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REGULAR ARTICLE

FAST NEUTRONS INDUCED GENETIC VARIABILITY ON BAMBARA NUT (*VIGNA SUBTERRANEAN* (L.) VERDC.)

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ABSTRACT

In this study, two accessions of Bambara groundnut were exposed to fast neutrons Americium-Beryllium (AmBe) source with flux of 1.5 ×10^4 ncm^{-2} s^{-1}for different hours to raise M_1 generation. The data recorded were percentage germination, plant height, number of leaves, leaf length, leaf width, days to 50% flowering, number of pods per plant, fresh weight of plants, dry weight of plants, dry weight of pods, weight of seeds and100 seeds weight. There was variation in morphological and yield parameters for Black accession. In the Cream accession, days to 50% flowering, number of pods per plant, fresh weight of plants, dry weight of plants, dry weight of pods, weight of seeds and100 seeds weight were significantly different. Treatment at 16 h performed best for plant height, leaf length, number of leaves, weight of seed per plant and 100 seed weight in Black accession while Cream performed best at 8 h exposure time. Fast neutron was observed to improve the performance of Bambara groundnut, thus can be used in breeding programme for Bambara groundnut.

Keywords: Fast neutrons, Breeding, Variation, Bambara groundnut, Induced Mutation

INTRODUCTION

Bambara nut (*Vigna subterranean* (L.) Verdc.) is a legume which belongs to the family Fabaceae. Its seed contains significant amount of protein, thus it can be considered as complete food [1] and also a nitrogen-fixing and drought tolerant legume. Artificial hybridization between Bambara nut accessions has not been easy because the plant is self-pollinating and cleistogamous (i.e. pollen is shed before the flower opens) and the crop is mainly cultivated as landraces [2]. In order to enhance the cultivational and nutritional qualities modern horticultural technologies including mutation breeding should be employed [3].

Mutation is a heritable change in the amount, arrangement or structure of the DNA as a result of genetic recombination [4]. If the mutations are artificially induced, it can create profound effects on quality and productivity of crops [5] and can be used for human benefit through breeding. Utilizing natural or induced genetic variation is a proven strategy in crop improvement [6]. There are many agents both chemical and physical for inducing mutation [7]. Fast Neutrons are uncharged atomic particles of varying levels of kinetic energy produced through nuclear fission in nuclear reactors. Fast neutrons irradiation is considered a valuable tool, from which varieties could be developed that is economically and agriculturally important and have high productivity potential [8]. Therefore, the study was aimed at providing information about the effects of fast neutron and on Bambara groundnut in creating variability as an alternative to artificial hybridization.

MATERIALS AND METHODS

Study area

The study was conducted in the botanical garden of the Department of Biological Sciences, Ahmadu Bello University, Samaru, Zaria. Samaru lies in the northern guinea savanna agro ecological zone of Nigeria with a mean annual rainfall of about 1011±16.1 mm (CV=16%) from 1960 to 2003 and an average relative humidity of 36.0% during the dry season and 78.5% for the wet season [9]. Zaria has three distinct seasons. The average temperature of 27 °C where average minimum and maximum temperatures recorded in the area are 15.6 and 38.5 °C respectively [10].

Source of material

Healthy, assessions of Bambara Groundnut, were obtained from the local farmers within Zaria and Kano. The seeds of two different colors (Black and speckled cream) uniform in sizes were selected for the study.

Mutagenic treatment

The seeds were exposed to Fast neutron Americium-Beryllium (AmBe) source with a flux of 1.5 ×10^4 ncm^{-2} s^{-1}

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and a dose rate of 8.15x10 Sv/hr at 0, 4, 8, 12, 16 h at the Center for Energy Research and Training (CERT), Ahmadu Bello University, Zaria Kaduna state.

The treated and the untreated control were sown directly into the ground on a bed with 20x40 cm intra and inter row spacing in a Completely Randomized Block Design (RCBD). Three replications were made to raise M_1 generation. The following agronomic parameters were recorded, percentage germination, plant height, number of leaves, leaf length, leaf width, days to 50% flowering, number of pods per plant, fresh weight of plants (g), dry weight of plants (g), dry weight of pods (g),100 seeds weight (g).

Data analysis

One analysis of variance (ANOVA) using SAS 2002 was carried out to determine significant difference between the means of different concentrations at $P<0.05$. Duncan's multiple range test (DMRT) was to separate the means

RESULTS AND DISCUSSION

The result on table 1 shows that plant height, number of leaves, leaf length, leaf width, weight of seeds per plant and100 seeds weight increased significantly with increase in time of exposure with 16hours showing highest mean values. Fresh weight of plants, dry weight of plants, dry weight of pods showed highest mean values at 8 h then began to decrease linearly for the Black accession. In the Cream accession (table 2), there was increase in days to 50% flowering, number of pods per plant, fresh weight of plants, dry weight of plants, dry weight of pods and weight of seeds with exposure to fast neutrons with 8 h showing highest mean value for this traits, while 100seed weight decreased with treatment. This could be attributed to mutation induced by fast neutrons as these changes were absent in the control. Fast neutron results in large scale deletion in DNA and changes in chromosome structure that range in size from a few base pairs to several megabases thereby modifying the expression of various traits [11]. Fast neutron may have cause special interference with at different point in the DNA [12]. These DNA structural changes (breaks, transpositions, deletion, etc.) which led to change in amino acids and consequently protein formed [13] may influence plant development, cell cycle, and other processes in plant [14]. Similar reports on increase in agronomic characters have been reported on African long pepper (*Capsicum annum*v ar. accuminatum) treated with fast neutrons [15] and *Ambrosia maritime* (Damsisa) treated with fast neutrons [16]. There are some contrary reports as well [17, 18]. The difference in response of two assessions to fast neutron may be due to difference in penetration rate of fast neutron which may be due to the size of seed or seed coat. This observation is in agreement with report of Falusi *et al.* [19] who reported that different accessions of sesame responded differently to treatment with fast neutrons.

CONCLUSION

In this study, fast neutrons were observed to cause variation in most traits in the two accessions of Bambara nut studied. 16 h' time of exposure to fast neutrons performed best for most traits in black accession while 8hours exposure to fast neutrons performed best for cream colour accession.

Table 1: Mean performance of effects of different time exposure of fast neutron on Black Bambara groundnut accession at M_1 generation

FN(HRS)	PGRM (%)	PHT	LL	LW	D50F	NOL	FWP	NOPP	DWP	DWPP	WSSP	W100S
0	100.00^{a}	24.53^{b}	6.87^{d}	2.30^{b}	36.33^{b}	100.67^{c}	43.40^{c}	16.00^{a}	19.11^{c}	9.53^{d}	7.52^{b}	61.00^{c}
4	94.33^{a}	28.87^{a}	8.23^{b}	2.50^{b}	40.00^{a}	110.67^{bc}	67.67^{b}	13.00^{a}	25.07^{bc}	12.63^{c}	7.83^{b}	85.27^{b}
8	94.33^{a}	29.30^{a}	8.47^{b}	2.73^{a}	36.67^{b}	147.00^{a}	99.30^{a}	16.00^{a}	35.92^{a}	18.53^{a}	10.02^{ab}	83.73^{b}
12	94.33^{a}	26.43^{b}	7.53^{c}	2.50^{b}	34.33^{c}	128.67^{b}	70.45^{b}	15.00^{a}	27.22^{b}	15.87^{ab}	10.17^{ab}	61.67^{c}
16	94.33^{a}	30.20^{a}	9.14^{a}	2.80^{a}	34.67^{c}	148.00^{a}	68.23^{b}	14.00^{a}	26.95^{b}	13.68^{bc}	11.97^{a}	107.80^{a}
SE±	6.07	0.59	0.17	0.07	0.36	6.23	4.69	0.84	2.05	0.82	1.21	1.19

Note: Means with the Same Letter within a Column are not Significantly Different at $P\geq0.05$

PGRM-percentage germination, PHT-plant height at maturity, LL-leaf length, LW-leaf width, NOL-number of leaves, D50F-days to 50% flowering, FWP-fresh weight of plant, NOPP-number of pods per plant, DWP-dry weight of plant, DWPP-dry weight of pod, WSSP-Weight of seeds, W100S-one hundred seed weight, SE-Standard error, M_1-First mutant generation, FN-fast neutron, HRS-Hours.

Table 2: Mean performance of effects of different time exposure of fast neutron on cream bambara groundnut accession at M_1 generation

FN(HRS)	PGRM (%)	PHT	LL	LW	D50F	NOL	FWP	NOPP	DWP	DWPP	WSSP	W100S
0	100.00^{a}	26.70^{a}	8.17^{a}	3.20^{a}	39.00^{a}	146.33^{b}	93.03^{b}	9.33^{c}	36.80^{ab}	16.58^{b}	10.20^{b}	130.31^{a}
4	94.33^{a}	26.50^{a}	8.23^{a}	3.07^{a}	38.00^{ab}	200.00^{a}	111.30^{ab}	11.67^{b}	39.82^{ab}	22.90^{ab}	13.43^{ab}	109.33^{c}
8	83.33^{a}	27.83^{a}	7.63^{a}	3.07^{a}	39.00^{a}	140.67^{b}	123.97^{a}	16.33^{a}	48.97^{a}	28.78^{a}	18.65^{a}	121.60^{b}
12	88.64^{a}	26.40^{a}	7.90^{a}	3.07^{a}	39.00^{a}	153.33^{b}	98.30^{b}	11.00^{bc}	34.23^{b}	19.02^{ab}	12.25^{b}	117.47^{b}
16	89.00^{a}	26.03^{a}	8.03^{a}	2.90^{a}	37.00^{b}	147.67^{b}	125.77^{a}	15.00^{a}	47.15^{a}	26.28^{a}	16.08^{ab}	118.00^{b}
SE±	8.8	1.28	0.17	0.11	0.64	5.8	6.49	0.63	4.09	3.39	1.77	1.99

Note: Means with the Same Letter within a Column are not Significantly Different at $P\geq0.05$

PGRM-percentage germination, PHT-plant height at maturity, LL-leaf length, LW-leaf width, NOL-number of leaves, D50F-days to 50% flowering, FWP-fresh weight of plant, NOPP-number of pods per plant, DWP-dry weight of plant, DWPP-dry weight of pod, WSSP-Weight of seeds, W100S-one hundred seed weight, SE-Standard error, M_1-First mutant generation, FN-fast neutron, HRS-Hours.

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