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Prolong the vase life of flower spike of Aster New York (*Symphyotrichum novi-belgii* L.) cv. white casablanca by Diphenylamine

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ABSTRACT

The present study was carried out at Antoniades Research Branch, Horticulture Research Institute, A.R.C. Alexandria, Egypt during the two successive seasons of 2017 and 2018 to study the effects of different concentrations and application methods of Diphenylamine (DPA) on the flower longevity of Aster New York plants (*Symphyotrichum novi-belgii*). Four concentrations of DPA (0, 25 , 50 and 100 ppm) and three application methods (pulsing , foliar spray and holding solution) were used in this experiment . The results showed that the highest significant vase life was obtained after application 50 ppm DPA as pulsing treatment for one hour , this treatment caused the lowest significant loss of flower fresh weight percentage (LFFW %), highest significant flower fresh weight/flower dry weight ratio (FWR), the highest relative fresh weight (RFW) value and the highest significant reducing sugar content . Moreover, foliar spray treatment of DPA caused the highest significant increase of chlorophyll a and b content along the experiment period.

KEYWORDS: Pulsing , holding solution , foliar spray , *Symphyotrichum novi-belgii* , Diphenylamine (DPA)

1. INTRODUCTION

Symphyotrichum novi-belgii (L) G. L. Nesom . (formerly Aster novi-belgii L.), plant belongs to the Asteraceae family. It is a perennial herb producing basal rosette leaves and a terminal paniculate inflorescence where tiny flower heads are attached. (Mohamed 2017) .There are 500 known species of Aster, the flower heads of which come in various colors white , purple, yellow & lavender) and sizes. The flowers are used in bouquets, centerpieces and vases as a filler flower. The tiny florets are often cut and used for corsages and boutonnieres. Moreover, it is used as a garden flower. Free radicals are naturally produced when cells use oxygen. This free radical can cause damage to plant cell. Antioxidants are substances act as "free radical scavengers" so it can prevent and repair the oxidative damage of the cell (Naglaa *et al.,* 2011). Diphenylamine [$(C_6H_5)_2$ NH] is an aromatic antioxidant amine, a plant growth regulator and a fungicide. (Eman and Amira 2014).

Jones and Clayton (1992) found that there was a significant reduction of leaf blackening of *Protea neriifolia R. BR.* after 7 days of Dipping stems in an anti-oxidant (Diphenylamine. 1.5 mg /L).

This investigation aimed to study the effect of different concentrations and methods of application of Diphenylamine on vase life of Aster New York plant.

2. MATERIALS AND METHODS

The present study was done at Antoniades Research Branch, Horticulture Research Institute, A.R.C. Alexandria, Egypt, during the two successive seasons of 2017 and 2018.

2.1. Source of the cut flowers:

Flower stalks were obtained from a well-known commercial nursery in Alexandria. The variety used in this experiment is white casablanca Aster

2.2. Cut flowers preparations:

The harvest stage were approximately 50% open florets (outer petals fully open but before disk flowers start to be elongated) (Mohamed, 2017). On the 21st of October 2017 and 2018 (in the first and second seasons, respectively) Flower spikes were transplanted to the laboratory under dry conditions, they were re cut before treatments to the length of 60 cm.

2.3. Chemicals used in the experiment:

Four concentrations of Diphenylamine (DPA) (0.0, 25, 50 and 100 ppm)

2.4. The following treatments were applied:

1- Pulsing treatments: The flowers spikes were placed in different concentrations of DPA (0.0, 25, 50 and 100 ppm) for one hour . After that, the flowers were transferred to vases containing

500 cm ^{3} distilled water (three spikes per vase) to supplement their shelf-life period.

2- Foliar spray treatments: The flower spikes were sprayed with different concentrations of DPA (0.0, 25, 50 and 100 ppm) by hand sprayer until the spikes were wet to drop off. After that, the flowers were transferred to vases containing 500 cm^3 distilled water to supplement their shelf-life period.

3- Holding solution treatments: the flower spikes were hold in vases containing 500 cm3 of different contentions of DPA (0.0, 25, 50 and 100 ppm) to supplement their shelf-life period.

4- Lab conditions : The flowers were remained at the average temperature of (18.6º-19º) , average humidity (63%-65%) and 24 hours fluorescent light (about 450- 500 lux).

2.5. Experimental layout and statistical analysis

The experimental layout was a randomized complete block design (RCBD). It consists of twelve treatments with three replicates each replicate contains three flower spikes. The means of the individual factors and their interactions were compared by L.S.D test at 5% level of probability. The data were statistically analyzed according to the method described by Snedecor and Cochran (1989).

2.6. Data were recorded as the following:

2.6.1. The postharvest characters:

2.6.1.1. Vase life (days):

It was determined as the number of days from starting the experiment to the fading stage. The fading stage was set at the wilting of 75 % florets of the total florets number of inflorescence spike (Mohamed, 2017).

2.6.1.2. Loss of flower fresh weight percentage (LFFW) :

It was determined at the fading stage as the flowing formula (Tarek *et al*., 2013)

$$\textbf{LFFW (\%)} = \frac{\textit{Initial fresh weight} - \textit{Final fresh weight}}{\textit{Initial fresh weight}} \times 100$$

2.6.1.3. Final water uptake (g):

It was calculated at the end of the experiment as the following formula (Soad *et al.*, 2014) .

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

2.6.1.4. Flower fresh weight / flower dry weight ratio (FWR):

At the fading stage the flowers were oven dried at 75ºc for 48 hours to get the flower dry weight (F.D.W.) Then the fresh weight was divided by the dry weight as below (Mahmoud ,2013).

$$\textbf{FWR} = \frac{\textbf{Fresh weight per flower (g)}}{\textbf{Dry weight per flower (g)}}$$

2.6.1.5. Relative fresh weight (RFW):

Fresh weight of the flowers was determined just before the immersion of the flowers into the solutions and collected every two days until the vase life of the flowers was terminated. The fresh weight of each flower was expressed relative to the initial weight to represent the water status of the flower (He *et al.*, 2006)

$$\textbf{Relative fresh weight (RFW)} = \frac{Wt}{W0} \times 100$$

Where *Wt* is the weight of spike (g) at 23rd of October (2 days), 25th of October (4 days) and 27th of October (6 days) and *W0* is the initial fresh weight of the same spike (g)

2.6.1.6. Vase Solution Uptake Rate:

The VSU rate was measured according to the formula below (Damunupola, 2009)

$$\textbf{VSU rate} = \frac{(St-1) - St}{\textbf{IFW of stem}} \times 100$$

Where (St) is weight of vase solution (g) at 23rd of October (2 days) , 25th of October (4 days) and 27th of October (6 days),(St-1) is weight of the vase solution (g) on the previous determination day and (IFW) is the initial fresh weight (g) .

2.6.2. Chemical analysis

Chlorophyll a and b content (mg/g fresh weight) was determined in leaves [at 24th of October (3 days), 27th of October the end of vase life control (6 days) and the 1st of November (10 days)] according to Moran, (1982) and reducing sugars content (mg/g dry weight) was determined at the end of the experiment in the flower spike according to Miller (1959).

3. RESULTS

3.1. The postharvest characters

3.1.1. Vase life (days)

Data in Table (1) cleared that there was a significant different after application DPA by different methods and the highest significant vase life was obtained after DPA flower pulsing or foliar spray of flower spike with the DPA at the same level of significant in both seasons; while the lowest significant vase life was obtained after application DPA as holding solution. For the effect of DPA concentration the Table (1) cleared that the lowest significant vase life was obtained after untreated flowers. Also there was a significant different for the interaction between the method of application DPA and its concentrations. The highest significant vase life

was obtained after application DPA as pulsing treatment at the concentration of 50 ppm in both seasons.

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

Data in Table (1) showed that there was a significant different after application DPA by different method and the lowest significant LFFW was obtained after pulsing treatments in both seasons. For the effect of DPA concentration Table (1) cleared that the highest significant decrease in LFFW was obtained after 50 ppm treatment. Also that there was a significant different for the interaction between the method of application DPA and its concentrations and the lowest LFFW was obtained after application DPA as pulsing treatment at the concentration of 50 ppm in both seasons.

Table 1. Average of vase life (days) and loss of flower fresh weight (LFFW%) , of *Symphyotrichum novi-belgii* L. as affected by different concentrations of DPA(C), DPA application method (M) and their interaction (M x C) in the seasons of 2017 and 2018.

DPA application methods	DPA Conc.(ppm)	Vase life (days)		Loss of flower fresh weight (LFFW %)	
		2017	2018	2017	2018
Pulsing	**0**	6.93 e	6.89 d	39.38 ab	40.00 a
	25	8.89 bc	8.44 c	34.18 abc	28.65 d
	50	11.33 a	11.22 a	15.04 e	18.62 e
	100	10.00 abc	9.89 b	29.72 cd	36.74 abc
Mean		**9.29**	**9.11**	**29.58**	**31.00**
Foliar spray	**0**	7.07 de	6.77 d	37.39 ab	39.66 a
	25	9.78 abc	9.89 b	31.91 bc	33.81 abcd
	50	10.33 ab	9.67 b	37.72 ab	37.94 ab
	100	9.44 bc	9.33 bc	32.50 abc	34.72 abcd
Mean		**9.16**	**8.92**	**34.88**	**36.53**
Holding solution	**0**	6.83 e	6.61 d	40.05 a	39.83 a
	25	8.50 cd	8.50 c	38.42 ab	34.75 abcd
	50	7.00 de	6.89 d	22.15 de	31.26 bcd
	100	7.00 de	7.00 d	35.95 bc	29.93 cd
Mean		**7.33**	**7.25**	**34.14**	**33.94**
Mean of	**0**	**6.94**	**6.76**	**38.94**	**39.83**
DPA Conc.	**25**	**9.06**	**8.94**	**34.83**	**32.40**
	50	**9.56**	**9.26**	**24.97**	**29.27**
	100	**8.81**	**8.74**	**32.72**	**33.80**
L.S.D.at 5%	**M**	0.78	0.51	3.93	3.80
	C	0.90	0.59	4.54	4.39
	M x C	1.56	1.02	7.86	7.60

Values in the same column not followed by the same letter are significantly different at the 5% level of probability.

3.1.3. Final water uptake (g)

Table (2) showed that there was a significant different after application DPA by different method and the lowest significant final water uptake was obtained after holding solution treatment in both seasons. For the effect of DPA concentration Table (2) cleared that the highest significant decrease for final water uptake was obtained after untreated treatments. Also there was a significant different for the interaction between the method of application DPA and its concentrations and the highest significant increase in final water uptake was obtained by applying DPA at 25, 50 and 100 ppm for pulsing or foliar spray treatments at the same level of significant in both seasons .

3.1.4. Flower fresh weight/flower dry weight ratio (FWR)

Data in Table (2) indicated that there was a significant different after application DPA by different application methods and the highest significant FWR ratio was obtained after pulsing the flower spikes in DPA in both seasons**.** For the effect of DPA

concentration Table (2) cleared that the highest significant increase for FWR ratio was obtained after 50 ppm DPA treatments in both seasons. Also that there was a significant different for the interaction between the method of DPA application and its concentrations. The highest FWR ratio was obtained after application DPA as pulsing treatment at the concentration of 50 ppm in both seasons.

Table 2. Average of vase life (days), loss of flower fresh weight (LFFW%) , Final water uptake (g) and Flower fresh weight/ flower dry weight ratio (FWR %) of *Symphyotrichum novi-belgii* L. as affected by different concentrations of DPA(Conc.), DPA application method (M) and their ineraction (M x C) in the seasons of 2017 and 2018.

DPA application methods	DPA Conc.(ppm)	Final water uptake (g) /plant		Flower fresh weight/flower dry weight ratio (FWR %)	
		2017	2018	2017	2018
Pulsing	0	26.67b	23.91c	2.10 c	2.02 d
	25	47.81a	49.77a	2.25 bc	2.68 ab
	50	50.08a	48.33a	3.07 a	2.88 a
	100	44.68a	50.12a	2.50 b	2.23 d
Mean		**42.31**	**43.03**	**2.48**	**2.45**
Foliar spray	0	23.98b	27.07bc	2.06 c	2.03 d
	25	44.59a	40.68ab	2.28 bc	2.26 cd
	50	45.02a	57.34a	2.10 c	2.13 d
	100	44.31a	44.80a	2.25 bc	2.14 d
Mean		**49.48**	**42.47**	**2.17**	**2.14**
Holding solution	0	25.88b	25.82bc	2.10 c	2.02 d
	25	12.94c	19.45c	2.09 c	2.11 d
	50	18.75bc	12.32c	2.57 b	2.51 bc
	100	10.89c	13.18c	2.08 c	2.22 d
Mean		**17.11**	**17.69**	**2.21**	**2.22**
Mean of DPA Conc.	**0**	**25.51**	**25.60**	**2.09**	**2.02**
	25	**35.11**	**36.63**	**2.21**	**2.35**
	50	**37.95**	**39.33**	**2.58**	**2.51**
	100	**33.29**	**36.03**	**2.28**	**2.20**
L.S.D.at 5%	**M**	5.18	7.71	0.20	0.13
	C	5.98	8.91	0.23	0.15
	M x C	10.36	15.43	0.39	0.25

Values in the same column not followed by the same letter are significantly different at the 5% level of probability.

3.1.5. Relative fresh weight (RFW)

For the effect of DPA application method on RFW Figure (1) illustrated that after two days from the experiment start, the highest significant RFW value was obtained after application of DPA as holding solution. On the other hand this value decreased moderately after four days and its value was with the same level of significant with pulsing treatments. After six days the value of RFW for holding solution method dropped sharply, while pulsing treatments recorded the highest RFW value leading to freshness of the flower along the experiment period, in both seasons. For the effect of DPA concentrations Figure (1) showed that the highest decrease of RFW was obtained after application of DPA at (0.0) along the experiment period, while the application of DPA at any concentration caused slightly decrease after 2 and 4 days from the start of the experiment . After 6 days application of DPA at 100 ppm caused sharp decrease compared with using DPA at 25 and 50 ppm which decreased a little in both seasons. For the effect of the interaction between DPA application method and its concentration the figure showed that application of 50 ppm as holding solution caused the highest RFW value after 2 and 4 days from the experiment start but this value decreased obviously after 6 days. While application DPA at 50 ppm as pulsing treatment caused a little decrease along the experiment period and recorded the highest value after six days of the experiment start.

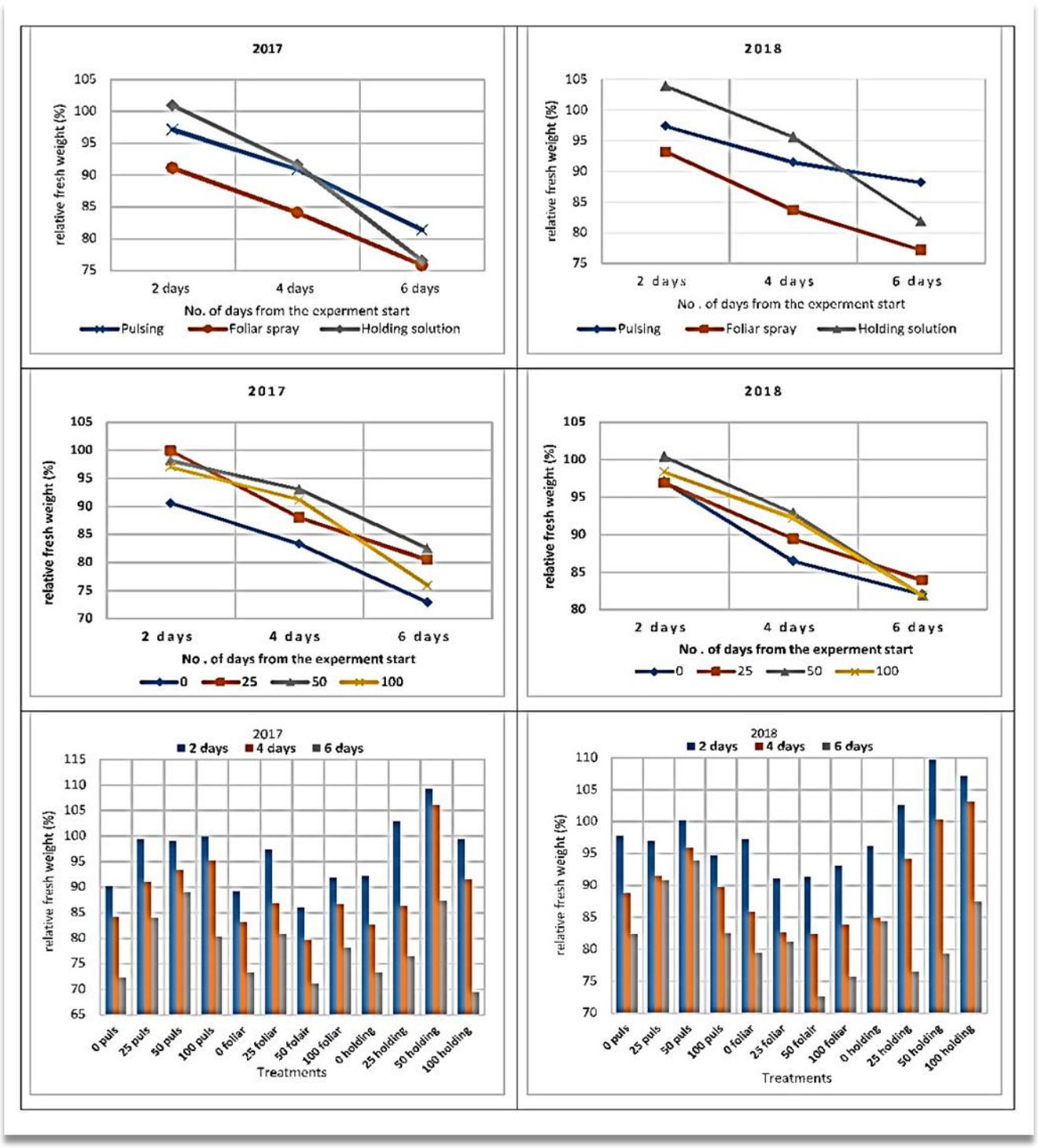

Figure (1) Effect of DPA application method, different concentrations of DPA and their interaction on the relative fresh weight (RFW%) in the seasons of 2017 and 2018.

3.1.6. Vase Solution Uptake Rate (VSU %):

Figure (2) showed that there was a significant different after application of DPA by different method on VSU and the highest value was obtained by holding solution application method after 2 days of the experiment start, while after 4 or 6 days from the experiment start there was insignificant different for VSU value in both seasons. For the effect of DPA concentrations on VSU, Figure (2) illustrated that highest increase in VSU was obtained by application of DPA at 25ppm after 2 days from the start of the experiment in the first season and in the second

season there was insignificant different. The value of VSU decreased after 4 and 6 days with no significant different for all treatments. The effect of the interaction between DPA applications methods and its concentrations the figure showed that the value of VSU is decreased along the experiment period. There was a significant different for the VSU value after 2 days. The highest significant increase of VSU value was obtained after application of 25 ppm as the holding solution, the changes of VSU value after 4 or 6 days were not significant in both season.

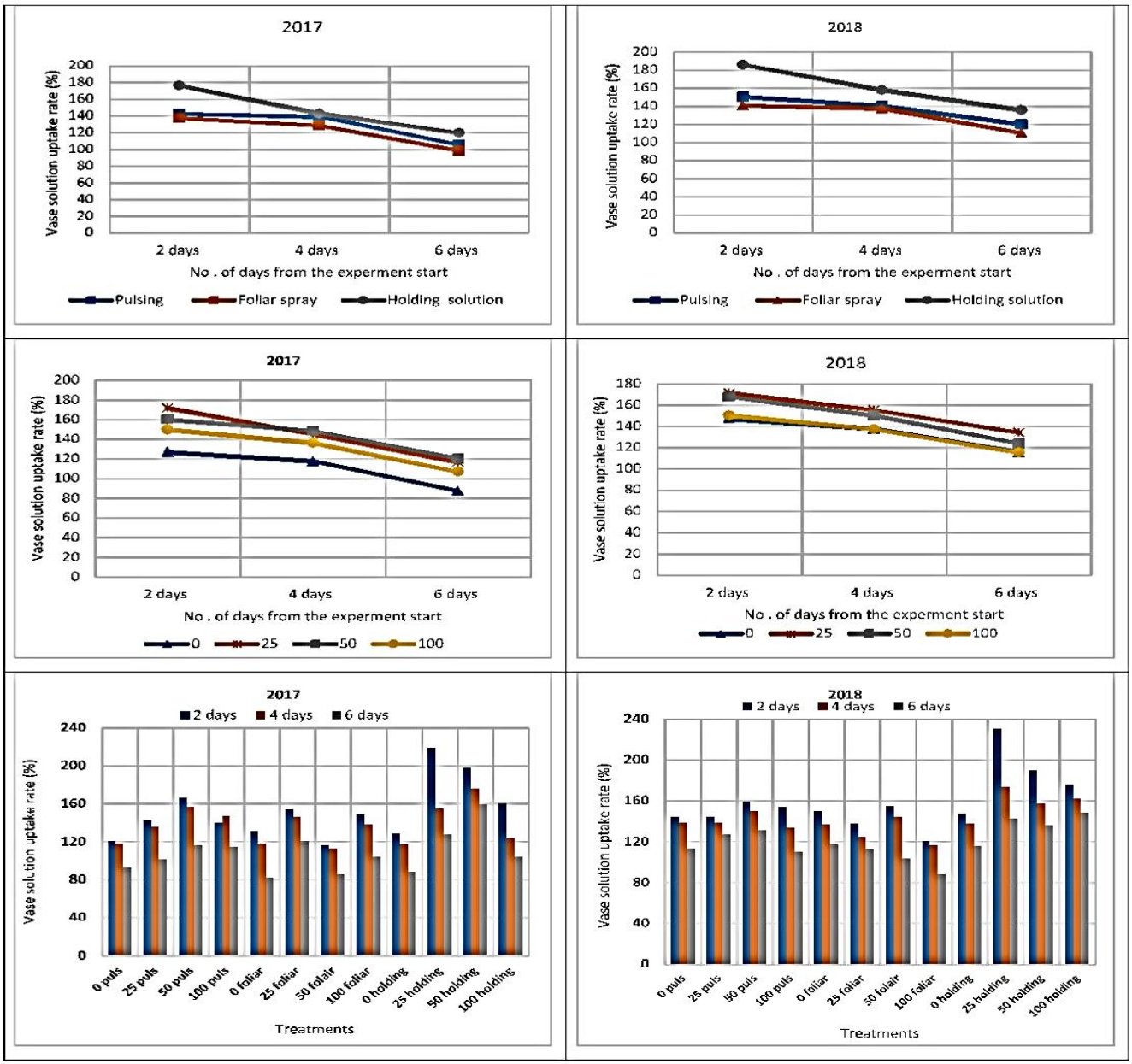

Figure (2) Effect of DPA application method, different concentrations of DPA and their interaction on the vase solution uptake rate (VSU %) in the seasons of 2017 and 2018.

3.2. Chemical analysis

3.2.1. Chlorophyll a and b content (mg/ g leaves fresh weight)

Data in Table (3) cleared that after six days (at the end of control vase life) the highest significant chlorophyll a was obtained after the application DPA as a foliar spray in both seasons. For chlorophyll b content the highest amount was obtained after the foliar spray treatments in both seasons. For the effect of the DPA concentrations all concentrations increased significantly in chlorophyll a and b content as compared to control treatment.

For the effect of the interaction between DPA application method and its concentrations Table (3) cleared that application of DPA at 25, 50,100 ppm foliar spray resulted in the highest chlorophyll content in both seasons

For chlorophyll b content application of DPA at 50 ,100 ppm foliar spray and 100 DPA as the holding solution resulted in the highest significant content in the first season; while for the second one the application of DPA at 25, 50 ,100 ppm foliar spray and 25 ,100 DPA as a holding solution resulted in the highest significant amount .

Table 3. Means of Chlorophyll a and b content (mg/ g fresh weight) after 6 days from the experiment start and reducing sugar content (mg/g dry weight) of *Symphyotrichum novi-belgii* L. as affected by different concentrations of DPA(C) , DPA application method (M) and their interactions (MxC) in the seasons of 2017 and 2018.

DPA application methods	DPA Conc.	Chlorophyll a (mg/ g fresh weight)		Chlorophyll b (mg/ g fresh weight)		Reducing sugar (mg/g dry weight)	
		2017	2018	2017	2018	2017	2018
Pulsing	0	9.07 f	8.81 d	3.83 cd	3.15 e	6.07 f	4.63 e
	25	12.77 cd	12.33 ab	4.69 cd	3.24 e	8.69 cd	7.06 d
	50	13.34 c	12.47 ab	4.10 cd	4.38 cd	11.28 a	11.33 a
	100	12.32 d	11.89 b	4.71 cd	3.83 de	8.10 d	9.73 a
Mean		**11.87**	**11.38**	**4.34**	**3.65**	**8.53**	**8.19**
Foliar spray	0	8.99 f	9.46 cd	3.31 d	3.10 e	7.07 e	5.63 d
	25	16.12 a	13.01 a	5.36 b	6.10 ab	9.25 bc	10.11 ab
	50	16.48 a	12.99 a	7.52 a	5.70 ab	9.27 bc	8.13 bcd
	100	16.67 a	12.70 a	6.65 ab	5.40 ab	8.97bcd	9.39 abc
Mean		**14.56**	**12.04**	**5.71**	**5.87**	**8.64**	**8.32**
Holding solution	0	9.02 f	9.83 c	4.45 cd	3.35 e	5.92 f	5.53 d
	25	14.35 b	12.33 ab	3.91 cd	5.25 abc	9.64 b	7.91 cd
	50	9.68 f	10.03 c	5.15 bc	5.01 bc	5.80 f	6.17 d
	100	11.34 e	12.63 ab	7.38 a	5.33 abc	6.29 e	7.40 d
Mean		**11.10**	**11.21**	**5.22**	**4.49**	**6.92**	**6.75**
Mean of DPA Conc.	**0**	**9.03**	**9.37**	**3.86**	**3.20**	**6.35**	**5.27**
	25	**14.41**	**12.56**	**4.66**	**4.85**	**9.19**	**8.36**
	50	**13.17**	**11.83**	**5.59**	**5.04**	**8.78**	**8.55**
	100	**13.44**	**12.41**	**6.25**	**4.85**	**7.79**	**8.84**
L.S.D.	**C**	0.46	0.37	0.90	0.50	0.46	1.03
	M	0.53	0.43	1.04	0.57	0.53	1.19
	M x C	0.91	0.75	1.80	0.99	0.92	2.06

Values in the same column not followed by the same letter are significantly different at the 5% level of probability

Figures (3 and 4) illustrated that the highest amount of chlorophyll a and b content was obtained after application of DPA by foliar spray treatments along the experiment period. Also Figures showed that chlorophyll a content decreased sharply for the untreated plants after 6 days from the experiment started.

3.2.2. Reducing sugar content (mg/g dry weight)

Data in Table (2) cleared that applying DPA as the holding solutions resulted in the lowest significant value of reducing sugar as compared to the other

applying methods. Also the Table (2) cleared that the highest significant reducing sugar was obtained after applying DPA at 25 or 50 ppm in the first season and 25, 50 and 100 ppm in the second season. For the interaction effect of DPA application method and its concentrations the table cleared that the highest significant reducing sugar amount was obtained after applying DPA at 50 ppm pulsing treatment in the first season , while in the second one the treatments 50, 100 ppm as pulsing or ,25.100 ppm as a foliar spray caused the highest significant amount

4. DISCUSSION

From the previous results it is noticed that using DPA at 50 ppm as a pulsing treatment resulted in the highest significant vase life 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). Also DPA acts as scavenger and prevent cells and tissues damage and delay the flowering senescence as mentioned by Naglaa *et al.,* 2011. Also, the results cleared that lowest significant LFFW and highest significant final water uptake was obtained after applying DPA by pulsing treatments which explain the highest significant vase life obtained after this treatment.

The highest significant FWR was obtained after application of DPA as a pulsing treatment at 50 ppm which may be the reason of the freshness of the flower and increasing of vase life after this treatment.

The cut flowers loses their water through transpiration and the perfect flower preservative is that which allows water absorption in flower tissues or water absorption from the preservative solution maintains a better water balance and flower freshness which save flower from early wilting and enhancing the vase-life. (Salunkhe *et al.,* 1990) . The results cleared that applying DPA as pulsing treatment at 50 ppm caused little decrease of RFW along the experiment period and recorded the highest value after 6 days of the experiment start which may illustrate the freshness and flower longevity of flowers after this treatments.

The highest value of chlorophyll a and b content along the experiment period was observed after application of DPA as foliar spray treatment which explain the greenish of the stems of the flowers after this treatment until the flower wilting. This results are in harmony with those obtained by (Abou Dahab and Abd El-Aziz 2006) on Philodendron , Eman *et al.,* 2012 on Gladiolus and Eman and Amira (2014) on *Dendranthema grandiflorum* . Nevertheless, more investigations are needed to study how foliar spray of DPA decrease the degradation of chlorophyll.

The results cleared that all treatments caused a significant increase in reducing sugar content which may increase the osmotic potential of the flowers, thus improving their ability to absorb nutrients and maintain their turgidity, which may explain the increase of flower longevity in different treatments in this study (Prathamesh and John 2013).

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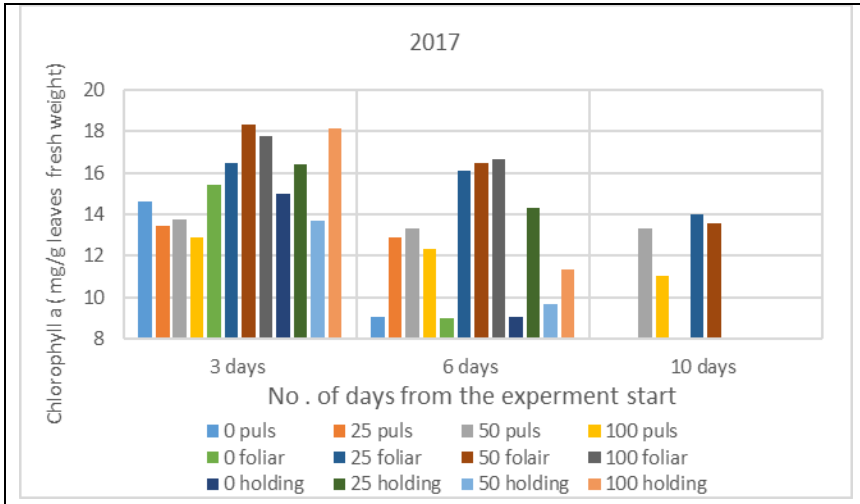

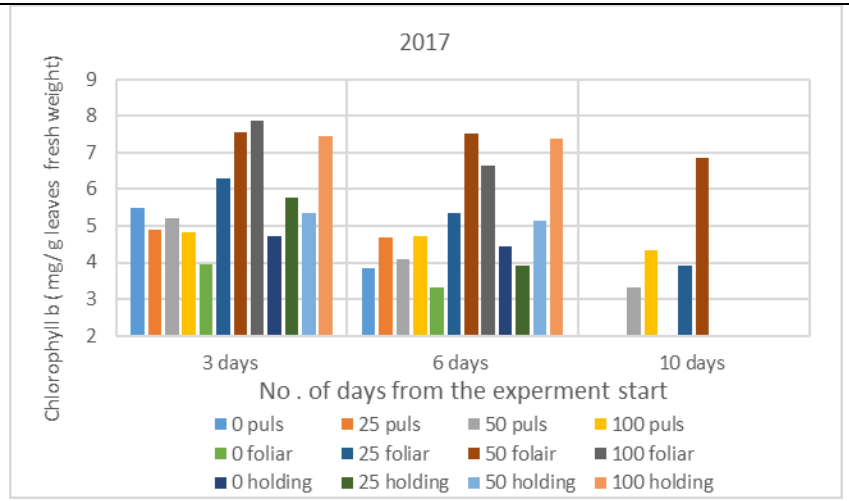

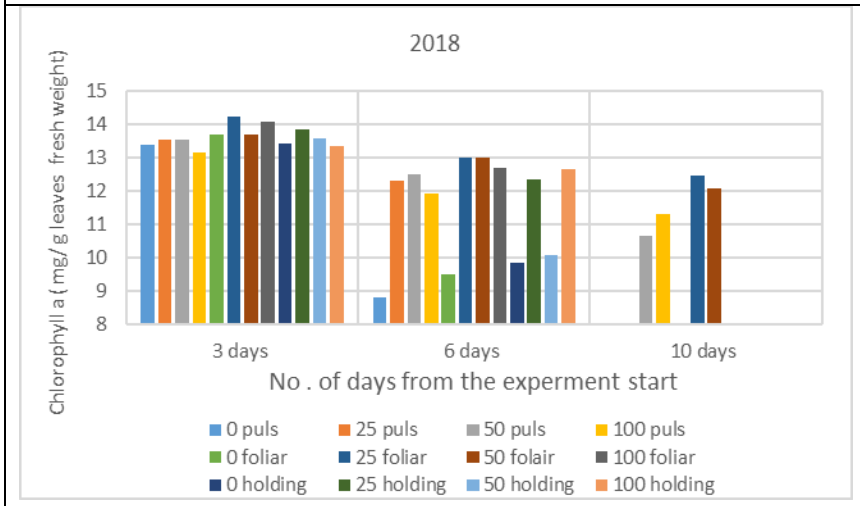

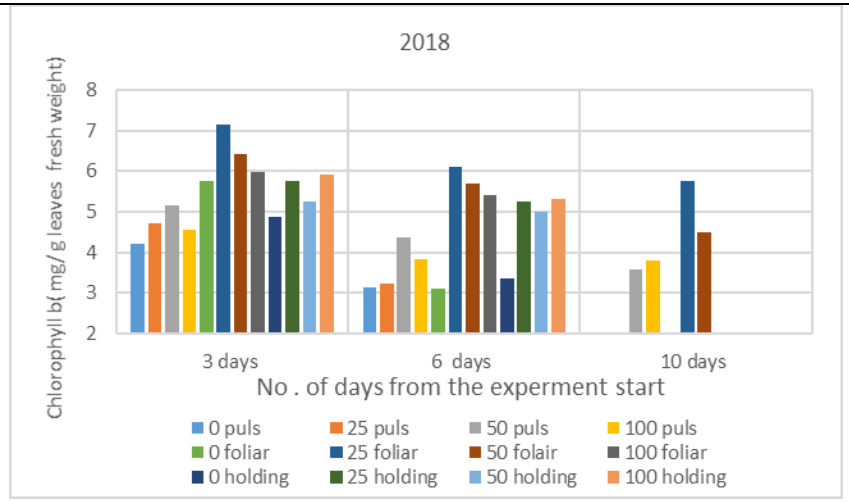

Figure (3). Effect of the interaction between different concentrations of DPA and its application method through the experiment period on Chlorophyll a content (mg/ g leaves fresh weight) during the seasons of 2017-2018.

Figure (4). Effect of the interaction between different concentrations of DPA and its application method through the experiment period on Chlorophyll b content (mg/ g leaves fresh weight) during the seasons of 2017-2018.

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الملخص العربي

إطالة عمر ازهار نبات الاستر نيويورك المقطوفة باستخدام الداي فينيل أمين

مجد الدين فؤاد رضا

فرع بحوث نباتات الزينة بأنطونيادس - الإسكندرية
قسم بحوث الزينة وتنسيق الحدائق- معهد بحوث البساتين - مركز البحوث الزراعية

أجريت هذه الدراسة خلال موسمي (٢٠١٧و ٢٠١٨) في فرع بحوث أنطونيادس ، معهد بحوث البساتين، وزارة الزراعة، الاسكندرية،جمهورية مصر العربية . لدراسة أثر التركيزات وطرق تطبيق الداي فينيل امين على عمر ازهار نباتات الأستر. أستخدمت ٤ تركيزات من الداي فينيل أمين (صفر – ٢٥ -٥٠ و١٠٠ جزء في المليون) وثلاث طرق للتطبيق (الأنباض – الرش على الساق الزهري – محلول الفازة). اظهرت النتائج ان إستخدام الداي فينيل أمين بتركيز ٥٠ جزء في المليون بطريقة الأنباض اعطى اعلى زيادة معنوية في عمر الأزهار -أقل فقد معنوي في نسبة الفقد في الوزن الخضري - أعلى زيادة في النسبة بين الوزن الخضري والجاف للازهار – أعلى زيادة معنوية في الوزن الخضري النسبي – أعلى قيمة معنوية في السكريات المختزلة . أما بالنسبة لتأثير المعاملات على كلورفيل أ وب أظهرت النتائج أن معاملات الرش تسببت في اعلى قيمة معنوية على امتداد فترة التجربة .