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Full Length Research Paper

Effects of sodium azide on yield parameters of groundnut (*Arachis hypogaea* L.)

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The mutagenic effects of different concentrations of sodium azide (0.01 – 0.05%) on groundnut (*Arachis hypogaea* L. cv SS1145B and RMP 91) were investigated. The characters studied include; plant height, number of branches per plant, pods/plant, seeds/pod, seeds/plant and 100 seed weight in the M_1 and M_2 generations. Both negative and positive shifts in mean values were recorded as a result of the chemical treatment. The most effective dosage for inducing mutation/morphological aberration was established at 0.03%. Increases in genetic parameters of variation, heritability and genetic gain under the chemical treatment indicate the possibility of evolving higher yield variants through proper crop selection. Thus, economic traits like pods/plant, seeds/plant with high heritability and genetic gain values in the M_3 generation offer good scope for selection and improvement.

Key words: Groundnut, mutagenic effects, phenotypic variance, sodium azide.

INTRODUCTION

Groundnut (*Arachis hypogaea* L.) is an important oil seed crop and grain legume worldwide. However, it is self-pollinating and possesses limited variability. Conseq-uently, the extent to which groundnut cultivars may be improved through conventional breeding methods is limited. Mutation breeding supplement conventional plant breeding as a source of increasing variability and could confer specific improvement without significantly altering its acceptable phenotype (Ojomo et al., 1979). The suc-cessful utilization of sodium azide to generate genetic variability in plant breeding has been reported in barley (Kleinhofs and Sander 1975) and other crops (Avila and Murty, 1983; Micke, 1988; Routaray, et al., 1995).

It has been demonstrated by many workers that genetic variability for several desired characters can be induced successfully through mutations and its practical value in plant improvement programmes has been well esta-blished. The main advantage of mutation breeding is the possibility of improving one or two characters without changing the rest of the genotype. The varieties of gro-undnut in West Africa have remained relatively unimpro-ved and little work has been carried out on them. The present study was undertaken to investigate the mutage-nic effects of sodium azide as a means of increasing the variability within the cultivars and hence improve its pro-ductivity.

MATERIALS AND METHODS

Seeds of groundnut (cv SS1145B and RMP 91) were selected from a batch obtained from the Nigeria Seed Company, Zaria, Nigeria. The seeds were treated with 0.01, 0.02, 0.3, 0.04, 0.05% (weight /volume) solutions of sodium azide (NaN3) at room temperature (25^{o}C) with intermittent shaking. A set of 100 seeds was kept in distilled water to serve as control. After 24 h of treatment, all seeds were washed in distilled water to remove toxic products, if any, and sown directly on field plots following a randomized block design and maintaining a spacing of 25 x 50 cm. The parameters studied inclu-ded: germination/emergence percentage, seedling survival at 21 days after planting (DAP), plant height at 21 DAP, number of days to maturity, branches/plant, pods/plant, seeds/pod, seeds/plant and 100 seed weight. The mutagenic effectiveness and efficiency were calculated following the methods of Sisikala and Kamala (1988).

At maturity, M1 plants where individually harvested and

Table 1. Effect of sodium azide on mutagenic effectiveness, efficiency and survival of groundnuts during the M_1 generation.

Variety/conc. (%)	Survival percentage	Percentage lethality (L)	Mutagenic frequency (M)	Mutagenic effectiveness M/C	Mutagenic efficiencyM/L
SS1145B					
0.01	65	35	2.07	2.07	0.06
0.02	50	50	14.05	7.03	0.28
0.03	45	55	27.15	9.05	0.49
0.04	35	65	23.50	5.88	0.36
0.05	25	75	10.40	2.08	0.14
RMP91					
0.01	87.5	12.5	3.70	3.70	0.30
0.02	43.8	56.2	14.0	7.00	0.25
0.03	25.0	75.0	42.4	14.13	0.57
0.04	12.0	88.0	19.7	4.93	0.22
0.05	6.5	93.5	8.5	1.70	0.09

sown as M2 family. During the M3 , five of the characters were evaluated further using the following genetic parameters: (a) genetic variance, (b) phenotypic variance, (c) heritability and genetic gain in accordance with Allard (1999). The selection pressure was 10% for the purpose of this investigation.

RESULTS AND DISCUSSION

The effect of the different concentrations of sodium azide on survival percentages, mutation frequency and muta-genic effectiveness is presented in Table 1. The survival percentages decreased progressively as the dosage increased. Mensah and Akomeah (1992) have reported that the higher the mutagenic dose, the lower the survival percentage, and the present results confirm these earlier reports. The decrease in survival percentage has been attributed to the physiological disturbance or chromo-somal damage caused to the cells of the plant by the mutagen. Adegoke (1984) reported that sodium azide induces chromosomal damages leading to bridge forma-tion during mitotic division and hence increased phenol-typic aberration Table 2.

The mutagenic frequency recorded in the present investtigations ranged from 2.07 to 54.0% and the freq-uency increased with increasing dosage of the chemical. The morphological aberrations used in the determination of the mutation frequency included distorted leaf forms and swollen and/or shortened internodes. The spectrum of chlorophyll mutants also considered in assessing the mutation frequency includes xantha (completely yellow), chlorina (variegated yellow and green) and albina (whi-tish). Out of these, xantha type was predominant in both cultivars.

The genetic parameters of variation, heritability and genetic gain for five selected yield parameters are given in Table 3. The genetic variance (GV) ranged from 0.90 to 15.1. Similarly, the phenotypic variance (PV) ranged from 1.91 to 18.01. The phenotypic variance was higher than the genetic variance. However, the differences bet-ween the two measurements were low for pods/plant and seed/plants, inferring low environmental influence on these traits. The differences were higher for primary bran-ches and 100 seed wt. The heritability expresses the reliability of the phenotypic value as a guide to breeding. Characters with high heritability can therefore be impro-ved rapidly through selection than those with low herita-bility, since the latter are influenced by environmental factors. In the present study, the heritability values recor-ded were greater than 50% in all traits studied. These values are considered high and varied from 62.49 to 92.45%. The predicted genetic gain at 10% selection varied from 2.59 to 16.06%. These values were generally higher in the treated plants than the control. This obser-vation is similar to what was reported in *V. unguiculata* by Mensah and Eruotor (1993) and Mensah et al. (2005).

High heritability, coupled with high expected gains were observed for number of pods/plant and number of seeds / plant indicating that additive gene effects played

Table 2. Effect of sodium azide on some yield parameters of groundnut in M_1 and M_2 generations.

	Plant Height (cm)		Number of days to maturity		Number of primary branches/plant		Number of pods/plant		Number of seeds/pod		Number of seeds/plant	
	M_1	M_2	M_1	M_2	M_1	M_2	M_1	M_2	M_1	M_2	M_1	M_2
	13.07± 1.0	13.90±1.3	56.0±2.4	54.1±2.7	1.7± 0.8	1.7 ± 0.9	38.3±2.8	37.2±2.6	5.13±1.4	6.1±1.5	22.5±2.8	21.9±2.9
	12.80±0.78	13.4±0.90	40.0±4.1	48.3±5.6	1.8 ± 0.9	1.8 ± 1.1	42.5±4.9	41.4±3.8	5.80±2.5	6.9±3.1	23.6±3.8	23.0±6.0
	9.40±0.90	12.70±1.68	50.0±3.8	52.4±5.7	1.8 ± 0.9	1.8 ± 1.2	42.6±5.6	43.9±6.3	6.00±2.4	6.8±4.2	23.7±4.4	24.4±5.5
	10.80±1.53	12.0±1.70	56.0±3.3	54.8±6.3	1.9 ± 0.9	1.9 ± 1.3	55.3±6.6	60.0±7.1	7.17±2.6	7.4±4.8	29.1±3.7	31.6±6.2
	12.3±1.15	13.4±2.30	56.0±3.7	56.4±5.8	1.9 ± 0.9	1.9 ± 0.8	51.3±6.1	57.4±8.9	6.60±2.8	6.8±4.9	27.1±3.7	30.2±6.4
	8.25±1.72	12.8±3.70	58.0±2.9	57.2±6.1	1.9 ± 0.7	1.9 ± 0.9	29.3±8.3	41.94±9.4	5.00±2.7	6.7±4.6	16.3±5.2	23.3±23.3
	10.0±1.00	11.4±1.15	56.4±2.6	56.8±2.4	1.8 ± 0.4	1.8 ± 0.3	36.4±2.3	37.1±2.2	6.1±1.6	6.6±1.5	2.820.2±	20.6±2.6
	9.6 ± 1.80	10.9±2.40	50.0±4.5	52.1±6.1	1.6 ± 0.6	1.6 ± 0.8	31.2±5.7	37.3±6.8	11.80±2.5	10.4±3.3	19.3.95±	20.7±5.8
0.02	9.6 ± 1.88	10.3±3.10	55.0±4.1	54.3±5.8	1.5 ± 0.8	1.5 ± 0.9	27.45±6.7	36.4±7.1	8.43±2.4	9.1±3.6	18.3±5.1	20.2±6.4
	5.76±2.12	8.4±2.45	58.0±3.8	54.3±5.3	1.7 ± 0.8	1.7 ± 0.9	24.5±5.5	37.8±6.8	5.33±2.7	5.8±2.9	14.4±5.5	21.0±5.3
0.04	8.03±2.92	10.57±3.53	56.5±4.4	55.5±7.1	1.7 ± 0.7	1.7 ± 0.9	20.9±3.9	50.8±8.9	11.80±2.9	10.4±3.0	12.3±6.1	24.2±11.9
	4.00± 3.1	9.52±4.1	45.8±4.3	50.5±5.8	1.5 ± 0.8	1.5 ± 1.0	17.1±4.3	32.4±9.2	5.42±3.1	4.8±3.1	11.4±7.1	18.0±10.2

Table 3. Estimate of parameters of variability, heritability and genetic gain of five yield characters of two groundnut cultivars grown from seeds treated with sodium azide and untreated seeds (control) in the M_3 generation.

Cultivar	Characters	Treatment	Range	Mean	PV	GV	H_o	GA	GG
SS1145B	Primary branches	Control	5.13 – 6.10	5.80	2.26	1.41	62.49	0.15	2.59
		Treated	5.0 – 7.4	6.45	2.38	1.63	68.49	0.269	4.45
	Pods/plant	Control	21.9 – 22.50	22.10	7.45	6.10	81.86	1.13	5.50
		Treated	16.3 – 31.60	26.50	8.55	7.90	92.45	4.04	15.25
	Seeds/pod	Control	1.70 – 1.80	1.76	1.58	1.19	75.32	0.47	2.67
		Treated	1.60 – 19.0	1.83	1.45	1.12	77.24	0.500	2.73
	100 sd wt	Control	40.07 – 40.98	40.25	2.64	1.82	68.94	2.34	5.81
		Treated	40.00 – 41.00	40.32	2.60	1.82	70.38	3.33	8.26
	No. of seeds/plant	Control	37.23 – 40.9	38.90	14.11	10.75	76.18	0.99	2.54
		Treated	29.34 – 60.04	48.50	18.01	15.1	83.84	3.63	7.48
RMP91	Primary branches	Control	6.10 – 6.8	6.51	2.16	1.40	74.80	.173	2.66
		Treated	4.80 – 10.4	7.33	2.26	1.55	68.60	.321	4.38
	Pods/plant	Control	14.14 – 14.42	14.28	7.95	6.30	79.25	.80	5.60
		Treated	12.6 – 19.94	15.75	8.74	7.90	90.4	2.53	16.06
	Seeds/pod	Control	1.75 – 1.82	1.75	1.19	0.98	70.90	0.4	2.74
		Treated	1.81 – 2.11	1.90	1.31	1.06	77.20	0.54	2.84
	100 sd wt	Control	36.06 – 36.88	36.23	2.70	1.80	66.70	2.11	5.82
		Treated	36.0 – 36.90	36.29	2.74	1.85	67.50	3.00	8.27
	No. of seeds/plant	Control	24.04 – 25.96	25.00	14.11	10.75	76.19	0.99	3.96
		Treated	22.68 – 32.19	29.93	18.01	15.10	83.84	3.63	12.12

PV = Phenotypic variance
GV = Genetic variance
H_o = Heritabilit y
GA = Genetic advance
GG = Genetic gain

an important role in the expression of such traits. Thus, these traits could be effective in the selection of high yiel-ding cultivars/genotypes. The characters in which herita-bility has already been reported among legumes include plant height, pods/plant, 100 seed weight and seed yield (Gregory, 1955; Williams and Hanway, 1961).

REFERENCES

Adegoke JA (1984). Bridge induction by sodium azide in *Allium cepa* Nig. J. Genet. 5: 86.

Allard RW (1999) Principles of Plant Breeding, John Wiley and Sons, New York.

Avila R, Murty, B. R. (1983). Cowpea and mungbean improvement by mutation induction Mutation Breeding Newsletter, 21: 9.

Gregory WC (1955). X-ray breeding of peanuts *Arachis hypogaea* L., Agron. J. 47: 394-399.

Kleinhofs W, Sander C (1975). Azide mutagenesis in Barley. Third Barley Genetics Symp. Garching. Proceedings of Symp. Pp113-122.

Mensah JK, Akomeah PA (1992). Mutagenetic effects of hydroxxlamine and streptomycin on the growth and yield of cowpea *Vigna unguicu-lata* (L.)Walp. Legume Res. 15:39 - 44

Mensah JK, Eruotor PG (1993). Genetic variation in agronomic characters of lima beans induced by seed irradiation. Trop. Agric. (Trinidad), 70: 342 – 344.

Mensah JK, Akomeah PA, Ekpekurede EO (2005). Gamma induced variation of yield parameters in cowpea (*Vigna unguiculata* (L.) Walp. Global J. Pure Appl. Sci. 11: 327-330.

Micke A (1988). Improvement of Grain Legume Production using Induced mutations IAEA, Vienna pp. 1 – 51.

Ojomo AO, Omueti O, Raji JA, Omueti O (1979) Studies in induced mutation in cowpea, 5. The variation in protein content following ionizing radiation, Nig. J. Appl. Sci. 21 61-64

Routaray BN, Mishra RG, Das SN (1995). Genetic variability and effectiveness of some chemical

mutagens on blackgram in relation to resistance source against *Meloidogyne* incognita. Curr. Agric. Res. 8: 3 - 4
Sisikala S and Kamala T. (1988). Mutagenic effectiveness and efficiency of gamma rays and four gingerly cultivars. Indian Journal Bot. 11 : 118 – 122.
Williams J H, Hanway DG (1961), Genetic variation in oil and protein content of soybeans induced by seed irradiation. Crop Sci. 1: 34 – 36.