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Effect of Some Growth Stimulants on Growth, Flowering and Postharvest Quality of Aster (*Symphyotrichum novi-belgii* L.) cv. Purple Monarch.

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ABSTRACT

This experiment was carried out under field conditions at the Experimental Farm and the laboratory of Horticulture Department, Faculty of Agriculture, Benha University, Egypt, during the two successive seasons of 2014-2015 and 2015-2016, to investigate the effect of some growth stimulants i.e., salicylic and Gibberellic acids each at 0.0,100 and 200ppm, and Benzyl adenine at 0.0,50 and 100ppm) on growth, flowering and postharvest quality of aster (*Symphyotrichum novi-belgii* L.) cv. Purple Monarch. Different applied concentrations of SA, GA_3 and BA statistically affected vegetative growth parameters i.e., plant height (cm), fresh and dry weights of vegetative herb/plant (g) and the number of main branches/plant. Also, flowering growth parameters i.e., number of inflorescence stalks/plant, length of inflorescence stalk, fresh weight of inflorescence stalk and dry weight of inflorescence stalk, postharvest parameters vase life, floret opening percentage and change percentage in fresh weight of cut inflorescence stalk were also positively affected. In addition, water relations characters i.e., water uptake, water loss and water balance as well as the chemical composition parameters i.e.,leaf total carbohydrates N, P and K content, total sugars percentage, total chlorophylls, total indoles and total phenols were also significantly responded with superior to the high rates, particularly using the treatments of GA_3 at 200 or BA 100 ppm in both seasons. Regardless control, the lowest means values of all abovementioned parameters of aster was registered by spray the plant of SA at 100 ppm in the first and the second season in most cases. Generally, from the aforementioned results, it could be recommended that to obtain the best vegetative, flowering, postharvest and chemical composition characteristics with high quality of *Symphyotrichum novi-belgii* L.; plants should be sprayed with GA_3 at 200 ppm or BA at 100 ppm.

Key words: *Symphyotrichum novi-belgii* L, gibberellic acid, benzyl adenine, Salicylic acid, postharvest quality and chemical composition.

Introduction

Aster belongs to the Asteraceae (or Composite) family, commonly called the Sunflower family.*Symphyotrichum novi-belgii* L. (formerly *Aster novi-belgii* L.), it is a perennial herb producing basal rosette leaves and a terminal paniculate inflorescence where tiny flower heads are attached. There are 500 known species of Aster, the flower heads of which come in various colors and sizes. Aster is not considered a major cut flower in the same class as that of orchid, rose, anthurium, gladiolus and chrysanthemum in this country but it plays an important role as filler in flower arrangement.Salicylic acid is a messenger molecule regulating developmental procedures and it control the biotic and abiotic stresses (Zarghami *et al*. 2014). It also inhibiting ethylene biosynthesis and delaying fruit senescence (Kademi and Ershadi 2013). In addition, responses of environmental stresses in plants could be modulated by salicylic acid signaling (Ramtin *et al*. 2015). Salicylic acid (SA) is a new phenolic phytohormone, which takes part in the adjusting different physiological processes in plants. The SA has been shown to interfere with the inhibition of ethylene production and promotion of stomatal closure (Nikkhah-Bahrami, 2013). Salicylic acid (SA) is one of natural and harmless chemicals used for postharvest quality conservation of horticultural and ornamental produces. Recently, many postharvest technologies for fresh and perishable produces including fruit, vegetables and ornamentals have been accepted where salicylic acid is in use (Supapvanich and Promyou, 2013). The cytokinins are plant specific phytohormones (Bubán, 2000) which play a central

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role in the regulation of cell cycle and numerous developmental processes. These are present in all plant tissues but are abundant in root tip, shoot apex and immature seeds (Schmülling, 2004). Cytokinins are well known to delay leaf senescence in carnation and rose flowers. The main group of synthetic cytokinins includes N6 substituted adenines like kinetin (6-furfurylaminopurine), benzyl adenine (6-benzylaminopurine, BA), 6-benzylamino-9-(tetrahydropyran-2-yl) -9H- purine; PBA (Bubán, 2000). Recently, a synthetic cytokinin benzyl adenine (BA) has been released in the U.S. as configure for use on ornamental plants (John Carey and Mark 2008). It elicits the plant growth and development responses, setting blossoms and stimulating fruit richness by stimulating cell division. Lately, numerous postharvest technologies have been established for enhancing postharvest of fresh and perishable products including fruit, vegetables and cut flowers.

Gibberellic acid form a large family of diterpenoid compounds, some of which are bioactive growth regulators, that control such diverse developmental processes as seed germination, stem elongation, leaf expansion, trichrome development, and flower and fruit development (Davies, 1995). In addition, GA_3, application increased petiole length, leaf area and delayed petal abscission and color fading (senescence) by the hydrolysis of starch and sucrose into fructose and glucose (Khan and Chaudhry, 2006). It has been known that growth regulators among the agriculture practices which is most favorable for promoting and improving plant-growth of different plants (Eid and Abou-Leila, 2006). Gibberellic acid is used to regulate plant growth through increasing cell division and cell elongation. GA_3 sprays enhanced plant dry mass, leaf area, plant growth rate and crop growth rate in Mustard (Khan *et al*., 2002). Gibberellic acid prevented leaf chlorosis, which was the major postharvest disorder in many cut flowers such as Santonia cv. Golden light flowers (Eason *et. al.*, 2001).

Therefore, the present work aimed to study, the effect of some growth stimulants (salicylic acid, Gibberellic acid, and Benzyl adenine), on growt h, flowering, postharvest quality, water relation and some chemical constituents of aster (*Symphyotrichum novi-belgii* L.) cv. Purple Monarch.

Material and Methods

The present study was conducted at the Experimental and the laboratory of Horticulture Department, Faculty of Agriculture, Benha University during the two seasons of (2014-2015, 2015-2016). The most important role as filler in flower arrangement in Egypt is aster (*Symphyotrichum novi-belgii* L.) cv. Purple Monarch which was chosen to be under our investigation. This work aimed to study the effects of some pretreatments as salicylic acid (SA at 100,200ppm) growth regulators GA_3 treatments (100 and 200 ppm) and benzyl adenine (BA at 50 and 100 ppm on Vegetative growth, flowering growth, chemical composition and some postharvest characters of cut inflorescence stalk of aster.

Plant material:

Shoot segments of aster (*Symphyotrichum novi-belgii* L.) were obtained from mother plants grown at experimental Farm Horticulture Dept., Fac. Agric., Benha Univ., Egypt. The experimental plot area was one square meter. An enrichment fertilizer dose of ammonium nitrate (33% N), calcium super-phosphate (15.5% P2O5) and potassium sulfate (48% K2O) was added at the rate of (60:45:48) unit NPK/fed. during site preparation. On 1st July in the two seasons the health and uniform shoot segments (2 to 4 branches and 10-12 leaves) were separated from mother plants and planted directly in the experimental plots ($1m^2$). Each plot contains 4 plants at the spacing of 30 cm.

Plants were sprayed with four application levels of:

- Salicylic acid (SA) 0.0,100 and 200ppm
- Gibberellic acid (GA_3) 0.0 ,100 and 200ppm
- Benzyl adenine (BA) 0.0., 50 and 100ppm

The initial application for all treatments was begun at 45 days after planting and repeated three times with 2 weeks intervals.

Particle size distribution and chemical analyses of experimental soil:

Experimental soil was subjected to particle size distribution and chemical analyses according to the method described by Page *et al*. (1982). Particle size distribution and chemical analyses are presented in Table (1).

Table 1: Particle size distribution and chemical analysis of the experimental soil

Parameters	Unit	Values	Parameters	Unit	Values
A. Particle size distribution			B. Chemical analysis		
Coarse sand	(%)	5.10	Organic matter	(%)	2.20
Fine sand	(%)	19.24	$CaCO_3$	(%)	0.55
Silt	(%)	28.22	Total nitrogen	(%)	0.66
Clay	(%)	50.18	Total phosphorus	(%)	0.25
Textural class	(%)	Clayey loam	Total potassium	(%)	0.44
			pH		7.90

Layout of the Experiment:

The experimental design was complete randomized block design (CRBD) including 7 treatments replicated three times (each replicate consisted of five beds, with four plants/bed) and every one represented by 20 plants.

Data recorded:

Three plants from each plot at 15 September were randomly taken at the flowering start during both seasons and the following data were recorded

Vegetative growth parameters:

Plant height (cm), fresh and dry weight of vegetative herb/plant (g) and number of main branches/plant

Flowering growth parameters:

Number of inflorescence stalk/plant, length of inflorescence stalk, fresh weight of inflorescence stalk and dry weight of inflorescence stalk

Postharvest characteristics:

At harvest, flower stalks grown from the different treatments with approximately 50% open florets (outer petals fully open but before disk flowers start to be elongated) were chosen for the determination of postharvest characteristics. The leaves of each stalk were removed from the lower half of the stem prior to placing them in bottles with distilled water.

Aster (*Symphyotrichum novi-belgii* L.) cv. Purple Monarch) inflorescences stalk bases were re-cut (5 cm.) just before treatments and placed in glass containers containing distilled water, under Lab. conditions; i. e., 24 hours fluorescent light (about 500 lux), temperature of 20±2 °C and at 60–70% relative humidity. The experiment was started at 15 September at the two assigned seasons of 2014-2015 and 2015-2016.

-Vase life (longevity) of aster was determined as day's number from beginning of holding flowers in distilled water (PH. = 6.77). until wilting of 75 % florets of the total florets number of inflorescence stalk.

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

-Change percentage in fresh weight of cut inflorescence stalk after 5 days from the treatment (based on the beginning fresh weight of cut inflorescence stalk)

Water relations characters:

The rate of water uptake and water loss per cut inflorescence stalk were determined by weighting the jars with and without the flowers and correcting for the evaporation. Water uptake, water loss and water balance per aster cut inflorescence stalk were measured and calculated as follows:

1- Water uptake (absorbed solution) (g/ spikes) was determined after 6 days from the treatment.
2- Water loss (g/ inflorescence stalk) was calculated as the difference between the beginning fresh weight of cut inflorescence stalk besides the beginning weight of solution and fresh weight of cut inflorescence stalk besides the weight of solution after 6 days from the treatment and at the end of longevity 17 days on aster.
3-Water balance (g/ inflorescence stalk) was calculated as the difference between water uptake and water loss after 6 days from the treatment on aster

Chemical composition determinations:

-Total nitrogen percentage was determined in the dried leaves by using modified micro-kjeldahl method as described by Pregl (1945).
-Phosphorus was determined colourimetrically in spectronic (20) spectrophotometer using the method described by Trouge and Meyer (1939).
-Potassium content was determined by flame photometer according to Brown and Lilleland (1946).
-Total carbohydrates content was determined in dry leaf powder according to Herbert *et al.* (1971).

Chemical determinations were done in flower petals at 6 days' vase life. They were implicated the flowing determinations:

-Total sugars percentage:

Total sugars percentage was calorimetrically determined in the fresh floret of aster cut inflorescence stalk samples according to the method described by Smith *et al.*(1956).

-Total chlorophylls, total indoles and total phenols: were determined in fresh floret of aster cut inflorescence stalk, according to A.O.A.C (1990).

Statistical analysis:

The statistical analysis was carried out according to (Snedecor & Cochran, 1989). The differences between the mean values of various treatments were compared by Duncan's multiple range test (Duncan's, 1955).

Results And Discussion

Effect of salicylic, gibberellic acids and benzyl adenine on:

Vegetative growth measurements:

Data in Table (2) show the effect of different applied treatments i.e., SA at 100 and 200 ppm, GA_3 at 100 and 200 ppm and BA at 50 and 100ppm on some vegetative growth measurements of aster plants. Thereby, it could be concluded that all these treatments were succeeded in increasing all the studied vegetative growth parameters in the two seasons of this study. However, 200ppm GA_3 treated plants showed to be the most effective treatment for inducing the tallest plants, the heaviest fresh and dry weights of herbs/plant, followed descendingly by the treatment of GA_3 at 100 in the two seasons. Meanwhile, the treatment of BA at 100ppm ranked the third order in this respect. In addition, the concentration of BA at 100ppm gave the highest significant increase of number of main branches/plant as compared to control and the other treatments in both season. Regardless control,

the lowest means values of all abovementioned parameters by aster cut inflorescence stalks were registered by spray the plant with SA at 100 ppm in the first and the second season in most cases.

Table 2: Effect of salicylic, gibberellic acids and benzyl adenine on plant height (cm), fresh and dry weights of vegetative herb/plant (g) and number of main branches/plant of aster (*Symphyotrichum novi-belgii* L.) during 2014-2015 /2015-2016 seasons.

Parameters	Plant Height (cm)		Fresh weight of vegetative herb/plant (g)		Dry weight of vegetative herb/plant (g)		No. of main branches/plant	
	Seasons							
Treatments	1st	2nd	1st	2nd	1st	2nd	1st	2nd
Control	55.00^{f}	57.00^{f}	150.9^{f}	153.2^{g}	22.27^{f}	24.07^{f}	26.00^{f}	27.33^{f}
SA at100 ppm	65.33^{e}	68.67^{d}	176.9^{e}	180.8^{f}	26.27^{e}	26.20^{e}	36.00^{e}	39.00^{e}
SA at 200 ppm	70.67^{c}	69.67^{cd}	182.5^{d}	184.2^{e}	28.20^{d}	28.33^{d}	40.67^{d}	39.00^{e}
GA_3 at 100ppm	78.33^{b}	80.67^{b}	210.1^{b}	212.1^{b}	30.97^{b}	32.03^{b}	41.67^{d}	44.33^{d}
GA_3 at 200ppm	86.00^{a}	87.00^{a}	218.2^{a}	220.0^{a}	33.40^{a}	34.23^{a}	47.33^{c}	47.67^{c}
BA at 50 ppm	69.00^{d}	70.67^{c}	205.3^{c}	204.8^{d}	29.20^{c}	30.30^{c}	50.67^{b}	51.67^{b}
BA at 100 ppm	64.67^{e}	63.67^{e}	210.8^{b}	211.1^{c}	31.20^{b}	32.47^{b}	54.33^{a}	56.67^{a}

The aforementioned results of GA_3 are in parallel with those attained by Padaganur *et. al.* (2005) on tuberose, Panwar *et. al.* (2006) on tuberose and Devadanam *et. al.* (2007) on tuberose. Also, Mohamed (2009) indicated that, the pre-harvest treatments with GA_3 at 200 and 300ppm gave the highest increases of vegetative parameters (number of leaves/plant, plant height (cm), fresh weight of leaves /g and dry weight of leaves/g) of tuberose and bird of paradise plants.The results of cytokinin are in conformity with those of Youssef (2000) on *Strelitzia reginae* .Also, Mohamed (2009) stated that, the pre-harvest treatments of BA at 25 and 50ppm improved all the studied vegetative parameters(number of leaves/plant, plant height (cm), fresh weight of leaves /g and dry weight of leaves/g) of tuberose and bird of paradise

Flowering growth measurements:

Data in Table (3) reveal that all tested growth stimulants treatments improved all the studied flowering parameters in both seasons. However, the highest values of number of Inflorescence stalk/plant, length of Inflorescence stalk, fresh Weight of inflorescence stalk and dry weight of Inflorescence stalk were recorded by using the treatment of GA_3 at 200ppm in both seasons. Also, GA_3 at 100ppm and BA at 100ppm produced the highest increments of these parameters in both seasons. While, the highest values of number of inflorescence stalk/plant was recorded by using the treatment of BA at 100ppm, BA at 50ppm and GA_3 at 200ppm in the two seasons, respectively.

Table 3: Effect of salicylic, gibberellic acids and benzyl adenine on No. of inflorescence stalk/plant, length of inflorescence stalk, fresh weight and dry weights of inflorescence stalk of aster (*Symphyotrichum novi-belgii* L.) during 2014-2015 /2015-2016 seasons.

Parameters	No. of inflorescence stalk/plant		Length of inflorescence stalk(cm)		Fresh weight of Inflorescence stalk (g)		Dry weight of inflorescence stalk (g)	
	Seasons							
Treatments	1st	2nd	1st	2nd	1st	2nd	1st	2nd
Control	34.33^{g}	35.67^{g}	44.27^{f}	45.73^{g}	61.37^{g}	63.57^{g}	10.30^{f}	10.53^{g}
SA at100 ppm	40.33^{f}	41.33^{f}	49.80^{e}	50.07^{f}	75.73^{f}	77.37^{f}	12.30^{e}	12.57^{f}
SA at 200 ppm	44.00^{e}	44.67^{e}	52.43^{d}	54.50^{d}	78.23^{e}	79.53^{e}	13.17^{d}	13.23^{e}
GA_3 at 100ppm	47.00^{d}	46.67^{d}	60.63^{b}	62.40^{b}	105.2^{c}	107.3^{b}	15.30^{b}	15.70^{b}
GA_3 at 200ppm	51.00^{c}	51.33^{c}	64.67^{a}	66.63^{a}	110.1^{a}	111.4^{a}	16.67^{a}	17.20^{a}
BA at 50 ppm	58.67^{b}	60.67^{b}	52.47^{d}	53.27^{e}	99.97^{d}	101.3^{d}	14.13^{c}	14.37^{d}
BA at 100 ppm	67.33^{a}	69.33^{a}	55.67^{c}	56.67^{c}	106.3^{b}	105.2^{c}	15.43^{b}	14.97^{c}

The aforementioned results of GA_3 on flowering growth measurements coincided with Youssef (2004) on *Strelitzia reginae* ,Davadanam et. al. (2007), Tyagi and Singh (2008) on tuberose and Mohamed (2009) who demonstrated that, GA_3 at 300 ppm scored the greatest fresh

weight of total flower spike, fresh weight of flower spike with floret, fresh weight of flower spike without floret, fresh weight of third floret, number of florets per spikes, length of flower spike, thickness of flower spike, dry weight of total flower spike, dry weight of flower spike with floret , dry weight of flower spike without floret and dry weight of the third floret of tuberose and bird of paradise plants.

The abovementioned results of cytokinin are in harmony with those attained by Mohamed (2009) who show that, the treatments of BA at 50 ppm and kinetin at 100ppm recorded highly increases of fresh weight of total flower spike, fresh weight of flower spike with floret, fresh weight of flower spike without floret, fresh weight of third floret, number of florets per spikes, length of flower spike, thickness of flower spike, dry weight of total flower spike, dry weight of flower spike with floret , dry weight of flower spike without floret and dry weight of the third floret of tuberose and bird of paradise.

It was indicated the use of salicylic acid increased antioxidant and non-antioxidant defense is power (Abbaspour and Rezaei, 2014). Another study revealed foliar application of salicylic acid (SA) significantly affected number of flower, diameter of flower, diameter of stalk, stalk length, fresh weight and total chlorophyll contents of rose (cv. 'Angelina'). About of using salicylic acid, the maximum number of flower, diameter of stalk and total chlorophyll contents reported at 14 ppm and most of flower diameter, stalk length and fresh weight was measured in 21 ppm (Jahanbazi *et al*.2014).

Postharvest characteristics:

Data presented in Table (4) indicated that all tested treatments recorded highly significant increase in postharvest characters' vase life, floret opening percentage and change percentage in fresh weight of cut inflorescence stalk of aster cut inflorescence stalk comparing to control in the two tested seasons. Also, the treatment of GA_3 at 200ppm showed the highest significant increase of these parameters comparing to control and the all other treatments during the two seasons. Furthermore, the treatment of GA_3 at 100ppm or BA at 100ppm recorded highly significant increase in vase life, floret opening percentage and change percentage in fresh weight of cut inflorescence stalk as compared to control in both seasons.

Table 4: Effect of salicylic, gibberellic acids and benzyl adenine on vase life, floret opening percentage and change percentage in fresh weight of aster (*Symphyotrichum novi-belgii* L.) during 2014-2015 /2015-2016 seasons.

Parameters	Vase life (days)		Floret opening percentage		Change percentage in fresh weight of cut inflorescence stalk	
	Seasons					
Treatments	1st	2nd	1st	2nd	1st	2nd
Control	8.67^{f}	9.33^{e}	74.63^{e}	75.80^{f}	-8.20^{g}	-6.79^{f}
SA at100 ppm	10.33^{e}	11.33^{d}	78.20^{d}	79.67^{e}	2.40^{f}	2.97^{e}
SA at 200 ppm	11.33^{d}	12.67^{cd}	81.77^{c}	83.10^{d}	3.70^{e}	4.20^{d}
GA_3 at 100ppm	14.67^{b}	14.33^{ab}	89.50^{b}	90.80^{b}	7.43^{c}	7.30^{c}
GA_3 at 200ppm	15.67^{a}	15.33^{a}	91.73^{a}	92.13^{a}	9.97^{a}	11.03^{a}
BA at 50 ppm	13.33^{c}	13.67^{bc}	88.93^{b}	88.71^{c}	6.47^{d}	7.57^{c}
BA at 100 ppm	11.67^{d}	12.33^{cd}	91.00^{a}	92.00a^{b}	8.57^{b}	9.17^{b}

Water relations characters:

As shown in Table (5) it is obvious that all studied growth stimulants treatments succeeded in increasing water uptake and water balance of aster cut inflorescence stalk as compared with control in both seasons. Moreover, GA_3 at 200ppm recorded the highest values of water uptake and water balance as compared to control and other treatments under study, followed descendingly by BA at 100ppm GA_3 100ppm in the two seasons. On the other hand, water loss of aster cut inflorescence stalk was decreased by using tested treatments as compared to control, especially the treatment of GA_3 at 200ppm that recorded the lowest values of water loss as compared to control and other treatments under study.

The aforementioned results of GA_3, cytokinin and salicylic acid are in harmony with those attained by Youssef (2004) on *Strelitzia reginae* , Tyagi and Singh (2006) on tuberose , Devadanam et. al. (2007) on tuberose, Mohamed (2009) on tuberose and bird of paradise, Asil and Karimi (2010) on Eustoma plant, Emami *et al*. (2011) on lily plant, Mohammadi *et al*. (2012) on tulip plant, Hamidimoghadam *et al*. (2014) on carnation plant, Ataii *et al*. (2015) on Lisianthus plant, Ramtin *et al*. (2015) on carnations plant, Ramtin *et al*. (2016) on carnation, showed that salicylic acid, and benzyl adenine had more effects than others. Due to their ease of use and positive effects on morphological parameters, spraying of benzyl adenine and salicylic acid are one of the best methods in floriculture.

Table 5: Effect of salicylic, gibberellic acids and benzyl adenine on water uptake (g) inflorescence stalk, water loss (g) inflorescence stalk and water balance (g) inflorescence stalk in fresh weight of aster (*Symphyotrichum novi-belgii* L.) during 2014-2015 /2015-2016 seasons.

Parameters	Water uptake (g)/ inflorescence stalk		Water loss (g)/ inflorescence stalk		Water balance (g)/ inflorescence stalk	
	Seasons					
Treatments	1st	2nd	1st	2nd	1st	2nd
Control	60.30^{e}	62.33^{e}	67.47^{a}	68.47^{a}	-7.17^{e}	-6.13^{e}
SA at100 ppm	65.70^{d}	66.27^{d}	64.27^{b}	63.47^{d}	1.43^{d}	2.80^{c}
SA at 200 ppm	69.80^{b}	70.33^{b}	63.30^{c}	64.27^{c}	6.50^{b}	6.07^{b}
GA_3 at 100ppm	68.80^{c}	69.43^{c}	64.43^{b}	63.97^{cd}	4.37^{c}	5.47^{b}
GA_3 at 200ppm	70.60^{a}	72.43^{a}	62.60^{d}	63.37^{d}	8.00^{a}	9.07^{a}
BA at 50 ppm	65.53^{d}	66.43^{d}	64.67^{b}	65.23^{b}	0.87^{d}	1.20^{d}
BA at 100 ppm	70.10a^{b}	70.27^{b}	62.53^{d}	64.50^{c}	7.57^{a}	5.77^{b}

Chemical composition determination:

Data in Table (6) revealed that, all growth stimulants treatments gave high significant increases in N, P, K and total carbohydrates percentage, when compared with control in both seasons. However, the highest values of N, P, and K contents of aster leaf were registered by 200 ppm GA_3 -sprayed plants, followed in descending order by GA_3 100ppm and BA at 100ppm in the two seasons.

Table 6: Effect of salicylic, gibberellic acids and benzyl adenine on leaf N, P, K contents and total carbohydrates percentage of aster (*Symphyotrichum novi-belgii* L.) during 2014-2015 /2015-2016 seasons.

Parameters	Total nitrogen percentage		Total phosphorus percentage		Total potassium percentage		Total carbohydrates percentage	
Treatments	Seasons							
	1st	2nd	1st	2nd	1st	2nd	1st	2nd
Control	2.13^{e}	2.16^{f}	0.213^{b}	0.215^{b}	1.35^{f}	1.41^{g}	9.93^{e}	9.98^{f}
SA at100 ppm	2.31^{d}	2.24^{e}	0.240a^{b}	0.241^{ab}	1.51^{e}	1.54^{f}	12.27^{d}	12.60^{e}
SA at 200 ppm	2.33^{d}	2.39^{d}	0.260a^{b}	0.257^{ab}	1.61^{d}	1.60^{e}	13.20^{c}	13.43^{d}
GA_3 at 100ppm	2.60^{a}	2.57^{b}	0.282^{a}	0.284^{a}	1.97^{a}	2.05^{b}	16.50^{a}	17.07^{a}
GA_3 at 200ppm	2.64^{a}	2.63^{a}	0.289^{a}	0.287^{a}	1.99^{a}	2.12^{a}	16.97^{a}	17.13^{a}
BA at 50 ppm	2.42^{c}	2.51^{c}	0.264^{ab}	0.266^{ab}	1.68^{c}	1.71^{d}	15.17^{b}	14.77^{c}
BA at 100 ppm	2.53^{b}	2.49^{c}	0.270^{a}	0.272^{a}	1.79^{b}	1.80^{c}	16.87^{a}	16.40^{b}

Also, data in Table (7) show that, all growth stimulants treatments resulted in an increments of total sugars percentage in petals, total chlorophylls in leaves of inflorescence stalk (mg /100 g F.W) and total indoles in petals (mg /100 g F.W) of aster cut inflorescence stalk when compared with control in both seasons. However, the highest values of total sugars percentage and total indoles were registered by 200 ppm GA_3 -sprayed plants in the two seasons. While, the highest values of total chlorophylls were gained by 100 ppm BA -sprayed plants, in the two seasons. On the contrast, all studied treatments of SA, GA_3 and BA decreased total phenols content (mg /100 g F.W) in petals of aster cut inflorescence stalk, especially 100 ppm GA_3 -sprayed plants as compared with control and the other one in both seasons.

The aforementioned results of GA_3 are in harmony with those obtained by Gomaa (2003) on *Dahlia pinnata*, Salama (2003) on *Strelitzia reginae* , Youssef and Gomaa (2007) on *Iris tingitana*

and Abou El-Ella (2007) on *Acanthus mollis* and Mohamed (2009) on tuberose and bird of paradise with GA_3 at 100 or 200 ppm increased leaf N,P.K and total chlorophyll contents. The aforementioned results of cytokinnins are in parallel with those attained by Youssef (2000) on *Strelitzia reginae* and Mohamed (2009) on tuberose and bird of paradise plant show that kinetin levels (50, 100 and 200 ppm) increased leaf N, P, K, total carbohydrates, chlorophyll a, b and carotenoids contents, but decreased total phenols content in leaves.The aforementioned results of salicylic acid are in parallel with those attained by (Abbaspour and Rezaei, 2014). Another study revealed that foliar application of salicylic acid (SA) significantly affected total chlorophyll contents of rose (cv. 'Angelina' (Jahanbazi *et al*.2014).

Table 7: Effect of salicylic, gibberellic acids and benzyl adenine on total sugars percentage in florets, total chlorophyllus (mg/100g FW), total indoles and total phenols (mg/100g FW of aster (*Symphyotrichum novi - belgii* L.) during 2014-2015 /2015-2016 seasons.

Parameters	Total sugars percentage in petals		Total chlorophylls (mg/100g F.W)		Total indoles (mg/100g F.W)		Total phenols (mg/100g F.W)	
Treatments	Seasons							
	1st	2nd	1st	2nd	1st	2nd	1st	2nd
Control	2.16^{f}	2.20^{f}	160.8^{g}	166.3^{g}	220.8^{f}	225.2^{f}	151.6^{a}	143.3^{a}
SA at100 ppm	2.31^{e}	2.40^{e}	180.3^{d}	185.1^{d}	260.9^{d}	266.4^{c}	141.1^{b}	139.0^{b}
SA at 200 ppm	2.44^{d}	2.47^{d}	188.6^{c}	190.7^{c}	270.8^{c}	266.3^{c}	135.6^{c}	130.9^{c}
GA_3 at 100ppm	3.20^{a}	3.20^{a}	177.7^{e}	176.2^{e}	279.7^{b}	286.1^{b}	117.5^{f}	114.2^{f}
GA_3 at 200ppm	3.24^{a}	3.23^{a}	176.3^{f}	173.9^{f}	288.2^{a}	291.7^{a}	121.6^{e}	118.1^{e}
BA at 50 ppm	2.95^{c}	2.90^{c}	198.4^{b}	205.1^{b}	244.0^{e}	252.2^{e}	130.9^{d}	128.8^{d}
BA at 100 ppm	3.12^{b}	3.14^{b}	210.0^{a}	212.2^{a}	261.2^{d}	260.1^{d}	121.3^{e}	128.7^{d}

Conclusion

Conclusively, the highest growth quality and the longest vase life of aster *(Symphyotrichum novi-belgii* L.) on all parameters vegetative, flowering, postharvest, water relation and chemical composition characteristics by sprayed aster with the treatment of GA_3 at 200 ppm and BA at 100 ppm in the first and the second seasons.

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