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Evaluation of *Chrysanthemum morifolium* cv. Maghi plants after sodium azide treatment

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ABSTRACT

The present study was carried out during two successive seasons 2015/2016 and 2016/2017 to study the genetic variability of some growth and flowering traits of *Chrysanthemum morifolium cv.* Maghi plants caused by Sodium Azide (SA) treatments. Shoot apical cuttings were dipped in the SA solution, at 0.0, 0.12 and 0.18% for two different soaking times (6 and 12h). The cutting survivability was immensely hampered (P>0.05) due to the SA concentrations and the time of the treatment.

In both seasons, there were remarkable variations in the range of all investigated traits due to the SA treatments such as plant height, number of branches and flower heads/plant, Flower head diameters and their fresh and dry weight. However, number of days till full blooming showed the lowest variation. All SA-treated plants had higher PCV and GCV than the control ones for all investigated traits except days to full bloom and flower head fresh weights. Moreover, The PCV was always higher than GCV for all the characters. Almost all traits had higher heritability. However, there were huge differences in heritability values between the control and SA-treated plants. Presence of narrow gap between phenotypic coefficient of variation and genotypic coefficient of variation for many the characters under the study suggested that expression of these traits studied showed low environmental influence, which provide ample scope for selection of superior and desired mutants.

KEYWORDS: Chrysanthemum morifolium, Sodium Azide, Heritability, genotypic coefficient of variation, phenotypic coefficient of variation, expected genetic advance

1. INTRODUCTION

Chrysanthemum (Chrysanthemum morifolium Ramat) which we commonly known as Autumn Queen is one of the most important ornamental plants as cut flowers and pot plants. It is a member of the Asteraceae family and native to Northern hemisphere, chiefly Europe and Asia (Anderson, 1987).

Plant breeding has a vital role in improving several plant traits such as; increase yield, tolerance of environmental stress, resistance to viruses, fungi and bacteria, insect pests, herbicides, longer storage period for the harvested crop, improve shape, size and color for plant flowers. It also used to improve the quality, such as increase nutrition value, flavor, or greater beauty (Poehlman and Sleper, 1995).

For a modern and industrialized floriculture, there is always a demand and necessity for new varieties. Mutagenesis is one of the most applicable methods that use in plant improvement for its features simplicity, technical and economic viability, applicability to all plant species and usability in small or large scales (Siddiqui and Khan, 1999). Sodium azide which creates a point mutation, is an important mutagen to enhance agronomic traits and induce new cultivars of many plants as found by Gruszka et al. (2012), El mokadem and Mostafa (2014) and Kapadiya et al. (2014)

The possibilities of using mutation breeding in vegetatively propagated plants are favorable for various reasons such as the usually large heterozygosity of the material which allows direct detection of mutations in the treated material. In the vegetatively propagated material, the intention which is often improving visible characteristics and selection of potentially useful mutations is generally easy (Broertjes, 1986).

Therefore, present study was conducted to study the effect of Sodium Azid(SA) treatments on the vegetative and flowering growth of Chrysanthemum morifolium cv. Maghi plants. Also, to evaluate genetic variability of these traits resulted from SA treatments.

2. MATERIALS AND METHODS

A pot experiment was carried out at the Nursery of Ornamental Plants, Faculty of Agriculture, Minia University, Minia Governorate during two successive seasons 2015/2016 and 2016/2017.

Shoot apical cuttings (about 13-15 cm long) of C. morifolium cv. Maghi were taken in 10th

March from healthy plants in both seasons. The bases of cuttings (about 3 cm) were dipped in the SA solution (Sigma Chem. Co., St. Louis, Mo, in three concentrations (0.0, 0.12 and 0.18%) for two different soaking times (6 and 12h). The SA was dissolved on buffer phosphate and the pH of solution was adjusted at 3.

Then cuttings were rinsed under running tap water for 10 min. Each 5 cuttings were planted in10-cm pot containing mixture of clay and sand (4:1 v/v)

After 45 days, the development plantlets were transferred into 25-cm pots filled with the same previous growth media. All ordinary agriculture treatments were applied.

The layout of the experiment was Completely Randomized Design (CRD) containing six treatments each contained 180 plants.

The recorded data were as follow survival percentage, plant height (cm), number of main branches, days to bloom, number of flower heads/plant, flower head diameter (FHD) (mm), flower head fresh and dry weights (mg)

Genetic parameters were estimate in both seasons. The magnitude of variance of each mean value, phenotypic (σ2P) and genotypic (σ2G) variances, phenotypic coefficient of variation (PCV), genotypic coefficient of variation (GCV) were estimated according to the method advocated by Singh and Chaudhary (1985). GCV and PCV values were categorized as low (0-10%), moderate (10-20%) and high (above 20) as indicated by Sivasubramanian and Menon (1973).

The expected genetic advance as a percent of mean (GAM) were considered as illustrated by (Panse and Sukhatme, 1967). Heritability in broad sense was determined according to the methodology given by Allard (1960). The heritability was categorized as low (0-30%), moderate (30-60%) and high (above 60%) as given by Robinson et al. (1949).

3. Results and Discussion

3.1. Cuttings survivability percentage

Survivability percentage of treated cuttings was recorded after a month of SA treatment. The survival percentage was immensely hampered (P>0.05) due to the SA concentrations and the time of the treatment. Moreover, there was a significant interaction between the concentration and time of treatment as shown in Fig 1. The concentration 0.18% for 6h and 12 h reduced the survivability to 38 and 43% in the first season respectively .Moreover, the survivability percentage was significantly lower when cuttings treated with SA at 0.18% for 6h and 12h (64 and 50%, respectively). Similar results were observed in the second season.

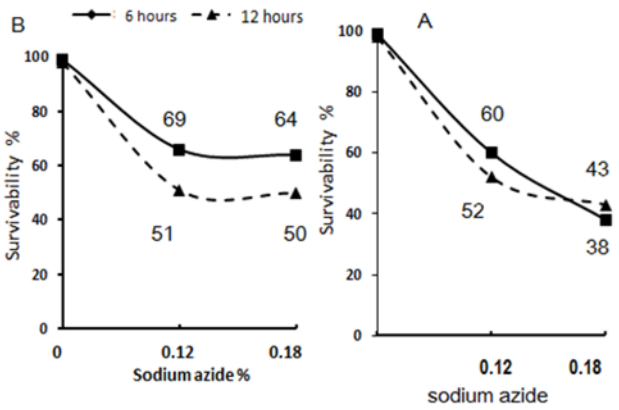

Fig 1. Effect of Sodium Azide on *chrysanthemum morifolium* cv.Maghi plant cuttings survivability (A and B in the 1st and 2nd seasons respectively.

These results might be attributed to the expected effect of mutagens on the meristematic tissues which may be due to delay in the beginning of mitosis (Yadav, 1987), physiological and acute chromosomal damage (Singh and Kole, 2005). Zhang (2000) suggested that the effect of SA could be traced to the azide anions that are strong inhibitors of cytochrome oxidase, which in turn inhibits oxidative phosphorylation. In addition, it is a potent inhibitor of the proton pump and alters the mitochondrial membrane potential. Liamngee *et al.* (2017) suggested that the injurious activity of SA on the root cap cells and the meristematic cells which replace the root cap cells can render it, thus exposing the tender root cells to injury and soil fungi and bacteria which can eventually kill the root hairs. This leaves a high probability for the death of the young seedling.

3.2. Plant height: The shortest significant mean (52.1 cm) was for the treatment 0.12% SA for 12h although, this treatment included the highest plant (90 cm)as shown in Table1. In the second season, results indicated that plants treated with 0.12% SA for 6 h gained the highest significant mean in plant height (89.7 cm). Moreover, significant variations among plant heights were observed due to the treatment. Surely, this wide variation which ranged e.g. from 10 to 122 cm following the treatment with 0.18% for 12h in the 2nd season caused a higher PCV (34.81), GCV (34.66) and consequences higher heritability and GAM. But in the 1st season, the highest GAM (93.75) was for plants treated with 0.18% for 6h which their height ranged from 17.03 to 19.66 cm.

3.3. Number of branches: The treatments had a significant effect on this trait. All treatments reduced number of branches compared to control especially the treatment of 0.12 % SA for 12 h (2.31and 3.9 in the 1st and 2nd seasons respectively) as shown in Table 1. The σ^2P and σ^2G values were

Table 1. Some genetic estimates for plant height (cm) and number of branches/plant traits of *Chrysanthemum morifolium* cv. Maghi following sodium azide treatment during two seasons

		First season								Second season							
SA %	Time (h)	Range	Mean	σ^2P	σ^2G	PCV	GCV	H	GAM	Range	Mean	σ^2P	σ^2G	PCV	GCV	H	GAM
plant height (cm)																	
0.0	6	55-79	67.1	54.26	47.14	10.89	10.23	86.88	19.66	57-80	68.3	48.43	41.73	10.19	09.46	86.17	18.09
	12	55-78	66.8	48.85	42.73	10.56	09.78	85.72	18.66	56-79	67.4	43.41	36.71	09.77	08.98	84.57	17.03
0.12	6	15-80	60.5	251.39	244.3	26.19	25.82	97.17	52.44	15-137	89.7	563.79	557.10	26.48	26.32	98.81	53.91
	12	23-90	52.1	253.51	246.4	30.57	30.14	97.19	61.22	35-138	78.3	434.76	428.10	26.61	26.41	98.46	53.99
0.18	6	17-88	54.2	622.82	615.7	46.03	45.77	98.86	93.75	25-125	85.7	691.09	684.40	30.66	30.51	99.03	62.56
	12	30-90	68.5	212.72	205.6	21.31	20.94	96.65	42.42	10-122	77.8	734.42	727.70	34.81	34.66	99.09	71.07
Number of branches/plant																	
0.0	6	1-8	4.6	03.83	01.72	44.03	29.47	44.79	40.63	1-7	4.9	3.27	1.41	36.90	24.23	43.12	32.78
	12	2-9	5.6	04.67	02.55	38.58	28.51	54.60	43.41	1-8	4.6	3.83	1.97	42.54	30.51	51.44	45.07
0.12	6	1-16	8.4	16.75	14.63	48.89	45.69	87.34	87.97	1-8	3.12	3.25	1.39	57.78	37.78	42.77	50.90
	12	1-14	3.9	11.21	09.09	84.76	76.32	81.09	141.58	1-7	2.31	2.25	0.39	64.93	27.03	17.33	23.18
0.18	6	1-13	5.9	14.54	12.42	63.97	59.13	85.42	112.57	1-6	2.62	2.19	0.33	56.48	21.92	15.07	17.53
	12	1-12	6.9	10.71	08.59	47.63	42.66	80.21	78.71	1-10	3.12	5.71	3.85	76.58	62.88	67.43	106.37

LSD 5%: (1st season: 17.68 and1.67, 2nd season: 9.1and 1.67for plant height and number of branches per plant respectively). **σ^2P:** Phenotypic variances**; σ^2G**: Genotypic variances**; PCV:** Phenotypic coefficient of variance**; GCV:** Genotypic coefficient of variance**; H:** Heritability**; GAM:** Genetic advance as a percent of mean.

noticeably differed among plants in both seasons. In the 1st one the control plants had very low σ2P and σ2G values (3.48 - 4.67 and 1.72-2.55, respectively) however the SA-treated plants had σ2P and σ2G values of (10.71-16.75) and (8.59-14.63) respectively In the 2nd season the control plants had similar values for that of the 1st one but these values were reduced to (2.19-5.71) and (0.33-3.85) for σ2P and σ2G respectively The H could be considering as high for SA-treated plant in the 1st season as well as the treatment 0.18% SA for 12h in the 2nd season. But in the 2nd season, the plants treated with 0.12% SA for 12h as well as 0.18% for 6h had a moderate H. These two treatments had low GAM (23.18 and 17.53) respectively, however the other SA treated plants had GAM varied between 50.9 and 141.58 depending on the concentration and time of treatment**.**

3.4. Days to bloom: The number of days till bloom was significantly varied among the treatments in both seasons as shown in Table2. In the 1st season only plants treated with 0.12% SA for 12h flowered late. There was a noticeable difference between the two seasons where the range was 211-258 days with a mean of 217.3-230.58 days in the1st one and 224-279 days with a mean of 243.76-254.50 days in the second one. The PCV and GCV were low for all plants. Although, the H could classified as high the GAM was very low.

3.5. Number of flower heads/plant: The control plants had number of flower heads were ranged between 12 and 26 with a mean of (17.5-19.4). Table 2 shows a significant effect of SA-treatments on number of flower heads/plant. For example some treatment prevented flower heads development. In the 1st season the SA-treated plant had a mean number of flower heads less than that of the control plants. However, in the2nd one plants treated with (0.12% SA for 6h) and (0.18% SA for 6h) had a higher mean number of flower heads (23.9 and 19.7, respectively) than that of the control plants.

The σ^2P and σ^2G values of SA-treated plants were quite higher than that of the control plants especially in the 2nd season. The PCV and GCV of SA-treated plant were higher however; these values were moderate for the control ones. The highest PCV and GCV value were observed in the 1st season for plants treated with 0.12% SA for 12h. The H values of the number of flower heads were high for all plants and varied between 62.63 and 98.49. Although, the GAM was considered as high for all SA-plants even the control ones, some of them had GAM values higher than 100 but the equivalent value for the control plants was (20.85-34-82).

Table 2. Some genetic estimates for number of days to flower and number of flower heads/plant traits of *Chrysanthemum morifolium* cv. Maghi following sodium azide treatment during two seasons

		First season								Second season							
SA %	Time (h)	Range	Mean	σ^2P	σ^2G	PCV	GCV	H	GAM	Range	Mean	σ^2P	σ^2G	PCV	GCV	H	GAM
								Number of days to flower									
0.0	6	211-230	217.30	27.06	21.71	2.39	2.14	80.23	03.96	232-247	239.3	17.88	13.67	1.77	1.55	76.45	2.78
	12	212-232	218.50	31.11	25.76	2.55	2.32	82.80	04.35	232-249	239.8	18.51	14.30	1.79	1.58	77.26	2.85
0.12	6	211-234	217.94	40.56	35.21	2.92	2.72	86.81	05.23	235-255	241.9	20.06	15.85	1.85	1.65	79.01	3.01
	12	212-258	230.58	135.67	130.30	5.05	4.95	96.06	10.00	235-253	241.0	36.72	32.51	2.51	2.37	88.53	4.58
0.18	6	211-231	218.42	61.14	55.79	3.58	3.42	91.25	06.73	235-255	240.4	24.59	20.38	2.06	1.88	82.88	3.52
	12	211-241	222.78	99.35	94.00	4.47	4.35	94.61	08.72	235-253	239.0	18.42	14.21	1.80	1.58	77.14	2.85
								Number of flower heads/plant									
0.0	6	15.0-26	19.4	11.72	08.36	17.64	14.90	71.33	25.93	12-25	17.5	15.11	11.50	22.21	19.37	76.11	34.82
	12	16.0-24	18.6	08.99	05.63	16.16	12.79	62.63	20.85	13.24	17.9	11.67	08.10	19.08	15.86	69.07	27.15
0.12	6	0.0-26	13.22	41.28	37.92	48.60	46.58	91.86	91.96	0.0-76	23.8	238.89	235.30	64.69	64.21	98.49	131.26
	12	0.0-23	07.14	45.09	41.73	94.04	90.47	92.55	179.29	0.0-48	11.4	85.02	81.41	80.88	79.14	95.75	159.54
0.18	6	0.0-33	12.22	79.34	75.98	72.89	71.33	95.77	143.79	0.0-43	19.7	211.74	208.10	73.52	72.89	98.30	148.88
	12	0.0-30	11.93	44.99	41.63	56.22	54.08	92.53	107.17	0.0-41	14.1	131.38	127.80	81.17	80.05	97.25	162.62

LSD 5%: (1st season: 4.28 3.09, 2nd season: 3.72 and 5.0.for **numbers of days to flower and flower heads/plant respectively**). **σ^2P:** Phenotypic variances**;** **σ^2G**: Genotypic variances**;** **PCV:** Phenotypic coefficient of variance**;** **GCV:** Genotypic coefficient of variance**;** **H:** Heritability**;** **GAM:** Genetic advance as a percent of mean.

Table 3: Some genetic estimates for flower head diameter (mm) trait of *Chrysanthemum morifolium* cv. Maghi following sodium azide treatment during two seasons

		First season								Second season							
SA %	Time (h)	Range	Mean	σ^2P	σ^2G	PCV	GCV	H	GAM	Range	Mean	σ^2P	σ^2G	PCV	GCV	H	GAM
0.0	6	65.4-74.2	70.2	11.06	07.89	04.74	04.00	71.34	06.96	64.8-75.4	69.8	15.43	11.8	05.62	04.92	76.47	08.86
	12	64.5-73.3	69.4	10.85	07.68	04.75	03.99	70.78	06.92	64.5-74.4	69.9	11.66	08.0	04.88	04.05	68.87	06.93
0.12	6	49.7-99.2	74.7	105.75	102.6	13.76	13.55	97.00	27.50	52.0-104.6	76.4	67.91	64.28	10.78	10.49	94.65	21.03
	12	54.5-68.0	72.1	74.88	71.71	12.00	11.74	95.77	23.67	70.7-104	84.2	48.56	44.93	08.27	07.95	92.52	15.77
0.18	6	60.2-89.5	76.3	59.55	56.38	10.11	09.84	94.68	19.72	65.6-91.6	81.6	34.58	30.95	07.20	06.81	89.50	13.27
	12	66.2-95.2	79.9	54.21	51.04	09.21	08.93	94.15	17.86	60.2-97.2	82.9	49.34	45.71	08.47	08.15	92.64	16.16

LSD 5%: (for 1st season: 4.67 and for the 2nd season: 3.00 plant height and number of branches per plant). **σ^2P:** Phenotypic variances**;** **σ^2G**: Genotypic variances**;** **PCV:** Phenotypic coefficient of variance**;** **GCV:** Genotypic coefficient of variance**;** **H:** Heritability**;** **GAM:** Genetic advance as a percent of mean.

3.6. Flower head diameters (FHD):

The control plants had a mean FHD about 70 mm in both seasons with a range of 64.5-75.4 mm as shown in Table 3. On some cases such as plants treated with 0.12% SA for 6h their FHD (49.7-99.2 and 52.0-104.6 mm) in both seasons, respectively) was wider than that of the control plants. However, the disparity of the FHD was not too high between the control plants (69.4 and 70.2 mm) and the SA-treated plants (72.1-84.2 mm). Overall, the control plants had the lowest σ^2P (10.85-15.43) and σ^2G (7.68-11.8) but there were a substantial increase on these values following some of SA treatments. For example, the treatment 0.12% SA for 6h had σ^2P (105.75 and 110.95) and σ^2G (102.6 and 107.3) in both seasons, respectively. The PCV and GCV were low (less than 10). Nevertheless, the control plants had very low PCV and GCV (4.0-5.62). Although, all plants had a high H value, the GAM of the control plants were very low (6.92-8.86) but it was ranged from 13.27 to 27.5 for SA-treated plants depending on the concentration and time of treatment.

3.7. Flower head fresh weights (FHFW):

The FHFW of control plants was ranged between 2.24 and 3.68 g/head with a mean of 2.61-

2.86 g/head in the 1st season with slightly differ in the 2nd one as shown in Table 4. In the 2nd season, plants treated with 0.18% SA for 6h had a mean FHFW (2.83g). Although, their FHFW was varied between 0.85 and 6.4 g/head**.** However, the analysis of variance showed no significant difference on FHFW among the treatments in both seasons.

The σ^2P and σ^2G values were strangely increased when plants treated with SA to reach the maximum value 9.01 and 8.69, respectively once plants treated with 0.18% SA for 6h in the 2nd season. However, the equivalent values for the control were 0.91 and 0.58. All investigated plants in both seasons had low PCV, GCV and H.

3.8. Flower head dry weights (FHDW)

The FHDW of the control plants was varied between 230 and 520 mg/head but SA treatment shifted this variation to 200 and 760 mg/plant as shown in Table 4. The highest significant FHDW mean (520.4 mg/head) was observed in the 1st season when plants treated with 0.18% SA for 12h however, this mean reduced to 396.7 mg/head in the 2nd season. In that season the treatment 0.12% SA for 12h had the highest significant value (431.4 mg/head). The PCV and GCV of control plants were moderate for both seasons. However, these parameters were high for all SA-treated plants; similarly, the H and GAM were high for all treatment.

The effect of SA on plant growth could be due to its ion influence which hinders the latter part of the electron transfer chain or inhibition of catalase, peroxidase, and cytochrome oxidation which affects the respiratory process (Gruszka et al., 2012). Alteration on growth may be attributed to (i) the increase in growth promoters, (ii) the sudden rise in metabolic status at certain levels of dose, (iii) the increase in destruction of growth inhibitors and (iv) drop in the auxin level or inhibition of auxin synthesis (Roychowdhury and Tah, 2011). In addition, inhibition of enzymes activity that catalyzes the biosynthesis of gibberellins which play a role in stem elongation probably was also affected (Dewi et al., 2016).

High GCV of many assessed traits for both Chrysanthemum genotypes suggested that these characters are under influence of genetic control. Hence, simple selection can be relied upon and practiced for further improvement of these characters. These results are in consonance with Nimbalikar et al. (2007), Lepecha et al. (2007), (Kumar et al., 2011) on gladiolus, Roychowdhury and Tah (2011) on carnation Singh et al. (2014). Higher estimates of heritability with genetic advance as per cent of mean were observed for many traits following SA treatments indicating the presence of additive gene action and so selection can be easily done for these traits. The trait which expressed high heritability and low genetic advance showed non additive gene interaction, hence heterosis breeding would be recommended for that trait (Roychowdhury and Tah, 2011).

Table 4: Some genetic estimates for Flower head fresh weights (g) and Flower head dry weights(mg) traits of *Chrysanthemum morifolium* cv. Maghi following sodium azide treatment during two seasons

		First season								Second season							
SA %	**Time (h)**	**Range**	**Mean**	**σ^2P**	**σ^2G**	**PCV**	**GCV**	**H**	**GAM**	**Range**	**Mean**	**σ^2P**	**σ^2G**	**PCV**	**GCV**	**H**	**GAM**
								Flower head fresh weights (g)									
0.0	6	2.24-3.47	2.86	2.18	1.74	1.63	1.45	7.96	2.68	2.51-3.57	2.98	1.20	0.88	1.16	0.99	7.33	1.75
	12	2.34-3.68	2.61	1.74	1.30	1.59	1.38	7.45	2.45	2.64-3.45	3.10	0.91	0.58	0.97	0.78	6.46	1.29
0.12	6	2.44-5.04	3.50	4.22	3.78	1.85	1.75	8.95	3.41	1.64-4.44	2.93	4.20	3.88	2.21	2.12	9.23	4.20
	12	1.65-4.91	2.77	4.99	4.54	2.55	2.43	9.11	4.78	1.28-4.93	3.18	6.71	6.39	2.57	2.51	9.52	5.04
0.18	6	2.14-4.61	3.63	3.94	3.49	1.72	1.62	8.87	3.15	0.85-6.40	2.83	9.01	8.69	3.34	3.28	9.64	6.64
	12	2.48-5.85	3.91	5.95	5.50	1.96	1.89	9.25	3.75	1.85-5.05	3.22	4.97	4.65	2.18	2.11	9.35	4.21
								Flower head dry weights(mg)									
0.0	6	240-390	334.0	1931.32	1886.00	13.15	13.00	97.67	26.47	340-510	420.5	2383.94	2337.00	11.61	11.49	98.05	23.45
	12	230-390	327.5	2198.68	2154.00	14.31	14.17	97.95	28.89	330-520	414.5	2036.57	1990.00	10.88	10.76	97.72	21.91
0.12	6	290-700	475.1	11856.24	11811.00	41.30	41.27	99.62	47.03	200-650	388.6	7495.24	7449.00	22.27	22.21	99.38	45.60
	12	230-640	403.4	12909.11	12864.00	80.51	80.46	99.65	57.81	280-720	431.4	18583.70	18537.00	31.59	31.56	99.75	64.93
0.18	6	290-760	494.2	17268.84	17224.00	66.13	66.11	99.74	54.63	220-570	382.8	7397.55	7351.00	22.46	22.39	99.37	45.98
	12	350-690	520.4	9736.91	9692.00	38.77	38.75	99.54	38.88	240-650	396.7	1229.60	12247.00	27.94	27.89	99.62	57.35

LSD 5%: (1st season: NS and53.21, 2nd season: NS and 15.5for fresh and dry weight of vegetative growth respectively). **σ^2P:** Phenotypic variances**;** **σ^2G**: Genotypic variances**; PCV:** Phenotypic coefficient of variance**; GCV:** Genotypic coefficient of variance**; H:** Heritability**; GAM:** Genetic advance as a percent of mean.

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الملخص العربى

تقييم نباتات الاراولا صنف Maghi المعاملة بالصوديوم أزيد

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أجريت الدراسة الحالية خلال ٢٠١٥/٢٠١٦ و ٢٠١٦/٢٠١٧ لدراسة التباين الوراثي لبعض صفات النمو والازهار لنبات الاراولا صنف "Maghi" بعد معاملة العقل قبل الزراعة بـ SA (Sodium azide). غمست قواعد العقل القمية في محلول SA بتركيز ٠.٠٠ و ٠.١٢ و ٠.١٨٪ لمدة ٦ و ١٢ ساعة.

إنخفضت قدرة النباتات على البقاء نتيجة المعاملة بالصوديوم أزيد و اختلفت وفقا للتركيز و فترة النقع. ظهرت تباينات واضحة فى المدى لكل الصفات المدروسة نتيجة المعاملة بالصوديوم ازيد فى كلا الموسمين بإستثناء صفة عدد الايام للازهار. جميع النباتات المعاملة بـ SAكانت أعلى فى معامل التباين المظرى PCV و معامل التباين الوراثى GCV مقارنة بالنباتات غير المعاملة لجميع الصفات بإستثناء محتوى الكلوروفيل، وعدد الأيام للإزهار و الوزن الطازج للنورات.

كان معامل التباين المظهري PCV دائما أعلى من معامل التباين الوراثي GCV لجميع الصفات علاوة على ذلك،إرتفاع درجة التوريث لكل الصفات مع وجود إختلافات فى درجة التوريث ما بين النباتات المعاملة و غير المعاملة. وجود فرق بسيط بين معامل تباين الشكل المظرى و معامل التباين الوراثى يشير للتأثير الضعيف للبيئة على الصفات المدروسة و التى تعطى مجال واسع للانتخاب للطفرات المتفوقة