Studying the Effect of Mutations on some genotypes of Peanut

Samah A. Sabry[1], Eman T. Abdou[2] and Amal M. Abd-El Mageed[1]
[1]Department of Agricultural Botany, Faculty of Agriculture, Suez Canal University, Ismailia, Egypt
[2]Field Crops Research Institution, Agricultural Research Center, Giza, Egypt

Received: *9/10/202*

Abstract: Peanut crop has a great economic value and it has special growth nature caused some difficulties in genetic improvement. This study aims to carry some genetic variations and improvement through treating seeds of four varieties of peanut with concentrations of mutagenic substance like sodium azid. An experiment was conducted at the Experimental Farm, Ismailia Research Station; Oil Crops Section- Agricultural Research Center (A.R.C). Four varieties of peanut (Giza 6, Var.112, Var.57, and Var.381) were treated with three different concentrations of sodium azide (NaN_3); 0.00 control (0.00), T1 (0.01) and T2 (0.03) % W/V for inducing mutation and planted in a randomized complete block design (RCBD) with three replications. The general mean of all 4 varieties was higher in the M1 than those in the M2 generation. T1 and T2 mutated plants displayed a high value of the stem height compared to control plants for all 4 varieties, The largest increase in branches per plant was observed in the M2 generation at a low dose of mutagen while the seeds number and 100 seeds weight were less than control at the low dose of mutagen in both generations. The values of phenotypic coefficient of variability (P.C.V. %) and genotypic coefficient of variability (G.C.V. %) were greater in the M1 generation than those in the M2 generation. GCV was less than PCV in SPAD, stem height, number of branches/plant, number of pods/plant and pod yield (Ardab/Fadden*)*. While GCV was more or less equal to PCV for pod weight/plant, 100 pod weight, and seed yield (seeds number/plant, seed weight/plant, and 100 seed weight) as well as oil percentage. Heritability values exceeded 65% for all traits examined in both the M1 and M2 generations, T2 mutant plants in the M2 generation had higher heritability scores than those in the M1 generation. They scored values between 82% and 99.88% for most of the traits investigated and all studied traits recorded different values of genetic gain by selection (GS), ranging from 0.7 to 105.8 and from 2.5 to 108.7 in M1 and M2 generations, respectively. 0.01% and 0.03% of sodium azide played an important role in inducing mutation to improve the quantitative characters of selected peanut varieties.

Keywords: Genetic gain, heritability, oil content, peanut, Sodium Azide Mutagens, yield and yield component

INTRODUCTION

Peanut (*Arachis hypogaea* L.) is an important economic crop planted to obtain its seeds which has a high content of protein and oil for use in food industries and for extracting edible oil (Juhaimi *et al.,* 2018; FAOSTAT, 2020). Peanut has a large genome (allotetraploid; 2n = 4x = 40) belong to the family Fabaceae and a self-pollinated crop so it has narrow genetic variability base. The increasing number of people in the world needs increase in food sources through improved agricultural production. Breeding for improved peanut crop varieties need genetic variation among their varieties. Several methods of breeding such as selection, hybridization and induced mutations were carried to obtain the genetic variability which achieves the goal of breeding programs. Mutations are the primary sources of genetic variations in organisms like plants (Kharkwal, 2012).

Mutagenesis an effective powerful tool, fast and a cheap method in the hands used for oligogenic and polygenic traits causing heritable changes in the phenotype and improve morpho-physiological traits and quantitative traits such as yielding ability for developing varieties (Sangle and Lad, 2020). The first time of using sodium azide (NaN_3) as mutagenic by Nillam *et al*. (1973) in barley which is a heavy metal enzyme and a chemical mutagen effect on most metabolism processes and respiration systems of plant cell causing point mutations in peanut and proved to be very effective in the generation of quality mutants with high frequency (Wang *et al*., 2013; Jadhav *et al*., 2018; Okasha *et al.,* 2021). NaN_3 had mutagenic efficiency on germination of seeds, early growth of seedling and peroxidase isozyme composition (Appara, 2005; Abdul Rahaman *et al.,* 2013; Panda *et al.,* 2022) and it could be effective in achieving early maturing mutants of peanut and employed to improve pod yield, nut size, protein, fat and other nutritional contents (Animasaun *et al.,* 2014). An increase in concentrations of NaN_3 above 1mM will not enhance germination at pH 3, but concentrations ranging from 1mM NaN_3 and lower with pH 3 will enhance germination and growth (Olise *et al.,* 2019). NaN_3 was recommended for effective use to enhance specific characters in plants by the farmer and finally increase the possibility of isolating meaningful mutants of economic crops (Abdul Rahaman *et al.,* 2018).

There was an increase in genotypic variability for some traits like pod number, pod yield and seed yield/plant in M2 generation of peanut (Bharathi *et al.,* 2005). The effect for inducing mutation/morphological aberration was established at 0.03% of NaN_3 which increases in genetic parameters of variation, genetic advance and heritability indicate the ability to obtain higher yield mutants through suitable selection. Thus, yield traits like pods, seeds/plant with high values of heritability and high values of genetic advance in the M3 generation offer a wide range for selection and improvement (Mensah and Obadoni, 2007). High-oleic content of seeds, suitable size and shape of pods and seeds in peanut cultivars was identified in the Virginia type peanut mutant through screening of a 15 mmol/L

NaN_3 mutagenized M3 population (Wang *et al.,* 2019; Nkuna *et al.,* 2021).

The aim of the present study: is to investigation the impact of NaN_3 concentrations for peanut seeds as a mutagenic agent on the yield and yield component traits.

MATERIALS AND METHODS

The study was based on laboratory as well as field was conducted at the Experimental Farm, Ismailia Research Station; Oil Crops Section- Agricultural Research Center (A.R.C) during the 2019 and 2020 summer sessions. Four varieties of peanut were used in the study. The selection of the crop plant was based on its economic importance as well as availability. The name and pedigree of the studied varieties are listed in Table (1). The experimental design was RCBD with three replications along with a respective control. The normal recommended agricultural practices for peanut production were applied at the proper time.

Table (1): Varieties studied, their origin and growth habit

Code	Varieties	Origin	Growth habit
1	**Giza6**	Egypt	Erect
2	**V57**	Local	semi spreading
3	**V112**	U.S.A	Erect
4	**V381**	Morocco	Erect

Studied Varieties obtained from Agricultural Research Center (A.R.C)-Giza – Egypt

Laboratory Examination

Two different concentrations of NaN_3; 0.01 and 0.03% W/V were prepared in plastic volumetric flask by using distilled water (Dhanavel *et al.,* 2008). The seeds of selected varieties were soaked in distilled water for about 6 hours. Then the control seeds were removed from distilled water and air dried for about 20 minutes. The control seeds for each of the varieties were soaked in the distilled water for 6 hours again, seeds were pre-soaked in a plastic Petri dish which contains distilled water for six hours, and air dried for about 20 minutes and then treated with freshly prepared mutagenic agent of NaN_3 solution at different concentrations (0.01% (T1), and 0.03% (T2) for 6 hrs. (Dhanavel *et al.,* 2008). Then, the seeds treated with NaN_3 were thoroughly washed in running tap water for ten minutes to remove excess exudates and chemicals from the seeds.

Evaluations

In the two mutational generations; the seeds were treated with a chemical mutagenic agent in the laboratory (M1 generation) and the control seeds were sown in the first season 2019 and the M2 seeds were raised by selfing M1 plants for each genotype. The M2 seeds were sown in the field in the second season (2020) in plots. The area of each plot was 2.5×3×0.6 m. Peanut seeds (2-3 seeds) were deposited in rows 3 m length, 60 cm width and 20 cm spacing between plants within rows and then the plants were thinned after complete emergence (one week from planting) to one plant/hill. The recommended doses of chemical fertilizer (NPK) were applied at sowing by banding on one side of the row at 5 cm depth.

SPAD chlorophyll reading: Leaf Chl. content was measured at flowering stage by a hand-held leaf Chl. meter (SPAD-502; Spectrum Technologies, Plainfield, IL) was used to measure Chl. content on three subsamples taken per plant. The Chl. meter gives an index of total leaf Chl. content.

At the harvest stage; ten guarded plants were randomly sampled from each plot to provide measurements. The growth and yield characteristics were measured for peanut varieties are: Stem height (cm), branch number/ plant, pod number/plant, pod weight/ plant (g), 100- pods weight (g), seeds number / plant, seeds weight/ plant (g), 100 seeds weight and pods yield ardab/ fad.

The oil content percent was determined according to A.O.A.C system (1984).

Statistical analysis

Statistical analysis in M1 and M2 generations for all quantitative characteristic: plant height, branch number, pod yield, seed yield, pod number / plant, 100 seed weight seed weight/ plant, pod weight/ plant, were recorded using the appropriate analysis of variance according to Steel *et al.* (1997). Combined analysis of variance of the two mutational generations was applied after using the homogeneity test. To confirm the relative importance of the various characters, a set of genetic parameters; a genotypic and phenotypic coefficient of variability and heritability in broad sense were calculated according to Hallauer and Miranda (1988) a computer program Genstat 8 Rel.PL16 was used for analyzing data.

Genetic Advance and Genetic Advance as Percent of Mean: were calculated to compare the extent of predicted advance of different traits under selection, using the following formula: $Gs\% = Gs \times 100 / \bar{x}$ Where, Gs% = Genetic advance as percent of the mean, $\bar{x}$ = Grand mean of the trait. $Gs = K.h^2b.\ \sigma p$ Where, Gs = Expected genetic advance, k = the standardized selection differential at 5% selection intensity (K = 2.063), h^2b= Heritability in broad sense σp = Phenotypic standard deviation.

RESULTS AND DISCUSSION

Variance Analysis

Analysis of variance summarized the mean squares of the varieties, mutagenesis treatment, and their interaction for all traits assessed in the study (Table 2). The results of the analysis of variance showed that there were significant differences in all eleven tested traits measured in the four peanut cultivars, as well as in both mutagen doses and their interactions. These differences indicated the tested varieties were diverse. The current study was conducted to investigate the effects of NaN_3 mutagen on four peanut varieties to improve yield-related traits and oil content percent. The results were in agreement with Kumar *et al.* (2015) who reported that highly effective mutagenesis is important in mutagenesis-based breeding programs. Progressive mutagenesis is determined by many factors, including mutagen concentration, temperature, and treatment time. Although, previous studies have confirmed that polyploid species are resistant to high-density induction of mutation compared to diploid that is because loss-of-function mutations in polyploidy is masked by genetic redundancy among homoerologists (Manal *et al*., 2009).

Table (2): Analysis of variance Mean squares of morphological, physiological and reproductive traits of peanut varieties for combined analysis

Characters	Source of variance	Replications	Na N_3 concentration	Error	Varieties	Varieties. * Na_3N.*Rep.	Error
	Degree of freedom.	2	2	4	3	6	18
SPAD. Values		0.95	10.7**	0.19	47.9***	29.1***	1.23
Stem height (cm).		9.25	634.5***	1.91	64.1***	179.9***	6.14
Branches number pl^{-1}		0.25	34.5**	1.07	2.7**	16.2***	0.38
Pods number pl^{-1}		8.78	631.4***	11.9	1320.3***	300.0***	8.41
pods. weight pl^{-1} (g).		0.51	1985.9***	1.12	4168.0***	3300.5***	0.99
100- pod weight (g)		1.13	301.5***	2.27	677.1***	419.9***	0.89
Seeds number pl^{-1}		0.86	985.0***	3.73	2148.7***	2148.7***	1.33
Seeds weight pl^{-1} (g).		0.35	260.0***	0.41	2478.8***	1449.6***	2.14
100 seeds weight		7.28	384.2***	1.76	108.21***	367.3***	4.66
Oil percent		0.31	21.27**	0.38	37.61***	72.81***	1.05
pods yield ardab fad^{-1}		2.54	72.6**	1.42	16.29**	50.35***	2.04

Mean Performance of Quantitative traits and Oil Content in the M1 and M2 Generations

Chlorophyll SPAD reading

The results showed the high content of chlorophyll in mutated T1 (0.01) and T2 (0.03) plants over control plants through the reading of SPAD values especially Giza 6 and Var.381 in M1 and M2 generations (Table 3). The mean values of all 4 varieties were higher in M1 than in M2 generations. On the other hand, each variety responded differently to the combined effects of the three treatments throughout the duration of each generation. In the M1 generation, Giza6 had the highest general mean (47.8) and Var. 112 had the lowest general mean (41.8). In the M2 generation, Var. 381 had the highest general mean (46.4) and Var. 57 had the lowest (41.4) (Fig.1.d). The findings revealed various amounts of SPAD in four different varieties of peanut mutant plants. It's possible that the difference in SPAD values is the result of mutations that happen at various genomic loci and NaN_3 concentrations (Al-Qurainy, 2009). These results contrasted with that of Okasha *et al*. (2021), who reported that mean SPAD values decreased when NaN3 concentrations increased in M1 and M2 compared to control. Similar to this, earlier investigations revealed that genotype influences the sensitivity to chemical mutagens (Ali *et al*, 2010; Kumar *et al*., 2015).

Growth characteristics:

The results of stem height trait are presented in Table (4) and showed that M1 had a lower overall mean than M2, regardless of whether the mutagen dose was modest or high. The average of each variety reacted uniformly to the combined effects of the three treatments over the course of each generation. In both generations, Var. 57 had the greatest general mean while Var. 381 had the lowest. T1 mutated plants and T2 mutated plants displayed a high value of the stem height compared to control plants for all 4 varieties, excluding T2 mutated plants of Giza 6, which had a lesser stem height (54.4 cm) in the M2 generation and T1 and T2 mutagens significantly reduced the stem height in Giza6 (49.1 and 51.9 cm, respectively) in the M1 generation. This indicates that mutagenic inhibition of mitosis and expression of plant hormone synthesis genes can cause plant height reduction (Cheng *et al.,* 2019). On the other hand, Var. 57 had higher values in both generations at both mutagen doses. This may indicate that plant growth hormones induced by these NaN_3 concentrations are maintained throughout the vegetative growth period of Var.57. Nevertheless, this finding is similar to the report by Animasaun *et al.* (2014) which stated that stem height was positively affected by these high concentrations of NaN_3 mutagen.

The results of branch number showed that the means of all four varieties were significantly impacted by both low and high dosages of mutagens when compared to the general means of the control plants in M1 and M2 although they had negative reactions to the high mutagen concentration (Table 4). The highest increases in the mean values in the M1 generation Var.112 (9.8) and Var.381 (8.3) when compared to the control plants of their respective types (6.8 and 7.4). When comparing Var. 57 and Var. 112 to their plant control (7.7 and 7.0, respectively), the largest increase in branches per plant was observed in M2 generation at a low dose of mutagen (10.1 and 8.5). Var. 112 increased at the same dose in both generations, probably due to rapid cell division, elongation and synthesis of plant hormones or nucleic acids (Khursheed *et al.,* 2019). This result is consistent with Kavera and Nadf (2017) and Raina *et al.* (2022).

Table (3): SPAD values reading of four peanut varieties treated with three NaN_3 concentrations in to mutational generations

Characters	Concentrations	Generations	Giza 6	Var.112	Var.57	Var.381	X`
SPAD values	Control (0.00)	M1	45.4	40.6	44.6	42.2	43.2
		M2	42.4	41.6	42.3	45.5	42.9
	T1 (Con. 0.01)	M1	47.5	44.6	43.5	46.3	45.5
		M2	45.3	44.5	36.1	47.4	43.4
	T2 (Con. 0.03)	M1	50.4	40.3	45.7	45.4	45.4
		M2	45.9	40.6	45.7	46.4	44.5
	X`	M1	47.8	41.8	44.6	44.6	
		M2	44.5	42.2	41.4	46.4	
	LSD.0.05 %	M.		Var		M.* Var	
		M1	M2	M1	M2	M1	M2
		0.87	0.87	1.03	1.10	1.75	1.73

Table (4): Mean values of stem height and branches number/plant of four peanut varieties treated with three NaN3 concentrations in to mutational generations

	Concentrations	Generations	Giza6	Var.112	Var.57	Var.381	X`
Stem height (cm).	Control (0.00)	M1	63.3	53.1	45.5	46.4	52.1
		M2	57.6	47.1	44.2	51.5	50.1
	T1 (Con. 0.01)	M1	49.1	59.3	61.5	54.1	56.0
		M2	62.2	65.9	65.7	51.3	61.3
	T2 (Con. 0.03)	M1	51.9	52.4	58.3	44.5	51.8
		M2	54.4	66.8	72.6	61.6	63.8
	X`	M1	54.8	54.9	55.1	48.3	
		M2	58.1	59.9	60.8	54.8	
	LSD.0.05 %	M.		Var		M.* Var	
		M1	M2	M1	M2	M1	M2
		1.23	1.96	1.26	2.45	2.46	3.92
		Season	Giza6	Var.112	Var.57	Var.381	X`
Branches number pl^{-1}	Control (0.00)	M1	7.8	6.8	9.7	7.4	7.9
		M2	9.4	7.0	7.7	10.2	8.6
	T1 (Con. 0.01)	M1	5.9	9.8	5.8	8.3	7.5
		M2	4.1	8.5	10.0	6.9	7.4
	T2 (Con. 0.03)	M1	7.5	6.9	4.1	4.2	5.7
		M2	5.7	5.7	4.1	3.7	5.3
	X`	M1	7.1	7.8	6.5	6.6	
		M2	6.4	7.1	7.3	6.9	
	LSD.0.05 %	M.		Var.		M.* Var	
		M1	M2	M1	M2	M1	M2
		0.80	0.60	0.99	0.61	1.60	1.20

Var.= Varieties M.= Mutations

Yield and yield component traits:

The pod number per plant is one of the most significant characteristics impacting yielding capacity (Table 5). However, in the M1 generation, this trait changed depending on the variety and treatment concentrations. For instance, T1 and T2 mutant plants, which produced an average of 71.0 and 95.7 pods per plant respectively in Var. 112, were considerably different from control plants which had an average of 66.0 pods per plant. The pattern was slightly different in Giza 6 and Var. 57 because T1 mutant plants produced lower pods per plant than control plants, whereas T2 mutant plants produced a mean of 75.0 and 93.0 in that order to keep ahead of the control plants (61.0 and 62.0, respectively). Comparing T2 plants to control plants in the M2 generation, the mean values of Giza6, Var.112, and Var.57 showed a significant improvement. Contrarily, Var.381 had fewer pods on average per plant (51) at high mutagen concentrations.

Most essentially observed that high doses of the mutagen increased the average number of pods per plant in the peanut varieties tested at both generations, except Var.381. However, this is considered a vital trait from a breeder's point of view. This property enhancement may be due to the physiological effects of high doses of mutagens and their hydrolysis products. A previous study of peanut varieties reported similar results (Chen *et al.,* 2020).

Table (5): Mean values of pod number, pods weight, 100 pods weight/plant of four peanut varieties treated with three NaN_3 concentrations in to mutational generations

Characters	Concentrations	Generations	Giza6	Var.112	Var.57	Var.381	X`
Pods number pl^{-1}	Control (0.00)	M1	61	66	62	66.3	63.8
		M2	74.0	74.0	73.0	57.0	69.5
	T1 (Con. 0.01)	M1	50.3	71.0	53.0	76.0	62.5
		M2	87.0	81.0	69.0	74.0	78.1
	T2 (Con. 0.03)	M1	75.0	95.7	93.0	54.0	79.4
		M2	93.0	96.0	96.0	51.0	84.0
	X`	M1	62.1	77.6	69.3	65.4	
		M2	84.7	83.7	79.3	60.7	
	LSD.0.05 %	M.		Var.		M.* Var	
		M1	M2	M1	M2	M1	M2
		2.20	2.55	2.57	2.87	4.41	5.09
		Generations	Giza6	Var.112	Var.57	Var.381	X`
Pods. weight pl^{-1} (g)	Control (0.00)	M1	124.4	93.5	94.4	115.5	106.9
		M2	172.6	144.2	163.5	129.5	152.5
	T1 (Con. 0.01)	M1	194.7	102.5	74.4	120.5	123.1
		2020	188.4	166.4	141.3	150.3	161.6
	T2 (Con. 0.03)	M1	100.5	130.5	146.5	107.2	121.2
		2020	151.5	225.4	218.3	116.4	177.9
	X`	M1	139.9	108.8	105.1	114.4	
		2020	170.8	178.7	174.4	132.1	
	LSD.0.05 %	M.		Var.		M.* Var	
		M1	M2	M1	M2	M1	M2
		0.91	0.85	0.96	0.98	1.82	1.71
		Generations	Giza6	Var.112	Var.57	Var.381	X`
100- pod weight (g)	Control (0.00)	M1	161.4	171.5	175.1	185.5	173.3
		M2	220.2	228.6	238.4	250.3	234.4
	T1 (Con. 0.01)	M1	220.1	197.4	163.2	188.4	192.1
		M2	227.6	234.7	230.2	241.5	233.5
	T2 (Con. 0.03)	M1	141.1	185.4	180.5	163.5	167.6
		M2	208.5	231.4	246.9	214.5	225.3
	X`	M1	174.2	184.8	172.9	179.1	
		M2	218.8	231.6	238.5	235.4	
	LSD.0.05 %	M.		Var.		M.* Var	
		M1	M2	M1	M2	M1	M2
		0.83	0.91	1.06	0.94	1.67	1.81

Var.= Varieties **M.= Mutations**

The data in Table (5) demonstrated the average pod weight per plant and the average of 100 pods weight in Var. 57, which responded favorably to high doses of mutagen compared to control plants in the M1 and M2 generations, but negatively to low doses of mutagen. Low dosages of mutagen in M1 and M2 had a beneficial effect on Giza6, whereas excessive amounts had the opposite effect. Both mutagen doses had an advantageous effect on Var.122 in the M1 and M2. Average pods weight per plant for both generations responded favorably to Var. 381 at low dose. Var. 381 enhanced value at low dose while decreasing value in the M2 generation, but decreased value at high dose in both generations for the average weight of 100 pods (Table 5). Indeed, these disparate results imply that various plants react to mutagenesis treatments at particular dosages or concentrations in different ways. To draw meaningful conclusion, it may be necessary to compare how various mutagens affect various crop growth metrics (Manal et al., 2009).

The results of the average values of the seed number/plant and seed yield (seeds weight per plant and 100 seeds weight) were variable in M1 and M2 plants (Table 6). The findings demonstrated that Var.112 displayed greater levels of these traits in M1 and M2 generations of T1 and T2 mutant plants compared to control plants, except the average number of seeds per plant at a lower mutagen dose was less as compared to control plants. Var.57 had high values of the average seed weight per plant in T1 and T2 mutated plants compared to control plants in both generations. The number of seeds and 100 seed weight were less than control at the low dose of mutagen in both generations. But when these traits were compared in Giza 6 between T1 and T2 mutated plants, the mean values in T2 mutated plants were lower in M1 and M2 generations. While Var.381 mutant plants from T1 and T2 exhibited fewer number of seeds per plant and seed weight per plant than control plants. On the other hand, the average weight of 100 seeds was larger in T1 mutant plants (97.4 g and 95.4) but in T2 mutant plants and control plants (78.9 g and 87.3 g and 82.6 g and 88.2 g, respectively) in the M1 and M2 generations.

Obviously, the low mutagen dose had a positive impact only on the number of seeds per plant in Giza 6, whereas the high mutagen dose had a negative impact on the seed yield traits in Giza 6 and Var.138 in the M1 and M2 generations. This may be due to physiological and biological processes related to yield, such as hormonal balance and enzymatic activity. In addition, mutagenic toxicity has been reported to damage cellular components and alter enzymatic activity at the molecular level (Ali *et al.*, 2010; Chen *et al.,* 2020). In contrast, Var 57 and Var. 122 responded positively to high-dose mutagens for seed yield traits possibly due to the predominant frequency of the desired mutations in the treated plants. Therefore, increases in polygenic traits such as seed yield could simply result from changes in inherited traits or mutations at structural loci. The current study is in agreement with previous reports of mutagenized peanut cultivars that recorded significant increases in seed yield (Manal *et al.*, 2009; Animasaun *et al.,* 2014). Although, yield (Ardab/Fadden) is a complex trait involving additive effects of multiple genes and it is difficult to identify the mutant genes that control performance improvement (Chen *et al.,* 2020; Raina *et al.*, 2022).

The results of this study showed that both doses of mutagens enhanced yield (Ardab/ Fadden) in peanut varieties of generations M1 and M2, with the exception of var. 381, which decreased at high dose (Table 7). Furthermore, the variation observed in the treated plants was greater than in the control plants since control plants are supposed to be genetically similar and any differences found therein can only be the result of environmental factors, which was the expected result. The present study is in coherence with Manal *et al.* (2009) and Ali *et al.* (2010).

Oil content percent trait:

Results of oil content percent In M1 and M2 generations. It was found that a low dose caused a positive effect on the average of the oil percent in Giza 6, but a high dose caused the opposite. Var. 112 had high values for both mutagen doses. Var. 381 had low values for both mutagen doses. Var. 57 responded negatively at the low mutagen dose, but positively at a high mutagen dose. In the M1 and M2 generations (Table 7). This finding is similar to the report by Wang *et al.* (2007) which revealed that mutagenesis treatment can either increase or decrease the oil content of peanuts. As a result, the oil content of peanut seeds is a complex and polygenic trait that responds to environmental factors that take place as a plant develops.

Low and High Mutagen Dosages Affect the Genetic Behavior of Plant Traits

Phenotypic and genotypic coefficients of variation

The variability in crops is classified as genetic and non-genetic, including phenotypic and genotypic coefficients of variation. Because it serves as the foundation for selection, understanding the level of variety in crop species is crucial. The data in Table (8) are the calculated phenotypic and genotypic coefficients of variability (PCV and GCV) for eleven traits that were examined in this study. The GCV values also varied from 3% to 41.77% and from 2.61% to 34.46% in the M1 and M2 generations, respectively. The PCV values also ranged from 3.65% to 41.77% and from 2.63 to 34.48% in the M1 and M2 generations, respectively. Obviously, the values of PCV and GCV were greater in the M1 generation than those in the M2 generation. As the performance stability of the mutants becomes pronounced in subsequent generations (M2, M3, etc.) through increased recombination and eradication of cytological mutations. Although less important in terms of obtaining stable genetic mutations, variations in M1 generation are often used as a barometer to assess the efficacy of mutagenic treatments (Raina *et al.,* 2022).

Table (6): Mean values of seed number, seeds weight, 100 seeds weight/plant of four peanut varieties treated with three NaN_3 concentrations in to mutational generations

Characters	**Concentration**	**Generations**	**Giza6**	**Var.112**	**Var.57**	**Var.381**	**X`**
Seed number pl^{-}	**Control (0.00)**	M1	116.0	83.0	104.6	123.0	106.6
		M2	106.0	106.4	126.0	127.0	116.2
	T1 (Con. 0.01)	M1	139.0	76.0	96.0	115.0	106.5
		M2	121.0	101.0	114.0	109.0	111.2
	T2 (Con. 0.03)	M1	86.0	93.0	187.0	96.0	115.5
		M2	97.0	132.0	192.3	94.0	128.8
	X`	M1	113.7	84.0	129.2	111.3	
		M2	108.0	113.1	144.1	110.0	
	LSD.0.05 %	M.		Var		M.* Var	
		M1	M2	M1	M2	M1	M2
		1.27	1.13	1.56	1.14	253	2.25
		Generations	Giza6	Var.112	Var.57	Var.381	X`
Seed weight pl^{-1} (g).	**Control (0.00)**	M1	106.3	65.9	88.2	122.6	95.8
		M2	97.3	87.3	109.6	117.2	102.8
	T1 (Con. 0.01)	M1	122.3	77.1	89.9	104.1	98.3
		M2	114.6	93.5	117.5	102.5	107.0
	T2 (Con. 0.03)	M1	80.3	94.6	160.5	95.1	107.6
		M2	89.9	105.4	168.7	84.8	112.2
	X`	M1	103.0	79.2	112.9	107.3	
		M2	100.6	95.4	131.9	101.5	
	LSD.0.05 %	M.		Var		M.* Var	
		M1	M2	M1	M2	M1	M2
		2.04	1.14	2.23	1.45	4.07	2.29
		Generations	Giza6	Var.112	Var.57	Var.381	X`
100 seeds weight	**Control (0.00)**	M1	67.4	72.5	85.4	82.6	77.0
		M2	80.9	77.5	92.8	88.2	84.8
	T1 (Con. 0.01)	M1	88.6	85.3	80.5	97.4	87.9
		M2	101.5	91.9	79.2	95.4	92.0
	T2 (Con. 0.03)	M1	73.3	85.8	95.6	78.9	83.4
		M2	91.9	91.1	113.8	87.3	96.1
	X`	M1	76.4	81.2	87.2	86.3	
		M2	91.4	86.8	95.3	90.3	
	LSD.0.05 %	M.		Var		M.* Var	
		M1	M2	M1	M2	M1	M2
		1.22	1.72	1.49	2.14	2.44	3.44

Var.= Varieties M.= Mutations

Table (7): Mean values of oil content percent and yield (ardab fad^{-1}) of four peanut varieties treated with three NaN_3 concentrations in to mutational generations

Characters	Concentrations	Generations	Giza6	Var.112	Var.57	Var.381	X`
Oil content percent	**Control (0.00)**	M1	48.2	51.3	51.2	68.1	54.6
		M2	51.4	47.5	52.5	51.5	50.7
	T1 (Con. 0.01)	M1	53.8	60.3	46.3	55.6	53.9
		M2	53.5	59.4	50.2	50.3	53.3
	T2 (Con. 0.03)	M1	47.2	52.3	63.4	48.0	52.7
		M	50.3	50.4	61.5	47.7	52.5
	X`	M1	49.7	54.6	53.6	57.2	
		M2	51.7	52.4	54.7	49.8	
	LSD.0.05 %	M.		Var		M.* Var	
		M1	M2	M1	M2	M1	M2
		0.84	0.81	1.06	1.01	1.69	1.63
		Generations	Giza6	Var.112	Var.57	Var.381	X`
Yield.ardab fad^{-1}	**Control (0.00)**	M1	10.5	12.0	13.4	16.6	13.1
		M2	12.4	15.1	14.0	14.9	14.9
	T1 (Con. 0.01)	M1	21.5	16.8	14.4	18.2	17.7
		M2	23.7	20.4	15.9	19.1	19.8
	T2 (Con. 0.03)	M1	15.6	20.7	19.4	10.4	16.5
		M2	13.8	22.4	20.3	12.6	17.3
	X`	M1	15.9	16.5	15.7	15.1	
		M2	16.6	19.3	16.7	15.5	
	LSD.0.05 %	M.		Var		M.* Var	
		M1	M2	M1	M2	M1	M2
		1.10	1.18	1.35	1.42	2.20	2.35

Var.= Varieties M.= Mutations

Table (8): Parameters of genotypic and phenotypic coefficient of variation for different characters at three different mutations concentration, heritability, genetic gain and genetic gain percent for peanut traits under three concentrations of NaN_3 in to mutation generations

Characters	Generations	Concentration	GCV%	PCV%	H^2%	GS	GS%
SPAD values	**M1**	Control (0.00)	4.88	5.53	77.67	3.8	8.9
		T1(Con. 0.01)	3.68	4.25	75.01	3.0	6.6
		T2(Con. 0.03)	8.99	9.26	94.32	8.2	18.0
	M2	Control (0.00)	3.73	4.60	65.86	2.7	6.2
		T1(Con. 0.01)	11.36	11.60	95.87	9.9	22.9
		T2(Con. 0.03)	5.81	6.41	82.03	4.8	10.8
Stem height (cm).	**M1**	Control (0.00)	15.70	15.83	98.33	16.7	32.1
		T1(Con. 0.01)	9.81	10.14	93.59	10.9	19.5
		T2(Con. 0.03)	10.83	11.12	94.93	11.3	21.7
	M2	Control (0.00)	11.57	11.73	97.29	11.8	23.5
		T1(Con. 0.01)	10.62	12.37	73.69	11.5	18.8
		T2(Con. 0.03)	12.05	12.29	96.15	15.5	24.3
No. of branches pl^{-1}	**M1**	Control (0.00)	15.36	17.12	80.49	2.3	28.4
		T1(Con. 0.01)	24.87	29.40	71.57	3.2	43.3
		T2(Con. 0.03)	29.31	35.34	68.80	2.9	50.1
	M2	Control (0.00)	16.27	18.91	74.05	2.5	28.8
		T1(Con. 0.01)	34.15	34.92	95.61	5.1	68.8
		T2(Con. 0.03)	33.11	33.94	95.20	3.5	66.6
No. of pods pl^{-1}	**M1**	Control (0.00)	3.00	3.65	67.72	3.2	5.1
		T1(Con. 0.01)	4.42	34.91	1.61	0.7	1.2
		T2(Con. 0.03)	24.25	24.29	99.66	39.6	49.9
	M2	Control (0.00)	12.00	12.02	99.64	17.2	24.7
		T1(Con. 0.01)	9.92	10.04	97.60	15.8	20.2
		T2(Con. 0.03)	26.23	26.26	99.78	45.3	54.0

Moreover, GCV was less than PCV for five traits including; SPAD, stem height, branches number/plant, pods number/plant and pods yield (Ardab/Fadden). Thus, a much larger PCV exhibits a strong environmental masking effect, which may complicate genetic improvement through mutant genotype selection. While GCV was more or less equal to PCV for pods weight/plant, 100 pods weight, and seeds yield (seeds number/plant, seed weight/plant, and 100 seed weight) as well as oil percentage. However, seed traits are highly variable traits and are susceptible to environmental factors. This finding showed that genetic factors have a significant impact on these traits. The results are consistent with Ali *et al.* (2010) and Chen *et al.* (2020).

Heritability

Heritability describes the reliability of a phenotypic value as a breeding guide which was includes both additive and non-additive gene activities. Thus, characters with high heritability can be improved more quickly by selection than characters with low heritability, as they are affected by environmental factors. In the current study, recorded heritability values exceeded 65% for all traits examined in both the M1 and M2 generations, excluding the trait of number of pods per plant which recorded 1.61% at a low mutagen dose in the M1 generation. Notably, T2 mutant plants in the M2 generation had higher heritability scores than those in the M1 generation. Here, heritability was considered very high if it was above 80%. Thus, in the M2 generation, at high NaN_3 concentrations, mutagenized plants exhibited high heritability values of up to 82%, reaching 99.8% for most of the traits tested. These traits are influenced by fewer environmental factors and can be easily selected for high additive effects (Table 8).

Con. Table (8): Parameters of genotypic and phenotypic coefficient of variation for different characters at three different mutations concentration, heritability, genetic gain and genetic gain percent for peanut traits under three concentrations of NaN_3in to mutation generations

Characters	Generations	Concentration	GCV%	PCV%	H^2%	GS	GS%
100 seeds weight	M1	Control (0.00)	10.98	11.05	98.69	17.3	22.5
		T1(Con. 0.01)	8.06	8.17	97.42	14.4	16.4
		T2(Con. 0.03)	11.43	11.71	95.26	19.2	23.0
	M2	Control (0.00)	7.94	8.53	86.57	12.9	15.2
		T1(Con. 0.01)	10.18	10.36	96.48	18.9	20.6
		T2(Con. 0.03)	12.46	12.62	97.46	24.3	25.3
Oil content percent	M1	Control (0.00)	16.49	16.59	98.79	18.5	33.8
		T1(Con. 0.01)	10.58	10.78	96.19	11.5	21.4
		T2(Con. 0.03)	14.12	14.26	97.99	15.2	28.8
	M2	Control (0.00)	4.22	4.56	85.79	4.1	8.1
		T1(Con. 0.01)	8.01	8.29	93.25	8.5	15.9
		T2(Con. 0.03)	11.62	11.78	97.24	12.4	23.6
pods Yield.ardab fad^{-1}	M1	Control (0.00)	18.45	22.17	69.29	4.2	31.6
		T1(Con. 0.01)	16.08	18.16	78.43	5.2	29.3
		T2(Con. 0.03)	27.73	28.20	96.74	9.3	56.2
	M2	Control (0.00)	14.86	17.48	72.24	3.9	26.0
		T1(Con. 0.01)	15.60	17.39	80.46	5.7	28.8
		T2(Con. 0.03)	27.48	28.64	92.09	9.4	54.3

Genetic gain by selection (GS) and its percentage (GS %)

All studied traits recorded different values of genetic gain by selection (GS), ranging from 0.7 to 105.8 and from 2.5 to 108.7 in M1 and M2 generations, respectively. Notably, T2 mutant plants in the M2 generation had higher GS scores than those in the M1 generation (Table 8).

When genetic gain by selection is expressed as a percentage (GS %) (Table 8), in the M1 generation, the highest value was 86% for pod weight per plant at the low mutagen dose, but the lowest value was 1.2% for the number of pods per plant at the low mutagen dose as well. In the M2 generation, the dose of mutagen successfully increased the GS value of pods weight per plant and the GS% of seed number per plant; the highest value was 73% for the number of seeds per plant at the high mutagen dose, whereas the lowest value was 6.2 for SPAD at control. An increase in genetic parameters can result from the pleiotropic effects of mutagens or newly mutated genes. This finding was supported by an excellent study by Raina *et al.* (2022).

Con. Table (8): Parameters of genotypic and phenotypic coefficient of variation for different characters at three different mutations concentration, heritability, genetic gain and genetic gain percent for peanut traits under three concentrations of NaN_3 in to mutation generations

Characters	Generations	Concentration	GCV%	PCV%	H^2%	GS	GS%
Pods weight pl^{-1} (g)	**M1**	Control (0.00)	14.46	14.49	99.67	31.8	29.7
		T1(Con. 0.01)	41.77	41.77	99.96	105.8	86.0
		T2(Con. 0.03)	17.51	17.53	99.77	43.7	36.0
	M2	Control (0.00)	12.68	12.70	99.68	39.8	26.1
		T1(Con. 0.01)	12.78	12.79	99.85	42.5	26.3
		T2(Con. 0.03)	29.68	29.69	99.96	108.7	61.1
100- pods weight (g)	**M1**	Control (0.00)	5.73	5.75	99.11	20.4	11.7
		T1(Con. 0.01)	12.45	12.47	99.76	49.2	25.6
		T2(Con. 0.03)	11.94	11.96	99.70	41.2	24.6
	M2	Control (0.00)	5.52	5.53	99.53	26.6	11.3
		T1(Con. 0.01)	2.61	2.63	98.54	12.5	5.3
		T2(Con. 0.03)	7.69	7.71	99.55	35.6	15.8
No. of seeds pl	**M1**	Control (0.00)	16.36	16.48	98.57	35.7	33.5
		T1(Con. 0.01)	25.24	25.26	99.83	55.3	52.0
		T2(Con. 0.03)	41.42	41.44	99.92	98.5	85.3
	M2	Control (0.00)	10.18	10.21	99.47	24.3	20.9
		T1(Con. 0.01)	7.55	7.62	98.14	17.1	15.4
		T2(Con. 0.03)	35.48	35.49	99.91	94.1	73.0
Seeds weight pl^{-1} (g).	**M1**	Control (0.00)	25.41	25.50	99.30	50.0	52.2
		T1(Con. 0.01)	19.68	19.88	98.04	39.5	40.1
		T2(Con. 0.03)	33.35	33.40	99.72	73.8	68.6
	M2	Control (0.00)	12.81	12.86	99.11	27.0	26.3
		T1(Con. 0.01)	10.34	10.47	97.52	22.5	21.0
		T2(Con. 0.03)	34.46	34.48	99.88	79.6	70.9

CONCLUSION

Based on the results of induced polygenic mutation of traits obtained in the four peanut varieties, mutagenesis using NaN_3 mutagen is particularly important method in the case of peanut varieties with very narrow natural gene pools. Therefore, from an agricultural point of view, economic characteristics such as pods weight/plant, 100 pods weight, and seed yield (seeds number/plant, seeds weight/plant and 100 seeds weight), and oil percentage along with high GCV and high heritability coupled with high values of genetic gain by selection in M2 generation that provide a good range of ability to induce desirable mutations of polygenic traits with effective selection and enrichment. In addition to increasing heritability to achieve confounding traits, this can result in rapid stability of mutant plants. Our results highlight the potential for NaN_3-induced mutagenesis in the tested peanut cultivars. In addition, work is currently underway on the molecular characterization of these induced mutants and mutations. This allowed us to select them as new germplasm and breeding material for use in the peanut breeding program in the future.

REFERENCES

Abdul Rahaman, A. A., A. A. Afolabi, D. A. Zhigila, F. A. Oladele and A. A. Al Sahli (2018). Morpho-anatomical effects of sodium azide and nitrous acid on *Citrullus lanatus* (Thunb.) Matsum & Nakai (Cucurbitaceae) and *Moringa oleifera* Lam. (Moringaceae). Hoehnea, 45(2): 225-237.

Abdul Rahaman, A. A., A. A. Afolabi, B. U. Olayinka, O. T. Mustapha, K. A. Abdulkareem and F. A. Oladele (2013). Effects of sodium azide and nitrous acid on the morphology and leaf

Anatomy of *Jatropha curcas* L. (Euphorbiaceae). Int. J. of Phytofuel and Allied Sciences, 2: 30-41.

Adamu, A. K. and H. Aliyu (2007). Morphological effects of sodium azide on tomato (*Lycopersicon esculentum* Mill.). The Sci. World J., 2(4): 9-12.

Ali, H., T. M. Shah, N. Iqbal, B. M. Atta and M. A. Haq (2010). Mutagenic induction of double-podding trait in deferent genotypes of chickpea and their characterization by STMS marker. Plant Breed., 129: 116-119.

Al-Qurainy, F. (2009). Effects of sodium azide on growth and yield traits of *Eruca sativa* (L.). World Applied Sci. J., 7(2): 220-226.

Animasaun, D. A., S. Oyedeji, M. A. Azeez and A. O. Onasanya (2014). Alkylating efficiency of sodium azide on pod yield, nut size and nutrition composition of samnut 10 and samnut 20 varieties of groundnut (*Arachis hypogea* L.) Afri. J. of food, agriculture, nutrition and Development, 14(7): 9497-9510.

Apparao, B. J. (2005). Effect of Sodium Azide on peroxidase isozyme profiles in cowpea [*Vigna unguiculata* (L) Walp]; Adv. Plant Sci, 18(1): 289-293.

Bharathi, V. B., M. Prakash, S. Jagadeesan, S. Kavimani, K. Saravanan and J. Ganesan (2005). Variability studies in M2 generation of groundnut (*Arachis hypogaea* L) Var. VRI-2; Legume Res., 28(1): 68-70.

Chen, T., L. Huang, M. Wang, Y. Huang, R. Zeng, X. Wang, L. Wang, S. Wan and L. Zhang (2020). Ethyl Methyl Sulfonate-Induced Mutagenesis and Its effects on Peanut agronomic, yield and quality traits. Agronomy, 10: 655.

Cheng**,** Q., L. Dong, T. Su, T. Li, Z. Gan, H. Nan and *et al.* (2019). CRISPR/Cas9-mediated targeted mutagenesis of GmLHY genes alters plant height and internode length in soybean. BMC Plant Biol., 19:562.doi: 10.1186/s12870-019-2145-8.

Dhanavel, D., P. Pavadai, L. Mullainathan, D. Mohana, G. Raju, M. Girija and C. Thilagavathi (2008). Effectiveness and efficiency of chemical mutagens in cowpea (*Vigna unguiculata* L.) Walp.) Afri. J. of Biotech., 7: 4116-4117.

FAOSTAT (2020). Food and Agriculture Organization of the United Nations. Available online: http://wwwfaoorg/ accessed on Jan 30(2020).

Hallauer, A. R. and J. B. Miranda (1988). Quantitative Genetics in Maize Breeding. 2nd ed. Iowa State Univ. Press, Ames. USA.

Jadhav, V. M., K. Z. Rahul and D. S. Amol (2018). Studies on induced chemical mutagenesis in peanut (*Arachis hypogaea* L.). Int. J. Curr. Microbiol. App. Sci., 7(10): 1662-1669.

Juhaimi, F. A., K. Ghafoor, E. E. Babiker and *et al.* (2018). Influence of storage and roasting on the quality properties of kernel and oils of raw and roasted peanuts. J. Oleo Sci., 67(6): 755-762.

Kavera, H. and H. L. Nadaf (2017). Genetic improvement for yield through induced mutagenesis in peanut (*Arachis hypogaea* L.). Legu. Res., 40(1): 32-35.

Kharkwal, M. C. (2012). A brief history of plant mutagenesis. In: Shu QY, Forster BP, Nakagawa H, editors. Plant mutation breeding and biotechnology. Wallingford: CABI; p. 21-30.

Khursheed, S., A. Raina, K. Parveen and S. Khan (2019). Induced phenotypic diversity in the mutagenized populations of faba bean using physical and chemical mutagenesis.

Kumar**,** A., V. Kumar, S. K. Lal, M. Jolly and A. Sachdev (2015). Influence of gamma rays and ethyl methane sulphonate (EMS) on the levels of phytic acid, ra_nose family oligosaccharides and antioxidants in soybean seeds of deferent genotypes. J. Plant Biochem. Biotechnol., 24: 204-209.

Manal Eid, S. Griesh, A. Gruigis and A. M. Abdel-Mageed. (**2009**). Induction of Genetic Variability for Quantitative Traits and Oil Content in Peanut (*Arachis hypogaea L.*) by Using Gamma Rays and Acriflavin Mutagens. Agric. Res. J., Suez Canal University, 9(2): 1-8.

Mensah, J. K. and B. Obadoni (2007). Effects of sodium azide on yield parameters of groundnut (*Arachis hypogaea* L.). Afri. J. of Biotech., 6(6): 668-671.

Mostafa, G. G. (2011). Effect of sodium azide on the growth and variability induction in *Helianthus annus* L.", Int. J. of Plant Breed. and Genet., 5: 76-85.

Nkuna, R. T., C. T. Wang, X. Z. Wang, Y. Y. Tang, Z. W. Wang and J. C. Zhang (2021). Sodium azide induced high-oleic peanut (*Arachis hypogaea* L.) mutant of Virginia type. Genet Resour Crop Evol., 68:1759–1767.

Okasha, S. A., S. E. Ammar, A. A. Aly and S. H. Salama (2021). Genetic Improvement for Yield and Its Components through Induced Chemical and Physical Mutagenesis in Peanut (*Arachis Hypogaea* L.) J. of Plant Prod. Sci.; Suez Canal University, 10(1): 49-66

Olise, F. O., D. I. Olorunfemi and F. I. Okoloafor (2019). Effects of sodium azide on seed germination of common beans (*Phaseolus vulgaris*). Journal of Underutilized Legumes, 1(1): 122-134.

Panda, P., B. Pradhan and G. R. Rout (2022). Comparative mutagenic frequency, efficiency, effectiveness and rate of ethyl methane sulphonate and sodium Azide in groundnut (*Arachis hypogaea* L.). The Pharma Innovation J., 11(4): 24-28.

Raina Aamir, R. A. Laskar, M. R. Wani, B. L. Jan, S. Ali and S. Khan (2022). Gamma Rays and Sodium Azide Induced Genetic Variability in High-Yielding and Biofortified Mutant Lines in Cowpea [*Vigna unguiculata* (L.) Walp.] Frontiers in plant science, 13 |Article 911049.

Sangle, S. M. and J. S. Lad (2020). Review on mutation breeding for improvement of food legumes – past and recent. Int. J. of Res. and Analytical Reviews (IJRAR), 7(1): 476-481.

Steel, R. G. D., J. H. Torrie and D. A. Dicky (1997). Principles and Procedures of Statistics, A Biometrical Approach. 3rd Edition, McGraw Hill, Inc. Book Co., New York, 352-358.

Wang, C., X. Yang, J. Tang., J. Zhang, Z. Xu and Z. Lui (2007). EMS-induced variations in pod characters of peanut. EJEAFCHE, 6: 2427-2433.

Wang, C. T., J. C. Zhang, Y. Y. Tang and *et al*. (2013). Peanut genetic improvement. Shanghai Science and Technology Press, Shanghai, China.

Wang, X. Z., W. G. Ning, Q. X. Sun and *et al*. (2019). An improved high oleic line created by chemical mutagen of 'Huayu 40.' Oil Crop Sci., 4(1): 47-54.

تأثير الصوديوم ازيد كمادة مستحثة للطفور على الصفات المورفولوجية والمحصول ومكوناته في الفول السوداني

سماح عبد العظيم صبري[1]، إيمان طلعت عبده[2]، أمل محمد عبد المجيد[1]

[1]قسم النبات الزراعي - كلية الزراعة - جامعة قناة السويس - الإسماعيلية - مصر

[2]معهد بحوث المحاصيل الحقلية - مركز البحوث الزراعية - الجيزة - مصر

محصول الفول السوداني له قيمة اقتصادية عالية. وله طبيعة نمو خاصة تسببت في صعوبة إجراء عمليات تحسين وراثي به. هذه الدراسة تهدف إلى إجراء تغيرات وراثية و تحسين لأربعة أصناف من الفول السوداني من خلال معاملاتها بتركيزات من مادة الصوديوم ازيد كمادة مستحثة للطفور. أجريت التجربة في المزرعة التجريبية بمحطة بحوث الإسماعيلية. قسم المحاصيل الزيتية - مركز البحوث الزراعية لتحديد تأثير الصوديوم أزيد على الصفات الكمية (الصفات المورفولوجية والمحصولية) وتحديد فعالية المادة الكيميائية المسببة للطفرات في نمو الفول السوداني. تم استخدام أربعة أصناف من الفول السوداني (جيزة ٦ ، صنف ١١٢ ، صنف ٥٧ ، صنف ٣٨١) لإحداث الطفرات وزرعت في تصميم القطاعات العشوائية الكاملة (RCBD) بثلاثة مكررات. كان المتوسط العام لجميع الأصناف الأربعة أعلى في M1 من تلك الموجودة في الجيل M2. أظهرت النباتات الطافرة T1 و T2 قيمة عالية لارتفاع الساق مقارنة بالنباتات الكنترول لجميع الأصناف الأربعة، وقد لوحظت أكبر زيادة في الفروع لكل نبات في جيل M2 بجرعة منخفضة من الصوديوم ازيد. أقل من التحكم في الجرعة المنخفضة للطفرات في كلا الجيلين، كانت قيم PCV وGCV أكبر في الجيل M1 من تلك الموجودة في الجيل M2. كان GCV أقل من PCV في SPAD، ارتفاع الساق، عدد الأفرع / النبات، عدد القرون/نبات ومحصول القرون/(أردب/فدان). بينما كان GCV مساويًا أكثر أو أقل لـ PCV لكل من وزن القرون/نبات، ووزن ١٠٠ قرن، ومحصول البذور (عدد البذور/ نبات، ووزن البذور/ نبات، ووزن ١٠٠ بذرة) بالإضافة إلى نسبة الزيت. تجاوزت قيم التوريث ٦٥٪ لجميع الصفات التي تم فحصها في كل من جيلين M1 و M2، كان للنباتات الطافرة T2 في الجيل M2 درجات وراثية أعلى من تلك الموجودة في الجيل M1. سجلوا قيمًا تتراوح بين ٨٢٪ و ٩٩.٨٨٪ لمعظم الصفات التي تم فحصها وسجلت جميع الصفات المدروسة قيمًا مختلفة للكسب الجيني عن طريق الانتقاء (GS)، تتراوح من ٠.٧ إلى ١٠٥.٨ ومن ٢.٥ إلى ١٠٨.٧ في أجيال M1 و M2 على التوالي. في هذه الدراسة، لعب تركيز ٠.٠١٪ و ٠.٠٣٪ من الصوديوم أزيد دورًا مهمًا في إحداث طفرة لتحسين الصفات الكمية لأصناف الفول السوداني المختارة.

الكلمات المفتاحية: الكسب الجينى، درجة التوريث، الصوديوم أزيد، الفول السوداني، محتوى الزيت، المحصول ومكوناته