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Influence of different levels and application method of Diphenylamine on production and quality of flower spike of *Symphyotrichum novi- belgii* L. cv. white Casablanca

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ABSTRACT

The present study was carried out under field conditions at the Experimental Farm and the laboratory of Antoniades Research Branch, Horticulture Research Institute, A.R.C. Alexandria, Egypt during the two successive seasons of (2017- 2018) and (2018-2019). The aim of this work was to study the effects of different application levels of diphenylamine (DPA) at rates of (zero, 50, 100 and 200 ppm) by two application methods (soil drench and foliar spray) on vegetative growth, flowering characteristics, leaves photosynthetic pigments content and postharvest characteristics of Aster New York plants (*Symphyotrichum novi-belgii* cv. white casablanca). The plants were treated four times at 30, 60, 90 and 120 days from the final transplanting. The results showed that there was no significant difference between DPA application method or their combinations with its different concentrations in most recorded data. On the other hand, using different concentrations of DPA caused a significant effect on all studied characteristics. The highest plant height, leaf area, number of shoots/plant, leaves dry weight, inflorescence stalk diameter and dry weight, root volume and dry weight and leaves content of chlorophyll a, chlorophyll b and total carbohydrate was obtained after using DPA at 100 ppm. Also, this treatment caused the longest vase life, the highest final water uptake and floret opening percentage and the lowest loss of flower fresh weight percentage.

KEYWORDS: Aster New York - diphenylamine - soil drench - foliar spray

1. INTRODUCTION

Symphyotrichum novi-belgii (L) G. L. Nesom (Aster New York) plant is a member of family Asteraceae. This plant is characterized by basal rosette leaves and terminal paniculate inflorescences with attached tinny flowers. (Mohamed 2017). The flower heads have several colors (white, purple, yellow and lavender) and sizes. It is used as a cut flower and garden plant. When many perennials are fading toward the end of the season, New York Aster burst into bloom and deliver an outstanding show of color in the late summer and fall. During the last years, its economic importance has been developed by using it as pot plant (Mørk *et.al.,* 2011).

Antioxidants are substances which can prevent or slow the oxidative damage of cell. When cells use oxygen, they naturally produce free radicals (by-products) which can cause damage. Antioxidants act as "free radical scavengers" and hence prevent and repair damage done by the other free radicals. Antioxidants such as diphenylamine have different biological and physiological roles, which reflect on different physiological processes in plant (Naglaa *et al.,* 2011).

Diphenylamine is an aromatic antioxidant amine, with the structural formula of $[(C_6H_5)_2\ NH]$. It acts as plant growth regulator and fungicide. (Eman and Amira, 2014). It is also, widely used to prevent post-harvest deterioration (storage scald) of apple and pear crops (Mir and Beaudry, 1999). As it has many effects on the treated plants (Cindy *et al.,* 2020). Huelin and Coggiola (1970) demonstrated that postharvest application of DPA increased the total antioxidant content and activity in apples, Lurie et al. (1989) found that postharvest treatment 0f 'Granny Smith' apples by DPA decrease of oxidative enzymes activity. Purvis and Gegogeine (2003) indicated that DPA reduces plant cell respiration by inhibiting the transport of mitochondrial electrons moreover, Du and Bramlage (1994) found that DPA reduced ethylene production and, consequently, the synthesis and oxidation of α-farnesene, with diminished surface scald in 'Cortland' apples.

The aim of the present work is to study the effects of different concentrations and application method of diphenylamine on the growth, flowering, postharvest characteristics and some chemical constituents of aster (*Symphyotrichum novi-belgii* L.) cv. White casablanka.

2. MATERIALS AND METHODS

The present study was carried out in the two successive seasons (2017-2018) and (2018-2019) at Experimental Farm and the laboratory of Antoniades Research Branch, Horticulture Research Institute, A.R.C. Alexandria, Egypt.

Seeds of Aster New York were planted in plastic trays, using a mixture of peat moss and sandy soil at the ratio of 1:1 by volume on the 14th of October, 2017 in the first season and repeated at the same date in 2018 for the second one. The seedlings were transplanted to plastic pots of 25 cm diameter using a mixture of sandy and clay soil at the ratio of 1:1 by volume on November 14th, 2017 and November 16th, 2018 (in the first and second seasons, respectively). The chemical analysis of the used medium is presented in Table (1).

Table 1. Chemical analysis of the used mixture soil for the two growing seasons (2018and 2019).

pH	EC ds/m	Cations (meq/l)				Anions (meq/l)		
		Ca^{++}	Mg^{++}	Na^{+}	K^{+}	HCO_3^{-}	Cl^{-}	SO_4^{--}
8.15	**1.7**	1.5	0.8	1.6	0.59	1.06	1.25	0.98

2.1. Treatments:

Four DPA concentrations (0, 50, 100 or 200 ppm) were applied by two methods either as soil drench (with 350 ml/plant of each concentration of DPA) or as foliar spray (with hand sprayer until the plants were wet to run off). The plants treated four times at 30, 60, 90 and 120 days from the transplanting.

2.2. The following data were measured in both of the two growing seasons:

Vegetative growth: Plant height (cm), number of leaves/plant, leaf area/plant (cm^2) (according to Zidan, 1962), number of shoots/plant and leaves dry weight/plant (g).

Flowering characteristics: Flowering time (day) (time taking from planting to showing color of the first floret on spike), flower duration (days) (the number of days from flowering time to wilting of 75% florets of the total florets of inflorescence stalk), inflorescence stalk diameter (cm), and inflorescence stalk dry weight (g).

Root characteristics: Volume of roots (cm^3) and root dry weight (g).

Chemical analysis of leaves: Chlorophyll a and b content (mg/100g fresh weight) was determined according to Moran (1982), carotenoids (mg /100 g fresh weight according to Wellburn (1994), and total carbohydrate content (%) according to Dubios *et al.* (1956).

Postharvest characteristics: At harvest, flower stalks grown from plants with different treatments with approximately 50% open florets were chosen for determination of postharvest characteristics. The stalks were re- cut to the length of 50 cm and the lower leaves of each stalk were removed from the stem prior to placing them in bottles with 500 ml distilled water at 24 hours fluorescent light (about 500 lux), temperature of 23±2 °C and at 65–70% relative humidity.

Vase life (longevity): It was determined as day's number from beginning of holding flowers in distilled water (pH = 6.79) till wilting of 75 % florets of the total florets number of inflorescence stalk.

Final water uptake (g): It was calculated at the end of the experiment as

Water uptake (g) **=** The amount of vase solution at the beginning of the experiment - the amount of the vase solution remaining at the end of the experiment.

Loss of flower fresh weight percentage (LFFW): Change percentage in fresh weight of cut inflorescence stalk after 5 days beginning of holding flowers in distilled water. It was determined as the flowing

$$\frac{\text{Initial fresh weight} - \text{Final fresh weight}}{\text{Initial fresh weight}} \text{x}100$$

Floret opening percentage: It was calculated as a percentage of opened florets from the total florets number of inflorescence stalk at the end of longevity.

$$= \frac{\text{Number of opened florets}}{\text{Nnumber of total florets}} \times 100$$

2.3. Experimental layout and statistical analysis

The experiment layout was designed to provide complete randomized block design in factorial experiment, which contained three replicates, each replicate contained eight treatments. Four pots were used as an experimental unit for each treatment in each replicate. The means of the individual factors and their interactions were compared by L.S.D test at 5% level of probability according to Snedecor and Cochran (1989).

3. RESULTS

3.1. Vegetative growth parameters:

The analysis of variance showed that, the F-value of the different concentrations of diphenylamine was significant for all recorded vegetative data in the two experimental seasons. While, it was not significant for the application methods and the interaction between the concentrations and application methods of diphenylamine for all recorded vegetative data in the both seasons except the F-value of application methods for plant height which was significant in the two seasons.

3.1.1. Plant height (cm)

Data represented in Table (2) revealed that, during the two experimental seasons, the addition of diphenylamine at either 50 or 100 ppm gave significant increases in plant height compared with the other treatments. On the other hand, using the highest concentration (200 ppm) led to a significant decrease in plant height compared with the control treatment. The tallest plants (61.61 and 62.71 cm in the two seasons, respectively) were found by using 100 ppm. Besides, the foliar application of diphenylamine outperformed significantly compared to the soil application of it during the two seasons (59.83 and 59.66 cm).

3.1.2. Leaves number per plant

Generally, using diphenylamine at any level significantly increased the number of leaves per plant, comparing with control treatment. The highest number of leaves per plant was obtained after using it at 200 ppm comparing with the other treatments (167.11 and 212.78 leaf/plant) in the first and second season, respectively (Table 2).

3.1.3. Leaf area per plant (cm2)

Data recorded in Table (2) showed that, all the used concentrations of diphenylamine significantly increased the leaf area per plant as compared to control treatment during the two seasons. Moreover, the data cleared that, the maximum expansion of aster leaves (1496.03 and 1484.13 cm^2) in the first and second season, respectively. was obtained from adding diphenylamine at 100 ppm.

Table 2. Means of plant height (cm), number of leaves/plant and leaf area/plant (cm^2) of *S. novi-belgii* L. cv white casablanca as influenced by different concentrations, application method of diphenylamine and their combinations during the two seasons of 2018 and 2019.

Diphenylamine concentrations(A) (ppm)	2018 Application methods (B) Soil drench	2018 Application methods (B) Foliar spray	Mean (A)	2019 Application methods (B) Soil drench	2019 Application methods (B) Foliar spray	Mean (A)
Plant height (cm)						
0	52.19	59.28	55.74	54.56	58.01	56.28
50	57.94	64.11	61.03	57.93	63.58	60.76
100	59.33	63.89	61.61	60.44	64.97	62.71
200	48.89	52.06	50.47	49.90	52.08	50.99
Mean (B)	54.59	59.83		55.71	59.66	
L.S.D. at 0.05	A = 3.67	B = 5.20	AxB =N.S	A = 2.72	B = 3.85	AxB =N.S
Number of leaves/plant						
0	81.64	81.14	81.39	82.67	100.44	91.56
50	121.94	116.00	119.97	167.78	120.00	143.89
100	118.67	172.78	145.72	172.56	158.56	165.56
200	150.56	183.67	167.11	194.89	230.67	212.78
Mean (B)	118.20	138.40		154.47	152.42	
L.S.D. at 0.05	A = 37.85	B = N.S	AXB =N.S	A = 47.29	B = N.S	AXB =N.S
Leaf area/plant (cm^2)						
0	629.35	667.02	648.19	614.98	699.68	657.33
50	975.25	1152.84	1064.04	1242.02	1140.97	1191.49
100	1465.90	1526.15	1496.03	1466.77	1501.49	1484.13
200	1307.87	1301.47	1304.67	1398.95	1399.75	1399.35
Mean (B)	1094.59	1161.87		1180.68	1185.47	
L.S.D. at 0.05	A = 182.55	B = N.S	AXB =N.S	A = 246.51	B = N.S	AXB =N.S

L.S.D. at 0.05 = least significant different at 0.05 probability. N.S= not significant.

3.1.4. Number of shoots/plant

Data of two seasons in Table (3) cleared that the addition of any level of diphenylamine caused significant increase in the number of shoots/plant compared to control treatment. Furthermore, data showed that the highest values of number of shoots/plant was recorded by using the treatment of diphenylamine at 100 ppm (19.25 and 22.11 shoots/plant in the first and second season, respectively).

3.1.5. Leaves dry weight (g)

Table (3) showed that the addition of diphenylamine at 50, 100 or 200 ppm led to a significant increase in leaves dry weight compared to control treatment during the two seasons. Also, application of diphenylamine at 100 ppm produced the highest increment of leaves dry weight which was 20.13 and 22.20 g in the first and second season respectively.

Table 3. Means of number of shoots/plant and leaves dry weight/plant (g) of *S. novi-belgii* L. cv white casablanca as influenced by different concentrations, application method of diphenylamine and their combinations during the two seasons of 2018 and 2019.

Diphenylamine concentrations(A) (ppm)	2018			2019		
	Application methods (B)		Mean (A)	Application methods (B)		Mean (A)
	Soil drench	Foliar spray		Soil drench	Foliar spray	
Number of shoots/plant						
0	8.75	10.44	9.60	10.78	12.92	11.85
50	16.33	13.00	14.67	16.75	17.39	17.07
100	16.56	21.94	19.25	19.67	24.56	22.11
200	14.28	18.61	16.44	19.00	21.50	20.25
Mean (B)	13.98	16.00		16.55	19.09	
L.S.D. at 0.05	A = 3.59	B = N.S	AxB =N.S	A=4.79	B = N.S	AxB =N.S
leaves dry weight/plant (g)						
0	7.96	11.01	9.48	9.46	10.78	10.12
50	18.20	19.88	19.04	14.33	19.73	17.03
100	18.57	21.69	20.13	19.07	25.33	22.20
200	19.81	19.14	19.47	17.90	17.93	17.91
Mean (B)	16.13	17.93		15.19	18.44	
L.S.D. at 0.05	A = 3.52	B = N.S	AXB =N.S	A = 4.13	B = N.S	AXB =N.S

L.S.D. at 0.05 = least significant different at 0.05 probability. N.S= not significant.

3.2. Flowering Characteristics:

The analysis of variance cleared that, the F-value of the different concentrations of diphenylamine was significant for all recorded flowering characteristics in the two experimental seasons. While, it was not significant for the application methods and the interaction between the concentrations and application methods of diphenylamine during the two seasons except the F value of the application methods for the inflorescence stalk dry weight parameter which was significant in the two seasons.

3.2.1. Flowering Time (days)

The reported data in Table (4) indicated that, using any level of the diphenylamine led to a significant reduction in the number of days needed for flowering, compared with the control treatment. Furthermore, the application of diphenylamine at 200 ppm gave the minimum time needed for flowering of aster (282.83 and 286.67 days in the first and second seasons, respectively) compared with other treatments in the two seasons, but it has the same level of significant of using 50 ppm.

3.2.2. Flowering duration (days)

Data of means of flowering duration of the two experimental seasons indicated that, the application of diphenylamine at 50 or 100 ppm led to a significant increase (at the same level of significant) as compared to the control treatment. On the other hand, using 200 ppm did not cause any significant increase in the flowering duration compared with the control treatment (Table 4). Furthermore, the addition of diphenylamine at 50 ppm gave the longest flowering duration on the plant which led to increase the flowering duration with 13.86 and 17.92 days over the control treatment in the first and second season respectively.

3.2.3. Inflorescence stalk diameter (cm)

Data in Table (4) showed that the inflorescence stalk diameter of aster plant significantly increased by applying diphenylamine only at 50 or 100 ppm as comparing with the control treatment. The maximum diameter was obtained from the addition 100 ppm (0.58 and 0.63 cm) in the first and second season respectively.

3.2.4. Inflorescence stalk dry weight (g)

Table (4) cleared that either using 50 or 100 ppm of diphenylamine led to a significant increase in dry weight of stalk compared to the control treatment. The highest increase in dry weight was obtained after using 100 ppm (24.77 and 30.79 g). Also, foliar spray of diphenylamine led to a significant increase in inflorescence stalk dry weight compared with the soil drench of it (16.83 and 20.90 g) in the first and second seasons respectively.

Table 4. Means of flowering time (days), flower duration (days), inflorescence stalk diameter (cm) and inflorescence stalk dry weight (g) of *S. novi-belgii* L. cv white casablanca as influenced by different concentrations, application method of diphenylamine and their combination during the two seasons of 2018 and 2019.

Diphenylamine concentrations(A) (ppm)	2018		Mean (A)	2019		Mean (A)
	Application methods (B)			Application methods (B)		
	Soil drench	Foliar spray		Soil drench	Foliar spray	
Flowering time (days)						
0	332.67	302.90	331.47	330.50	300.17	332.29
50	289.27	330.27	292.14	283.83	334.08	287.11
100	305.67	295.00	303.38	303.53	290.38	304.26
200	284.00	301.08	282.83	282.00	305.00	286.67
Mean (B)	281.67	302.01		291.34	305.97	
L.S.D. at 0.05	A = 10.25	B = N.S	AxB =N.S	A = 18.93	B = N.S	AxB =N.S
Flower duration (days)						
0	19.68	19.35	19.51	19.17	16.78	17.97
50	31.85	34.90	33.37	34.61	37.17	35.89
100	31.03	31.33	31.18	31.78	35.17	33.47
200	22.66	20.58	21.62	23.67	19.00	21.33
Mean (B)	26.30	26.54		27.31	27.03	
L.S.D. at 0.05	A = 3.68	B = N.S	AXB =N.S	A = 4.78	B = N.S	AXB =N.S
Inflorescence stalk diameter (cm)						
0	0.46	0.48	0.47	0.47	0.49	0.48
50	0.54	0.52	0.54	0.58	0.58	0.58
100	0.60	0.56	0.58	0.65	0.61	0.63
200	0.52	0.45	0.49	0.47	0.46	0.47
Mean (B)	0.53	0.50		0.54	0.54	
L.S.D. at 0.05	A = 0.06	B = N.S	AXB =N.S	A = 0.04	B = N.S	AXB =N.S
Inflorescence stalk dry weight (g)						
0	9.38	9.81	9.59	11.02	10.97	10.99
50	14.97	16.78	15.87	21.95	25.44	23.70
100	21.32	28.22	24.77	27.87	33.72	30.79
200	12.19	12.53	12.36	12.62	13.47	13.04
Mean (B)	14.47	16.83		18.36	20.90	
L.S.D. at 0.05	A = 2.78	B = 1.97	AXB =N.S	A = 2.39	B = 1.69	AXB =N.S

L.S.D. at 0.05 = least significant different at 0.05 probability. N.S= not significant.

3.3. Root characteristics:

The analysis of variance showed that, the F-value of the different concentrations of diphenylamine was significant for all recorded data in the two experimental seasons. While, it was not significant for the application methods and the interaction between the concentrations and application methods of diphenylamine for all recorded data in both seasons.

3.3.1. Root volume (cm^3)

Data in Table (5) showed that application of diphenylamine with any of the tested concentrations gave a significant increase in root volume compared with the control treatment. However, the greatest volume of root was obtained by using 100 ppm of diphenylamine (89.17 and 101.39 cm^3) in the first and second season respectively.

3.3.2. Root dry weight (g)

Data in Table (5) cleared that all concentrations of diphenylamine gave a significant increase in root dry weight as compared with the control treatment. Moreover, the greatest dry weight of root was obtained by using 100 ppm of diphenylamine (20.80 and 22.20 g) in the first and second season respectively.

Table 5. Means of root volume (cm^3) and root dry weight (g) of *S. novi-belgii* L. cv white casablanca as influenced by different concentrations, application method of diphenylamine and their combinations during the two seasons of 2018 and 2019.

Diphenylamine concentrations(A) (ppm)	2018 Application methods (B) Soil drench	2018 Application methods (B) Foliar spray	2018 Mean (A)	2019 Application methods (B) Soil drench	2019 Application methods (B) Foliar spray	2019 Mean (A)
Root volume (cm^3)						
0	27.50	33.33	30.42	33.33	35.83	34.58
50	75.00	74.44	74.72	71.11	75.83	73.47
100	85.00	93.33	89.17	90.56	112.22	101.39
200	83.33	90.56	86.94	87.22	88.33	87.78
Mean (B)	67.71	72.92		70.56	78.06	
L.S.D. at 0.05	A = 13.93	B = N.S	AxB =N.S	A = 10.76	B = N.S	AxB =N.S
Root dry weight (g)						
0	7.68	9.70	8.69	9.46	10.78	10.12
50	17.11	16.72	16.91	14.33	19.73	17.03
100	20.28	21.33	20.80	19.07	25.33	22.20
200	17.08	19.27	18.17	17.90	17.93	17.91
Mean (B)	15.53	16.75		15.19	18.44	
L.S.D. at 0.05	A = 3.27	B = N.S	AXB =N.S	A = 4.13	B = N.S	AXB =N.S

L.S.D. at 0.05 = least significant different at 0.05 probability. N.S= not significant.

3.4. Postharvest characteristics:

The analysis of variance showed that, only the F-value of the concentrations of diphenylamine was significant for all recorded data in the two experimental seasons.

3.4.1. Vase life (days)

Data recorded in Table (6) indicated that, using 50 or 100 ppm of diphenylamine increased the vase life of cut flower with the same level of significant in both seasons as compared to the control treatment. On the other hand, using 200 ppm of it caused a significant decrease in the vase life as compared to control, which gave 7.33 and 7.67 day in first and second season. However, the longest significant vase life was obtained after using diphenylamine at 100 ppm which was 11.50 and 12.67 day in the two seasons respectively (21.05 and 35.80% more than the control in the two seasons, respectively).

3.4.2. Final water uptake (g)

As general, the final water uptake of cut flower was increased by application of diphenylamine. The highest significant increase in final water uptake was occurred by using of 100 ppm which was 218.40 and 226.20 g during the first and second seasons respectively (37.82 and 34.10% more than the control in the two seasons respectively) (Table 6).

3.4.3. Loss of flower fresh weight percentage (LFFW) (%)

Data recorded in Table (6) cleared that, only using 50 or 100 ppm of diphenylamine decreased the LFFW significantly as compared to control treatment with the same level of significant in both seasons. However, the lowest LFFW was obtained after application diphenylamine by 100 ppm which was 15.79 and 12.44 % in the first and second seasons respectively (51.25 and 59.39% less than the control in the two seasons, respectively).

3.4.4. Floret opening percentage (%)

Table (6) show that, there was a significant increase in floret opening percentage after application of diphenylamine by 50 or 100 ppm comparing with the control treatment with the same level of significant in both seasons. Results cleared that the highest floret opening percentage was obtained after using DPA by 100 ppm, which was 91.63 and 89.66% in the first and second seasons respectively (18.73 and 19.11% less than the control in the two seasons, respectively).

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Table 6. Means of Vase life (days), Final water uptake (g) and Loss of flower fresh weight percentage LFFW (%) and Floret opening (%) of *S. novi-belgii* L. cv white casablanca as influenced by different concentrations, application method of diphenylamine and their combinations during the two seasons of 2018 and 2019.

Diphenylamine concentrations(A) (ppm)	2018 Application methods (B) Soil drench	2018 Application methods (B) Foliar spray	Mean (A)	2019 Application methods (B) Soil drench	2019 Application methods (B) Foliar spray	Mean (A)
Vase life (days)						
0	9.67	9.33	9.50	9.33	9.33	9.33
50	11.00	11.67	11.33	11.33	12.00	11.67
100	11.33	11.67	11.50	12.67	12.67	12.67
200	7.00	7.67	7.33	6.67	8.67	7.67
Mean (B)	9.75	10.08		10.00	10.67	
L.S.D. at 0.05	A = 1.45	B = N.S	AxB =N.S	A = 1.85	B = N.S	AxB =N.S
Final water uptake (g)						
0	156.05	160.89	158.47	159.63	177.72	168.68
50	194.98	204.06	199.52	183.00	229.82	206.41
100	193.40	243.40	218.40	214.49	237.92	226.20
200	130.00	120.79	125.40	119.60	121.33	120.47
Mean (B)	168.61	182.28		169.18	191.70	
L.S.D. at 0.05	A = 50.26	B = N.S	AXB =N.S	A = 52.95	B = N.S	AXB =N.S
Loss of flower fresh weight percentage LFFW (%)						
0	31.50	33.28	32.39	31.60	29.66	30.63
50	20.12	18.45	19.28	18.69	15.28	16.99
100	15.53	16.06	15.79	13.35	11.54	12.44
200	32.53	32.47	32.50	28.34	30.28	29.31
Mean (B)	24.92	25.06		22.99	21.69	
L.S.D. at 0.05	A = 8.88	B = N.S	AXB =N.S	A = 6.16	B = N.S	AXB =N.S
Floret opening (%)						
0	76.67	77.68	77.17	73.89	76.67	75.28
50	87.00	85.74	86.37	86.00	88.93	87.47
100	90.44	92.82	91.63	88.99	90.33	89.66
200	77.59	66.33	71.96	77.93	64.67	71.30
Mean (B)	82.92	80.64		81.70	80.15	
L.S.D. at 0.05	A = 7.94	B = 1.97	AXB =N.S	A = 2.39	B = 6.45	AXB =N.S

L.S.D. at 0.05 = least significant different at 0.05 probability. N.S= not significant.

3.5. Chemical characteristics:

The analysis of variance showed that, only the F-value of the different concentrations of diphenylamine was significant for all recorded data in the two experimental seasons with one exception of the F value of the interaction between the concentrations and application methods of diphenylamine in chlorophyll b which was significant in the second season.

3.5.1. Chlorophyll a and b content (mg/100g fresh weight)

Data in Table (7) show that, using of diphenylamine by any level caused significant increase in chlorophyll a and b as compared to control treatment during the two seasons. However, the highest increase in chlorophyll a and b in both seasons was obtained by applying diphenylamine at 100 ppm, which was 151.60 and 157.85 mg/100 g fresh weight for chlorophyll and 44.71 and 49.09 mg/100g fresh weight for chlorophyll b in the first and second seasons, respectively.

3.5.2. Total carotenoids content (mg/100g fresh weight)

Data in Table (7) cleared that, using of diphenylamine by 50 or 100 ppm caused significant increase in leaves content of carotenoids as compared to the control treatment during the two seasons. However, application of 100 ppm gave the highest increase in carotenoids comparing with the other treatments which was 396.76 and 425.94 mg/100g fresh weight in the first and second seasons, respectively.

3.5.3. Total carbohydrates content (%)

Data reported in Table (7) explain that, there was a significant difference after applying different concentration of diphenylamine on carbohydrates content as compared to the control treatment and the highest carbohydrates content (12.36 and 12.91% in

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Table 7. Means of chlorophyll a, b (mg/100g fresh weight), total carotenoids (mg/100g fresh weight) and total carbohydrates contents (%) of *S. novi-belgii* L. cv white casablanca as influenced by different concentrations, application method of diphenylamine and their combinations during the two seasons of 2018 and 2019.

Diphenylamine concentrations(A) (ppm)	2018 Application methods (B) Soil drench	2018 Application methods (B) Foliar spray	Mean (A)	2019 Application methods (B) Soil drench	2019 Application methods (B) Foliar spray	Mean (A)
Chlorophyll a (mg/100g fresh weight)						
0	73.02	117.81	95.42	90.02	78.67	84.35
50	152.36	134.63	143.50	152.14	156.66	154.40
100	156.56	146.64	151.60	154.93	160.76	157.85
200	118.82	107.70	113.26	134.26	124.43	129.34
Mean (B)	125.19	126.70		132.84	130.13	
L.S.D. at 0.05	A = 23.87	B = N.S	AxB =N.S	A = 25.03	B = N.S	AxB =N.S
Chlorophyll b (mg/100g fresh weight)						
0	25.41	35.55	30.48	29.61	29.67	29.64
50	48.02	37.60	42.81	50.22	39.49	44.86
100	43.24	46.17	44.71	32.38	65.80	49.09
200	43.14	40.03	41.58	29.79	32.76	31.27
Mean (B)	39.95	39.84		35.50	41.93	
L.S.D. at 0.05	A = 7.00	B = N.S	AXB =N.S	A = 10.73	B = N.S	AXB =15.17
Total Carotenoids (mg/100g fresh weight)						
0	231.07	334.88	282.98	304.95	211.10	258.03
50	408.91	373.78	391.35	406.47	416.90	411.68
100	412.02	381.50	396.76	411.46	440.43	425.94
200	296.53	287.71	292.12	346.93	322.70	334.82
Mean (B)	337.13	344.47		367.45	347.78	
L.S.D. at 0.05	A = 69.56	B = N.S	AXB =N.S	A =65.59	B = N.S	AXB =N.S
Total Carbohydrates contents (%)						
0	9.86	9.90	9.88	9.45	10.53	9.99
50	10.90	10.93	10.92	11.24	11.53	11.38
100	12.00	12.71	12.36	12.67	13.15	12.91
200	11.41	11.60	11.50	11.88	11.86	11.87
Mean (B)	11.04	11.29		11.31	11.77	
L.S.D. at 0.05	A = 1.08	B = N.S	AXB =N.S	A = 1.30	B = N.S	AXB =N.S

L.S.D. at 0.05 = least significant different at 0.05 probability. N.S= not significant.

the first and second seasons, respectively) was obtained from using 100 ppm.

4. DISCUSSION

The results cleared that all studied vegetative and root growth parameters significantly increased after application of DPA at any of the tested concentration levels as compared to control. Furthermore, using DPA at 100 ppm resulted in the highest increase in plant height, leaves area, number of shoots per plant and leaves dry weight, while, the highest number of leaves was obtained after using DPA at 200 ppm. These results may be due to using DPA that resulted in activation the biosynthesizes processes inside the plant which led to increase of cell division and/or enlargement or both which improve , consequently the vegetative growth parameters .Moreover , DPA may exhilarate growth by rising accumulations of the dry matter especially carbohydrates and protein (Karagiannis*et al*., 2018).These results are in agreement with those obtained by Abou Dahab and Abdel-Aziz, (2006) on *Philodendron erubescens*and Naglaa *et al*., (2011)on tuberose

Generally, results of the two seasons indicated that using DPA at 50 or 100 ppm caused a significant increase in flower duration, inflorescence stalk diameter and dry weight compared with control treatment. Also, using any level of the diphenylamine led to a significant reduction in the number of days needed for flowering, compared with the control treatment. These results may be due to that presence of DPA can promote the composition of auxins, protein or enzymes (John *et al.*, 1997 and Karagiannis *et al*., 2018), Moreover, this amendment in f lowering growth characteristics perhaps it is due to the remarkable improvement in the vegetative growth of the plant which in turn increased the flower characteristics.

These results agree with those obtained by Eman *et al.,* (2012) on glandulous and Naglaa *et al.,* (2011) on tuberose.

Also, the results showed that the values of chlorophyll a, chlorophyll b and total carotinoides content were increased significantly as result of using DPA at 50 or100 ppm during the two seasons. This increment may be due to the effect of DPA as an antioxidant on preservation the plant pigments from degradation and delaying its senescence consequentially the chlorophyll a and b in leaves could be increased. These results are in harmony with those obtained by Abou Dahab and Abdel-Aziz, (2006) on *Philodendron erubescens* and Eman and Amira, (2014) on *Dendranthema grandiflorum*. The increase in chlorophyll a and b leads to a consequent increase in total carbohydrates (Stino*et al.,*2009). Similar findings were obtained by Naglaa *et al.,* (2011) on tuberose.

The application of DPA at (50 and 100 ppm) led to significant improvement of cut flower quality. Using of DPA at 100 ppm gave the longest vase life and the highest floret opening percentage which it could be attributed to the ability of DPA in inhibition Polyphenol oxidase (PPO) activity and its general effect as antioxidant (Lurie *et al.,* 1989), where DPA acts as scavenger and prevent cells and tissues damage and delay the flowering senescence as mentioned by Naglaa *et al., (*2011). Also, DPA reduced respiration (Purvis and Gegogeine, 2003) and ethylene production by cells Du and Bramlage (1994). Furthermore, the results cleared that lowest LFFW and highest final water uptake was obtained after applying the same treatment which explain the highest vase life obtained after this treatment (Rida, 2019).

5. CONCLUSION

Based on the previous results, it could recommend using diphenylamine (DPA) at 100 ppm as foliar spray treatment four times 30, 60, 90 and 120 days after final transplanting. This treatment resulted in the highest values of plant height, leaf area, number of shoots/plant, leaves dry weight, diameter and dry weight of inflorescence stalk, root volume and dry weight and leaves chlorophyll, total carotenoids and total carbohydrate contents. Besides, this treatment caused the longest vase life, the highest final water uptake and floret opening percentage and the lowest loss of flower fresh weight percentage.

6. REFERENCES

Abou Dahab T, Abdel-Aziz N(2006). Physiological effect of diphenylamine and tryptophan on the growth and chemical constituents of Philodendron erubescens plants. World J. of Agri. Sci., 2 (1): 75-81.

Cindy D, Ana LA, Ângelo CS, Armando JD, Sílvia MR, Nélson I, Manuela P(2020). Strategies to Preserve Postharvest Quality of Horticultural Crops and Superficial Scald Control: From Diphenylamine Antioxidant Usage to More Recent Approaches. Antioxidants 9(4):356.

Du Z, Bramlage WJ(1994). Roles of ethylene in the development of superficial scald in ‘Cortland’ apples. J. Am. Soc. Hortic. Sci., 119: 516-523.

Dubios M, Gilles K, Hamlton J, Rebers P, Smith F(1956). Colourimetric method for determination of sugars and related substances. Anal. Chem., 28(3): 350- 356.

Eman S, Amira O (2014). Influence of Diphenylamine and Ascorbic acid on the production of *Dendranthema grandiflorum,* Ram. Life Sci. J., 11(9) 846-852.

Eman S, El-Naggar HH, Amira O (2012). Effect of Nitrogen and Diphenylamine on *Gladiolus hybrida*cv. Sancerre Production. J. Hort. Sci. & Orna.. Plants, 4 (3): 267-274.

Huelin FE, Coggiola IM (1970). Superficial scald, a functional disorder of stored apples. V.- Oxidation of α-farnesene and its inhibition by diphenylamine. J. Sci. Food Agric.,21, 44–48.

John A, Paul T, Siddique M (1997). Nutritional studies in gladiolus 1: Growth and floral characters Advanced in plant Sci., 10: 45- 49.

Karagiannis, E, Michailidis M, Tanou G, Samiotaki M, Karamanoli K, Avramidou E, Ganopoulos I, Madesis P, Molassiotis A (2018). Ethylene -dependent and -independent superficial scald resistance mechanisms in ‘Granny Smith’ apple fruit. *Sci. Rep.*, *8* :11436.

Lurie S, Klein J, Ben-Arie R (1989). Physiological changes in diphenylamine-treated ‘Granny Smith’ apples. Isr. J. Bot. 38:199-207.

Mir NA, Beaudry R (1999). Effect of superficial scald suppression by diphenylamine application on volatile evolution by stored Cortland apple fruit. J. Agr. Food Chem. 47, 7–11.

Mohamed YFY (2017). Effect of some growth stimulants on growth, flowering and postharvest quality of Aster (*Symphyotrichum novi-belgii*L.) cv. Purple Monarch. Middle East J. Agric. Res., 6(2): 264-273.

Moran R (1982). Formula for determination of chlorophyll pigment extracted with N,N diethyl formamide. Plant Phys., 69: .1376-1381

Mørk EK, Kristiansen K, LyngsJørgensen HJ, Sundelin T (2011). First Report of *Golovinomyces cichoracearum* as the Causal Agent of Powdery

Mildew on *Symphyotrichum novi-belgii* (Synonym Aster novi-belgii) in Denmark. J. Plant Dis., 95 (2) :228.

Naglaa M, Khattab M, El-Shennawy O, Mostafa M (2011). Effect of nitrogen and some antioxidants on tuberose production, Alex. J. Agric. Res., 56: 49-63.

Purvis AC, Gegogeine JW (2003). Diphenylamine inhibits respiration of Green Bell peppers. J. Am. Soc. Hortic. Sci., 128: 924–929.

Rida M (2019). Prolong the vase life of flower spike of Aster New York (*Symphyotrichum novi-belgii* L.) cv. white casablanca by Diphenylamine. Scientific J. of Agri. Sci.1 (2): 10-19.

Snedecor GW, Cochran W (1989). Statistical Methods, 8^{th} ed. Edition, Iowa State University Press.

Stino RG, Mohsen AT, Maksouds MA, Abd El-Migeed MM, Gomaa AM, Ibrahim AY (2009). Bioorganic fertilization and its Impact on Apricot young trees in newly reclaimed soil. American-Eurasion. J. Agric. Environ. Sci., 6(1): 62-69.

Wellburn AR (1994). The spectral determination of chlorophylls *a* and *b*, as well as total carotenoids, using various solvents with spectrophotometers of different resolution. J. Plant Physiol. 144(3): 307-313.

Zidan E (1962). Evaluation of some tomato lives of tomato in record to leaf area and leaf efficiency and relation of partial to early and total yield, fruit size, soluble solids, leaf rolling and blossom – end rot ph. D. thesis, Cornel Univ. Itacha N.Y., U.S.A.

الملخص العربي

تأثير االمستويات المختلفة وطرق إضافة الداي فينيل امين على انتاج وجودة ازهار نباتات الاستر

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فرع بحوث نباتات الزينة بانطونيادس – الإسكندرية – قسم بحوث نباتات الزينة وتنسيق الحدائق – معهد بحوث البساتين – مركز البحوث الزراعية – جمهورية مصر العربية.

أجريت هذه الدراسة بمزرعة ومعمل فرع بحوث نباتات الزينة بأنطونيادس خلال الموسمين (٢٠١٧ – ٢٠١٨) و(٢٠١٨ – ٢٠١٩) لدراسة تأثير الاضافة الأرضية اوالرش الورقي للداي فينيل امين بتركيزات مختلفة (صفر ، ٥٠ ، ١٠٠ ، ٢٠٠ جزء في المليون) على النمو الخضري، الإزهار، وبعض المكونات البيو كيميائية وبعض قياسات جوده الازهار بعد القطف لنباتات الاستر . أجريت المعاملة ٤ مرات بعد ٣٠، ٦٠، ٩٠ و ١٢٠ يوم من التدوير النهائي في الأصص . أوضحت النتائج أن معظم القياسات تأثرت بشكل كبير بتطبيق التركيزات المختلفة من الداي فينيل امين، خاصة مع استخدام ٥٠ أو ١٠٠ جزء في المليون. وقد ادي استخدام الداي فينيل امين بتركيز ١٠٠ جزء في المليون إلي اعلي زيادة في طول النبات، المساحة الورقية، عدد النموات الجانبية/النبات، الوزن الجاف للأوراق، سمك الحامل النوري، الوزن الجاف للحامل النوري، حجم الجذور، وزن الجذور بالأضافة إلى أعلى زيادة في تركيز كلورفيل أ وب والكاروتينات والكربوهيدرات الكلية. كما ادي استخدام هذه المعاملة الي اعلي تحسن في قياسات الازهار بعد الحصاد، حيث أدت الي أعلى زيادة في عمر الأزهار، أقل نسبة فقد في الوزن الخضري، أعلى كميه ماء ممتصه، أعلي نسبة تفتح للزهيرات.