Original Article

EFFECTS OF Sodium Azide ON YIELD TRAITS OF TWO VARIETIES OF SESAME (*Sesamum indicum*).

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ABSTRACT

The effect of Sodium azide (a chemical mutagen) and the yield traits of two varieties of sesame (*Sesamum indicum*) viz; Kenana-4 and Ex-Sudan were studied. Three hundred seeds of each variety were treated with Sodium azide at five different concentrations (0.00%, 0.02%, 0.04%, 0.06% and 0.08%) before they were sown and grown to maturity in order to assess the effects of the different concentrations of the chemical on th plants. The results showed that 0.02% Sodium azide concentration had significantly higher values ($p<0.05$) when compared with its control in most of the characters. It was observed tha, t one of the variety Kenana-4 had hiher value ($p<0.05$) for oil content at 0.08% sodium azide concentration. The results suggest that while 0.02% Sodium Azide concentrations is the most effective to induce valuable and useful mutants for many of the yield parameters, 0.08% is effective with respect to all contents of sesame. Therefore, sodium azide can be an important tool for enhancing yield traits in sesame.

Keywords: sodium azide, *Sesamum indicum*, chemical mutagen, Ex-sudan

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INTRODUCTION

It belongs to the family Pedaliaceae and genus Sesamum. The genus consists of about 36 species out of which the commonly recognized is Sesamum indicum L. (Falusi, 2006). Sesamum indicum is very drought tolerant. It has been called a survivor crop because of its ability to grow where most plants fail. The crop is believed to have originated from

Africa where the greatest diversity of the genus sesamum and its family Pedaliaceae is present (Falusi and Salako, 2003). Currently it is cultivated in the tropical and sub tropical region of Africa, South America, North America and Asia, principally for its seeds which contains about 50-52 % oil, 17-19 % Protein and 16-18 % carbohydrate (Falusi and Salako, 2003). Some of the local names of the crop in Nigeria are ("Ridi" Hausa) ("Ishwa" Tiv), ("Gorigo" Igbira), ("Eeku" Yoruba) and ("Doo"Jukun) (Falusi, Salako and Ishaq, 2001). It is an annual plant growing to 50 - 100cm (1.6 to 3.3 ft) tall, with opposite leaves 4 -14cm (1.6 - 55 in) long with an entire margin: they are broad lanceolate, to 5cm (2in) broad at the base of the plant, narrowing to just 1 cm (0.4in) broad on the flowering stem. The flowers are yellow, tubular, 3 to 5cm (1.2 to 2.0m) long, with four lobed mouths. The flower may vary in colour with some being white, blue or purple. Sesame fruit is a capsule, normally pubescent, rectangular in section and typically grooved with a short triangular beak. The length of the fruit capsule varies from 2 to 8 cm. Its width varies between 0.5 to 2cm, and the number of loculi from 4 to 12. The fruit naturally splits opens (dehisces) to release the seed by splitting along the septa from top to bottom or by means of two apical pores, depending on the varietal cultivar. Sesame seeds are small, about 3to4mm long by 2mm wide and 1mm thick. The seeds are ovate, slightly flattened and somewhat thinner at the eye of the seed (helium) than the opposite end with the weight of the seed between 20 to 40 mg. Sesame is grown primarily for its oil-rich seeds. The oil is used locally for cooking as well as for medicinal purposes such as the treatment of ulcers and burns. The stem and the oil extracts are equally used in making local soup. The products are locally processed and utilized in various forms. Principally among the products are "KATUN RIDI" and "KANUN RIDI". After oil has been extracted from the seeds, the cake is made into "Kuli Kuli" which together with the leaves is used to prepare local soup known as "MIYAR TAUSHE".

The uses of Sesame have triggered increasing demand for the crop. This has made it necessary to increase its production to meet up with its needs. However, several attempts have been made to increase supply through cultivation of different varieties and species; but the successes of such attempts were prejudice by challenges ranging from environmental factors, availability of manpower and inadequate farming techniques. It is against these shortcomings that attention is shifting towards improving genetic quality of the existing species through plant breeding and selection made possible by chemical-induced genetic variability.

Mutation refers to the change in DNA sequence, which may involve only few bases or the large scale chromosome abnormality. Induced mutations have recently become the subject of biotechnology and molecular investigation leading to description of the structure and function of related genes. Induced mutations are highly effective in enhancing natural genetic resources and have been used in developing beneficial variation for practical plant breeding purpose and novel crop cultivars (Lee and Lee, 2002). During the last seven decades, more than 2,252 mutant varieties have been officially released in the world (Maluszynski, Nichterlein, Zanten and Ahloowalia, 2000). Induced mutation have been used to improve major crop such as wheat, rice, sesame, barley, cotton, peanut and Cowpea which are seed propagated (Khan, 2009).

MATERIALS AND METHODS

Collection and treatment of sesame seeds with Sodium Azide

Seeds of two varieties of sesame (Ex-Sudan and Kenana-4) were obtained from the National Cereal Research Institute (NCRI) Baddegi, Niger State, Nigeria. The seeds were treated with Sodium Azide at five different concentrations, 0.00%, 0.02%, 0.04%, 0.06%, 0.08%. These were obtained by dissolving 0.02g, 0.04g, 0.06g, 0.08g in 100ml of distilled water. The seeds were soaked in the water for six hours to initiate Biochemical reaction. The presoaked seeds were put in separate, labeled flasks and Sodium Azide was added unto each flask until the seeds were completely soaked and left for eight hours. Intermittent shaking was done to ensure uniform exposure of the seeds. The chemical was drained out after eight hours and seeds were washed immediately.

Experimental design
Field experiments were conducted during the 2012 rainy season between May and August in the Experimental Garden, Federal University of Technology, Minna, Niger State, Nigeria. The experimental design used was a randomized block design with 30, six litres pots per block. The experiment was replicated three times, with a total of 90 pots. Ten seeds were planted per pot (that is, 5 per hole in each pot). Three weeks after planting, each pot was thinned to two plants per pot. A total of 6 pots for each treatment combination were used.

Soil analysis
The physical and chemical properties of the soil used were determined using the procedures adopted by International Institute for Tropical Agriculture (IITA) Ibadan, Nigeria.

Measurement of Yield parameters
The percentage flowering 45 days after planting (for each treatment) was taking as number of plants bearing flower over the total number of the treated plant within a given dose. The length of capsule was taken using a metre rule, number of seeds per capsule and number of capsules per plant were taken using direct counting and weight per capsule was taken using weighing balance.

Data analysis
The results of this research were subjected to the analysis of variance (ANOVA) to show whether there were significant differences among the yield parameters. Duncan Multiple Range Test (DMRT) was used to separate the means. The Pearson's correlation was used to show relationships between the chemical treatments and the parameters.

RESULTS

The results obtained for all the yield parameters showed an interesting variation between and within the varieties.

Number of flower/plant

The number of flowers per plant were not statistically uniform in Kenana 4 and Ex-Sudan at different concentrations of SA at p<0.05 level of significance (Table 2). The number of flowers in the control (0.00%) was 14.60±2.05 while that of 0.20% gave the highest yield with 29.80±5.14. Higher concentrations gave lower yield (0.40%= 21.80±4.69, 0.06%=14.70±2.62,0.60%=14.70± 2.62 and 0.80%=15.70±2.28.The same trend was observed in Ex-sudan. Both Kenena and Ex-sudan had highest yield at 0.20% with 29.80±5.14 and 29.90±3.99 respectively. Higher concentration treatments gave lower yields in both varieties. Correlations in number of flowers were negative (-0.067 and -0.932).

Number of capsule/plant

For number of capsule per plant all the two varieties showed statistical differences at p<0.05 level of significance (Table 2). The control (0.00%) had the lowest yield with 10.10±6.69 in Ke and 14.90±16.46a in Ex-Sudan. The highest in kenena was 0.40% with 19.90±14.21 and 0.20% in Ex -Sudan with 22.10±9.09 The correlations in capsule number were both negative in Kenana and Ex-sudan (-0.685 and -0.87 respectively)

Length of capsule (cm)

The capsule length in Ex-Sudan was not significantly different at different doses of SA but Kenana-4 showed significant differences at certain doses of SA at p<0.05 (Table 2). 0.20% had the highest in Ke with 2.49±0.07 and the lowest was in 0.80% with 1.91±0.81. In Ex Sudan there were no statistical differences.However, there were negative correlations Ex-Sudan (-0.431) but positively modest (0.537) in Kenana (Table 3).

Weight of capsule (g)

The two varieties treated with sodium azide showed significant differences (p<0.05) with respect to capsule Weight. (Table 2). The weight of capsule within Kenena were not statistically uniform. the control (0.00%) was 0.21±0.01. while that of 0.20% gave the highest yield with 0.50±0.06. the lowest yield was recorded in 0.80% with a mean value of 0.11±0.01 the same trend was observed in Ex-Sudan. The highest yield in Ex-sudan was in 0.20% with 0.28±0.02 and the lowest yield in 0.60% with 0.16±0.01. The correlations in the weight per capsule were all negative and not significant (Table 3).

Number of seeds per capsule

Similarly Kenana and Ex-Sudan showed significant differences (p<0.05) with respect to number of seed per capsule (Table 2). In terms of number of seed per capsule in Kenena 0.00% has 49.50±3.40 while 0.20% has the highest yield with 54.70±3.64 low yield was recorded in 0.60% with 45.00±3.40 and 0.80% with 46.00±1.61.

Ex-Sudan 0.00% has 43.10±3.55, and the highest yield was recorded in 0.20% with a mean value of 52.20±2.18, the lower yield was recorded in 0.80% with a mean value of 45.90±1.66.The correlations in number of seed per capsule in Kenena was negative and significant (-0.915*)(Table 3).

Percentage Oil

In kenana-4 there were variations in oil content at different treatment of sodium azide but only the doses

0.6% (16.53%) performed below the control (24.45%) (Figure 1). In contrast, Ex-Sudan had highest oil percentage at control (30.01%) and 0.2% has the least (17.21%) (Figure 1).

Percentage Flowering

The flowering percentages in the two varieties were affected by chemical with Kenana-4 having the highest (78.12%) at 0.40% (Figure 2) while Ex-sudan at 0.00 and 0.20% (75%).

Table 1. Some physical and chemical properties of the soil used.

pH	OC	OM	TN	Exchangeable Cations				EA	CEC (Cmol/kg)	Sand (%)	Silt (%)	Clay (%)
				Na	K	Ca	Mg					
6.84	1.65	2.87	0.06	0.13	0.41	6.20	7.01	0.10	13.85	86.52	7.28	6.20

Table 2: The yield parameters of the two varieties at different concentration of sodium azide.

TREATMENT COMBINATION	NO. OF FLOWER PER PLANT	NO. OF FRUIT PER PLANT	LENGTH OF CAPSULE	NO. OF SEED PER CAPSULE	WEIGHT OF CAPSULE
KENANA					
0.00%	14.60±2.05a	10.10±6.69a	2.10±0.12ab	49.50±3.40b	0.21±0.02b
0.02%	29.90±5.14d	12.90±6.20b	2.49±0.07c	54.70±3.64c	0.50±0.06c
0.04%	21.80±4.69c	19.90±14.21d	2.35±0.14bc	50.70±1.43c	0.23±0.01b
0.06%	14.70±2.62a	12.70±6.81b	2.22±0.10b	48.00±3.04a	0.23±0.03b
0.08%	15.70±2.28b	14.30±7.42c	1.91±0.10a	46.00±1.61a	0.11±0.01a
EX-SUDAN					
0.00%	20.70±2.98a	14.90±16.46a	2.08±0.09a	43.10±3.55a	0.21±0.01b
0.02%	29.90±3.99c	22.10±9.09d	2.37±0.06a	52.20±2.10b	0.28±0.02c
0.04%	23.40±3.24b	19.40±8.04c	2.21±0.11a	51.70±2.84b	0.24±0.01b
0.06%	21.00±3.32a	19.90±10.11c	2.06±0.18a	49.40±1.55b	0.16±0.01a
0.08%	18.10±2.92a	16.70±9.40b	2.12±0.06a	45.90±1.66a	0.20±0.01b

**Values are mean ± SD. Values followed by the same letter (s) within the same column do not statistically differ at the 5% level according to DMRT, analysed for the Treatment combination*

Table 3: Correlations of the Various Yield Parameters with the Chemical Treatment

Variety	NOF/P	NOC/P	LOC (cm)	WCP (g)	NOS/C	OIL %	FLW %
Kenana-4	-0.567	-0.685	0.537	-0.84	-0.915*	0.375	0.012
Ex-Sudan	-0.932	-0.87	-0.431	-0.75	-0.278	0.823	0.555

*NOF/P=Number of flower/plant, NOC/P=Number of capsule/plant, LOC=Length of capsule, WCP=Weight/capsule, NOS/C=Number of seed/capsule, FLW%= Flowering percentage
*Significant

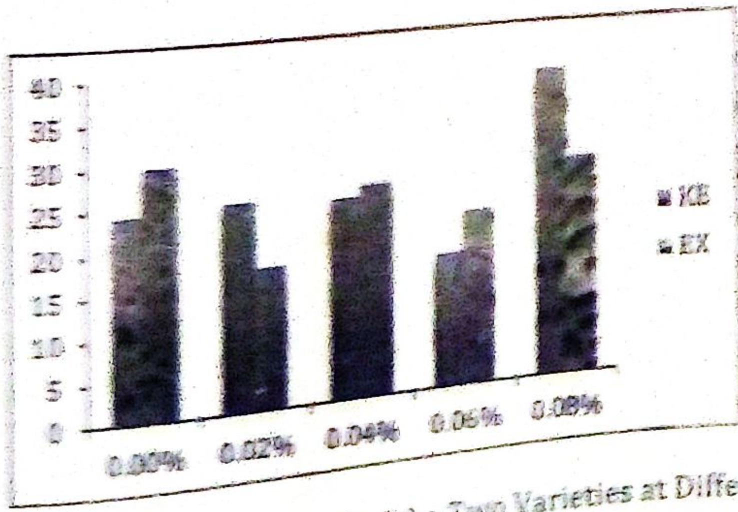

Figure 1: Percentage oil of the Two Varieties at Different Doses of SA

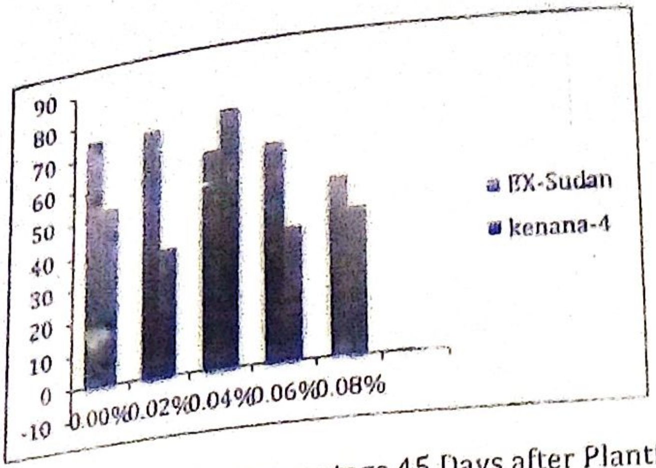

Figure 2: Flowering Percentage 45 Days after Planting

DISCUSSION

The insignificant differences in capsule number per plant in Ex-Sudan treated with Sodium azide could be associated to high Chemical tolerance of sesame as reported by (IAEA, 1994). However, the variations observed in the Kenana-4 and Ex-Sudan in the other yield parameters might be due to varietal response to Chemical as reported by Pathirana and Subasingbe, (1993). The increase in the number of pods facilitates increase in the number of seeds produced /pod due to Sodium azide concentrations. This is in conformity with the findings of Pathak (1991) in M_2 cowpea mutants and Lonnig (1982) in the X-ray induced mutants of Pea. The negative correlations observed with respect to some of the parameters imply that as the Chemical level increases, these parameters decrease. This is close to the findings of Muhammad, Akbar, Muhammad, and Zia (2003), who reported that Seedling emergence, panicle fertility and grain yield declined with increasing dose level in all the varieties of Basmati rice studied. The negative correlation is in line with the report of Nura, *et al.* (2011), they observed highly significant variation (P≤0.01) in number of pods/plant which decreased with increase in colchicines concentrations.

The positive correlations observed with respect to some of the parameters imply that as the Chemical level increases, these parameters also increase. This is in line with Falusi *et al* (2012); Daudu *et al.*, 2012.They all reported positive correlations between the irradiation exposure period with certain morphological and yield traits. The positive correlations are in agreement with the report of Daudu *et al.* (2012), they observed that yield parameters such as number of fruits/plant, number of seeds per fruit, length of fruit (cm), width of fruit (cm) and weight of fruit (g) increased as the Irradiation Exposure Period increased. The variations in oil contents obtained might be due to environmental factors. This is in close agreement with Carlsson *et al.*, 2008; Rai and Jacob, (1957). Carlsson *et al.*, 2008 reported that Genetic and environmental factors influence the oil content and fatty acid compositions in sesame. Rai and Jacob (1957), studied induced mutations in a black seeded variety T.16 by treating with X-rays and reported mutant in M3 and M4 generations respectively and both were found to have higher oil percentage (52.10%).

The results also showed that flowering percentages were affected by chemical doses which are in close agreement with Shad, Tariq, Said and Shamsur (1986), who reported that Days to flowering were significantly affected both by gamma ray and fast neutron but differences in days to flowering were not significant statistically for varieties.

CONCLUSION

Genetic diversity is of great significance for breeding programmes as well as for taxonomic studies. Ex-Sudan appeared to be the most sensitive to Sodium azide and Kenana-4 is the least. The dose 0.02% show more significant effects in the two varieties. Thus Sodium azide can serve as useful tool for creating variability in sesame. Artificial induction of mutation through the use of sodium azide proves vital in the improvement of genetic variability in sesame. Certain concentrations of Sodium azide (0.02% through 0.04% sodium azide concentration) have the potentiality of inducing variability that could be used in the improvement of the yield of sesame.

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