	18.80±2.97 ^{bc}	30.70±5.13 ^{bc}	57.40±4.39 ^d	9.50±0.89 ^b	63.80±5.93 ^a	4.20±0.80 ^{ab}
04E-550-G3-3	6.36±1.77 ^{ab}	12.06±1.31 ^{ab}	28.60±1.81 ^{abc}	44.60±4.45 ^{abcd}	10.30±1.02 ^b	56.60±4.68 ^a	4.80±0.73 ^{ab}
Check One	7.70±1.39 ^{ab}	11.40±2.37 ^a	21.20±3.62 ^a	36.60±6.83 ^a	5.50±0.65 ^a	61.80±11.0 ^a	3.40±0.75 ^{ab}
NCRIBEN01M (V2)							
01M-350-G1-2	7.30±1.00 ^{ab}	16.30±3.56 ^{abc}	30.50±1.95 ^{bc}	46.00±4.83 ^{abcd}	10.68±0.42 ^b	61.60±11.47 ^a	3.60±1.03 ^{ab}
01M-350-G2-2	5.08±0.44 ^{ab}	19.00±0.71 ^{ab}	29.00±1.58 ^{abc}	57.20±3.00 ^{cd}	8.50±0.54 ^b	57.40±4.74 ^a	2.40±0.68 ^a
Check Two	8.50±1.50 ^{ab}	13.60±2.75 ^{ab}	24.50±2.38 ^b	39.90±3.13 ^{ab}	9.38±0.47 ^b	51.60±6.90 ^a	3.60±1.21 ^{ab}
NCRIBEN 03M (V3)							
03L-250-G1-1	7.30±1.00 ^{ab}	16.30±3.56 ^{abc}	30.50±1.95 ^{bc}	46.00±4.83 ^{abcd}	10.68±0.42 ^b	61.60±11.47 ^a	3.60±1.03 ^{ab}
03L-450-G1-2	8.50±0.97 ^{ab}	17.40±2.27 ^{abc}	30.10±0.93 ^{abc}	51.20±5.40 ^{abcd}	8.95±0.49 ^b	91.00±4.83 ^b	5.80±0.86 ^b
03L-450-G2-2	5.80±0.78 ^a	18.90±1.14 ^{ab}	25.80±2.92 ^{abc}	50.80±2.13 ^{abcd}	12.45±0.61 ^c	88.20±4.51 ^b	4.20±1.16 ^{ab}
Check Three	9.70±1.80 ^b	22.50±1.50 ^c	33.80±3.07 ^c	53.00±3.30 ^{bcd}	12.25±0.14 ^c	54.60±9.77 ^a	5.40±0.81 ^b

Values are Means ± Standard Error. Values followed by different superscript(s) along the column are significantly different at $P \leq 0.05$. PH=Plant height, LP=Length of petiole, NL=Number of leaves, NB=Number of branches

Discussion

The variations observed in mean plant heights of the three parental stocks could be as a result of the gamma irradiation treatments.

There was no significant difference in plant height of NCRIBEN 04E and NCRIBEN 01M parents at the third week. This result is similar to the results of IAEA (1994) on sesame who reported that sesame varieties are highly resistant to gamma irradiation doses. However, significant differences were observed in the NCRIBEN 03L parent at the third week. This may be due to the inhibitory effects of the gamma irradiation on the irradiated sesame varieties. This result is similar to the results of Boureima *et al.* (2009) and Begum and Dasgupta (2011) who both reported a decrease in plant height with increasing irradiation doses. However, the increasing plant height recorded in the 04E-550-G1-3 at the sixth week may be due to the production of growth hormones and cell elongation as a result of irradiation treatments. This result is similar to the work of Daudu (2011) on pepper who reported increase in morphology as a result of increasing exposure to irradiation especially plant height and contrary to the result obtained by the two authors (Boureima *et al.*, 2009 and Begum and Dasgupta, 2011).

The increase in petiole length with increasing irradiation doses in 03L-450-G2-2 is an indication of a stimulating effect of gamma irradiation on petiole length. This result is similar to the work of Muhammad (2018) who recommended gamma irradiation dose of 150-550Gy to be effective for the improvement of vegetative parameters of sesame and contrary to the work of Titus *et al.* (2018) on egg plant, who reported increase in petiole length with decrease in irradiation treatment.

A similar trend was observed in the number of leaves per plant where 03L-450-G1-2 had the highest number of leaves which was observed in the line with higher dose of gamma irradiation exposure. This result is similar to the result obtained by Nura *et al.* (2013) who reported a greater number of leaves with increasing dose of gamma irradiation in sesame.

03L-450-G1-2 had the highest number of branches which may ultimately increase the capsule bearing ability of a plant thereby increasing the plant yield. This may be as a result of the irradiation treatments.

Conclusions

The results of this study showed variations among the different sesame lines used in this study. Although NCRIBEN 03L (V₃) appears to be most favoured morphologically, different vegetative parameters favoured other varieties. Thus, gamma irradiation can be used as a mechanism for creating faster and useful variability in sesame.

Authors' Contributions

All authors contributed equally to this research, such as data curation, formal analysis, funding acquisition, investigation, methodology, project administration, resources, software, supervision, validation, writing review and editing. All authors read and approved the manuscript.

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Conflict of Interests

The authors declare that there are no conflicts of interest related to this article.

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