J. of Plant Production, Mansoura Univ.,Vol 11 (12):1399 - 1410, 2020

Journal of Plant Production

Journal homepage: www.jpp.mans.edu.eg
Available online at: www.jpp.journals.ekb.eg

Water Relationships, Vase Life and Quality of Solidago Cut Spikes as affected by some Natural Extracts in Holding Solutions

Cross Mark

Kasem, M. M.* ; **H. H. Abdel-Kader and Nermin M. M. A. El Banhawy**

Veget. and Flori. Dept., Fac. of Agric., Mansoura Univ.

ABSTRACT

Solidago (*Solidago canadensis* L.) is an excellent cut spikes commonly used for indoor decoration in vases and bowls and as a dried flower. Microorganisms activities in vases solutions is the main cause of limiting the vase life of all cut flowers and preservative solutions is recommended to maintain quality and reduce losses after harvesting. To achieve this purpose, this research was conducted in vegetable and floriculture Department, Faculty of Agriculture, Mansoura Univ., Egypt during two successive seasons of 2019 and 2020. Three ethanolic leaf extracts (neem, oleander and guava) at concentrations of 0.5, 1.0 and 2.0% individually from each of them, besides $AgNo_3$ (10 ppm) and the control (distilled water) treatments were examined. All holding solutions were fortified by sucrose in a concentration of 2.0%. Data were recorded for vase life (days), change in fresh weight (g/100g F.W./2days), the maximum increase in fresh weight (%), relative fresh weight (%), total water uptake(g/ spike), change in water uptake (g/100g F.W./2days), change in water loss (g/100g F.W./2days) and change in water balance (g/100g F.W./2days) were evaluation. Also, chlorophyll a, b, total chl., carotenoids, total sugar (%), N, P and K (%) and total bacterial counts (cfu/ml) were determined. Results showed that the more effective holding solutions in most of the studied postharvest characteristics especially vase life and water relationships besides minimizing the bacterial counts were 0.5% oleander extract, 2.0% neem extract and 2.0% guava extract plus 2.0% sucrose for all.

Keywords: Solidago, Postharvest, Vase life, Water relationships, Natural extracts

INTRODUCTION

Solidago (*Solidago canaddensis* L.) commonly called goldenrods family (Asteraceae), is a genus of about approximately 120 species of flowering plants. Most of them are herbaceous perennial species found in open areas such as meadows, prairies, and savannas. They are mostly native to North America, including Mexico; a few species are native to South America and Eurasia. It is an excellent cut spike commonly used for indoor decoration in vases and bowls and as a dried flower. Demand for solidago has been dramatically over the past years, it is a new crop among the top 25 most popular cut flowers around the world, the microbial contamination is the main cause of limiting the vase life of cut flowers (Taha *et al.*, 2015). Preservative solutions aim to provide the cut floral stems and could be considered as hydrating substrate (water), energetic (sucrose) and phytosanitary (fungicide and bactericide). There is also the use of other ingredients for the formulation of solutions, for example, mineral ions, ethylene inhibitors, growth regulators, antioxidants, among others. Its composition must provide energy to the floral stems, preventing the microbial development or the ethylene synthesis (Reid and Jiang, 2012). Most preservative solutions contain two basic components: sugar and germicide. The sugar provides a respiratory substrate, whereas the germicide controls harmful bacteria and prevents plugging of the conducting tissues (Rahman *et al.* 2012). A major form of deterioration in cut flowers is the blockage of xylem vessels by air and microorganisms that cause xylem occlusion (Ahmad *et al.*, 2016). Numerous natural extracts and chemical preservatives are available to increment longevity. The majority of them work superbly of prolonging vase live (Rahman *et al.*, 2012 and Carrillo-López *et al.*, 2016).

In recent years, interest is renewed in environmentally friendly materials especially of plant origin because of their availability, biodegradable, low cost and being safer. Among these are organic extracts for all plant parts of neem, oleander and guava which are a source of various compounds that have anti-fungal and bacterial properties in addition to being rich in natural nutrients and antioxidants. Silver nitrate ($AgNo_3$) is one of the most common forms of silver salts used in commercial flower preservatives solutions and mostly used as ethylene binding inhibitor. Pulsing with ($AgNo_3$) strikingly enhanced vase life and solution uptake in rose cut flowers (Elgimabi, 2011).

Neem (*Azadirachta indica* L) which native to family Meliaceae contains more than 135 compounds have been isolated from different parts of neem. The compounds have been divided into two major classes: isoprenoids [like diterpenoids and triterpenoids containing protomeliacins, limonoids, azadirone and its derivatives, gedunin and its derivatives, vilasinin type of compounds and C-secomeliacins such as nimbin, salanin and azadirachtin] and non-isoprenoids, which are proteins/amino acids and carbohydrates [polysaccharides], sulphurous compounds, polyphenolics such as flavonoids and their glycosides, dihydrochalcone, coumarin and tannins, aliphatic compounds, etc. Most of the compounds have the

*** Corresponding author.**
E-mail address: mmk@mans.edu.eg
DOI: 10.21608/jpp.2021.54746.1011

fungistatic ability (Asif, 2012). In addition, (Pandey *et al.*, 2014) suggested that leaves of *Azadirachta indica* possess significant antioxidant and antibacterial properties. Also, (Elaigwu *et al.*, 2019) showed that ethanolic extracts of A. *indica* has constituents that have been severally reported to have antioxidant properties including phytol and palmitic acid and other important phytochemicals. Moreover, (Murthy *et al.*, 2015) illustrated that neem extract at 1% is most effective locally available preservative which can be successfully used to extend the vase life of cut gerberas as it is biocidal in nature that prevented microbial growth which causes vascular blockage. The oleander (*Nerium oleander* L.) native to family Apocyanaceae which contains nerin, folineriin, and oleandrin. Many of its types are toxic to humans, animals and plants and have wide medical uses. To contribute to finding effective alternatives in combating plant diseases (insects, bacteria, fungi), oleander plant extracts have been used in many studies (Hadizadeh *et al.*, 2009 and Phalisteen *et al.*, 2008). *Psidium gujajava* is a member of the Myrtaceae family and its mature leaf extract has antimicrobial, astringent and bactericide properties. Since (Rahman *et al*., 2012) found that guava leaf extracts, 8-HQC and copper coins significantly prolonged the vase life of carnation flowers compared to the control (tap water).

Moreover, (Pandey *et al.*, 2014) revealed that ethanolic extracts of neem leaves contain of various chemical substances. The most important of these are alkaloids, glycosides, saponins, steroids, phenols, flavonoids and tannins. Flavonoids act as antioxidants which provide protection against free radicals that damage cells and tissues and tannins promote healing of wounds. Also, quercetin and ß-sitosterol were the first polyphenolic flavonoids purified from neem fresh leaves and were known to have antibacterial and antifungal properties (Mahmoud *et al.*, 2011). Besides that, saponins show anti-fungal, anti-bacterial and anti-protozoal effects. (Morisaki *et al.*, 1995). Finally, the phytoconstituents i.e., alkaloids, glycosides, flavonoids and saponins which observed in the leaves extracts of neem, oleander and guava are antibiotic principles of plants. These antibiotic principles are the defensive mechanism of the plants against different pathogens (Hafiza, 2000).

Thus, the purpose of this research was to study the influence of leaf extracts from neem (*Azadirachta indica*), oleander (*Nerium oleander*) and guava *(Psidium guajava)* with different concentrations in comparison with $AgNo_3$ (10 ppm) and the control (distilled water) as environmentally friendly material additive in preservative solutions for improving the vase life, water relationships, chemical constituents and reducing the bacterial counts of solidago cut spikes during the shelf-life period.

MATERIALS AND METHODS

The present investigation was carried out at the Laboratory of Vegetable and Floriculture Department, Faculty of Agriculture, Mansoura University, Egypt during the two successive seasons of 2019 and 2020. The aim of this study was to investigate the effect of neem, oleander and guava ethanolic leaf extracts at different concentrations in comparison with silver nitrate ($AgNo_3$ at 10 ppm) and the control (distilled water) as holding solutions on the postharvest characteristics of goldenrod (*Solidago canadensis* L.) cut spikes for keeping quality and extending the vase life.

Plant material

Solidago (*Solidago canadensis*, L c.v. "Tara") cut spikes were brought from a commercial nursery (Tabaraq) in El-Qanater area, El-Qaluobiya Governorate, Egypt at 23 and 19 June during both seasons, respectively. Cut spikes were harvested in the early morning and potted in icebox collar and were transported under controlled environment conditions during the transporting process which take about 3 hours. Spikes were harvested at the normal commercial harvest stage at 60-70 cm in length and were re-cut under water to 55 cm in length with 45 degrees before postharvest treatments and lower leaves were removed leaving only eight upper leaves.

Ethanolic extracts Preparation

Mature neem (*Azadirachta indica*) and guava (*Pisidium gujava*) leaves were collected from the Nursery of Agriculture Faculty, Mansoura University, Egypt. Oleander (*Nerium oleander*) leaves were collected from campus plants of Mansoura University. All collected leaves were ensured that the plant was healthy and uninfected. All collected leaves were properly identified by a botanist at the Department of Horticulture, Faculty of Agriculture, Mansoura University, Dakahlia Governorate, Egypt. The leaves of three types were washed under running tap water to remove any traces of soil particles and other dirt then washed with distilled water, air-dried at room temperature in the shade to avoid exposure to sunlight for 14 days before being, subsequently crushed mechanically and then coarsely powdered to pass through a sieve before being stored in labelled polyethene bags to use when needed for further extracts. Absolute ethanol was obtained from El Nasr Pharmaceutical Chemicals Co., Egypt. The other chemicals used were of analytical grade. Extraction of leaves was done by cold maceration according to the method of Pandey *et al.* (2014) with some modification. 80g of ground leaves (neem, oleander and guava) were weighed and macerated in 600ml absolute ethanol in a well-labelled container wrapped in aluminum foil to avoid evaporation and away from direct light, then mixtures were shaken occasionally for 24 h. After extraction, all the crude extracts were filtered twice using filter paper (Whatman No. 41) to obtain particle-free crude stock solutions. The stock solutions obtained were kept in a well-labelled brown sterile specimen container in the refrigerator at 4°C until further use and some chemical analysis of all extract types were achieved and presented in Table (1).

Table 1. Some chemical analysis and pH of the ethanolic leaf extracts of neem, guava and oleander stocks.

Extract types	Chemical analysis of extracts				
	N%	P%	K%	Total sugar%	pH
Neem	2.66	0.266	1.64	5.86	4.55
Oleander	2.28	0.221	1.56	5.14	5.03
Guava	2.39	0.249	2.74	6.76	4.80

Experiment treatments

Three dilutions 0.5, 1.0 and 2.0% of leaves ethanolic stock extracts were used for preparing preservative solutions, 10 ppm silver nitrate ($Ag\ No_3$) and the control (distilled water) were prepared. Spikes were held in glass bottles contained 400g of each preservative solution. Approximately one cm from the end of all spike stems were cut every 3 days after calculating their weights. All vase solutions used in the two seasons were prepared freshly with distilled water, and cut spikes were held in fresh solutions after approximately one hour of preparation.

All the preservative solutions were fortified with 2.0% sucrose and the experiment treatment could be summarizing as follows:

- Control (distilled water).
- Silver nitrate ($Ag\ No_3$) 10 ppm.
- Neem 2.0, 1.0 and 0.5%.
- Oleander 2.0, 1.0 and 0.5%.
- Guava 2.0, 1.0 and 0.5%.

Experiment conditions

In both seasons, cut spikes held in different preservative solutions were kept at 28 ± 2 ºC under 65%- 78% relative humidity and cool white, fluorescent lamps provided by 1000 lux light for 12 h photoperiod.

Experimental design

The layout of this experiment was a simple experiment in a complete randomized design (CRD) since there were eleven treatments each contained three replicates and each replicate consist of three cut spikes.

Data recorded:

A- Post harvest characteristics

1. **Vase life (days)**: was measured as the longevity of cut spikes in the vase solution. Vase life was ended when the spikes reached browning of up to 25% (Hassan *et al.,* 2003).
2. **Change in fresh weights (CFW) g/100g cut spike /2days:** was calculated every two days as the difference between weights of cut flowers (g) at days 3, 5, 7, etc., and weights of the same cut flowers (g) at the first day (initial weight), Then divide the result by the fresh weight of the cut spike on the first day and converting to 100g fresh weight as indicated by (He *et al.*, 2006).
3. **Maximum increasing in fresh weight (%):** was determined by subtracting the initial fresh weight from the biggest fresh weight of cut spikes then divide the result by the fresh weight of the cut spike on the first day and converting to a percentage.
4. **Relative fresh weight (RFW) %:** was calculated every two days using the following formula:

$$\textbf{RFW (\%)} = (FW_d / FW_{d1}) \times 100.$$

(FW_d: is the cut spike weight (g) at d=day 3, 5, 7, etc., and $FW_{d1}$is the weight of the same cut spike (g) at the initial day). (He *et al.*, 2006).

5. **Total water uptake (g/cut spike):** was estimated by aggregate of all absorbed water during the shelf-life period of the cut spikes in accordance with (Rahman *et al.*, 2012).
6. **Change of water uptake (g/100g cut spike/2days)**: recorded at days 3, 5 , 7,… days, during the vase life (after rectification with the mean evaporation value) accordant with (Hatamzadeh *et al*., 2012) after minor modification by the following formula;

Change in water uptake (g/100g fw/2days)

$$= \frac{\text{solution uptake on day(n) of the cut flower}}{\text{fresh weight (g) on day(n) of the same cut flower}} \times 100$$

7. **Change of water loss (g/100g cut spike/2days)**: calculated by using the following formula:

$$\textbf{Water loss} = (WU_d - (\pm CFW_d)/ FW_{d1}) \times 100.$$

Whereas

WU= Water uptake (absorption) was measured in days 3, 5, 7, 9, etc. and were calculated using the following formula: WU= $((S_{t-1})-S_t / FW_{d1})$ X100: The amount of absorbed solution S_t: Solution weight (g) in days 3,5, etc. and S_{t-1}: Solution weight (g) in the previous day FW_{d1}: Cut spike fresh weight in day one (the initial day) (Ghale-Shahi *et al.*, 2015).

8. **Change in water balance (g/ 100g cut spike/2days)**: calculated by using the following formula:

Water balance = change in water uptake (#6) – change in water loss (#7).

B-Chemical analysis:

1. **Chlorophyll a, b, total chlorophyll and total carotenoids in fresh leaves (mg/g F.W.):** were determined in fresh leaves sample as mg/g fresh weight according to (Sumanta *et al.*, 2014).
2. **Total sugar percentage in leaves (%)**: Total sugar percentage in air dried solidago leaves were stipulated by using colorimetric technique as indicated by (Dubois *et al*., 1956) additionally the glucose standard.
3. **N, P and K (%) in leaves (season 2019)**: The samples were digested by applying perchloric and sulphuric acids as specified by (Chapman and Pratt, 1978). Nitrogen (N%) was specified depending on (Nelson and Sommers, 1980). Phosphorus (P%) was evaluated as specified by (Jackson, 1967). (K%) was specified by applying the Gallen Kamp flame photometer as mentioned by (Jackson, 1967).

The ensuing estimations were taken in both experimental seasons on solidago cut spikes: Chlorophyll a, b, total chlorophyll and carotenoids content in fresh leaves were assessed at the 5th day of experiment. While total sugar percentage was estimated in solidago's leaves taken on the 5th day of experiment after drying them. As for N, P and K percentages determination, also the dried leaves of solidago were used only in the first season of study at 5th day.

C-Microbial growth

Averages of total plate counts (cfu/ml): Bacterial contamination was determined in the solution after 3 days of the experiment. The samples of the preservative solutions were taken (1 ml of each) and diluted using sterilized distilled water. One ml of each diluted solution was streaked on nutrient agar into Petri dishes. Cultures were incubated 2 days at 30°C and the colonies appearing on the plates were counted. This experiment was repeated two times with 2 replicates in each treatment in the laboratory of Microbiology Department, Faculty of Agriculture, Mansoura University. (APHA, 1984)

Statistical Analysis

Data were subjected to analysis of variance (ANOVA) using the Costate (1986) V. 3.30 program and comparing between means were achieved by using Duncan test at 5% probability according to Snedecor and Cochran (1968).

RESULTS AND DISCUSSION

Results

1- Impact of silver nitrate and some natural extracts on postharvest characteristics:

Vase life (days):

Concerning the impact of preservative solutions on vase life of solidago cut spikes, data recorded in Chart (1) and Photo (1) cleared that using holding solutions contains neem extract at 2.0% or oleander extracts at 0.5% significantly increased the vase life of 'Tara C.V' solidago cut spikes reached to (40.58% and 45.21%), (40.58% and 42.01%) in both seasons, respectively when compared with the control one. On the other hand, there wasn't significant difference between the treatments of neem extract, oleander extract 1.0% and guava extract 2.0%, 1.0% and 0.5% which gave long vase life values in both seasons. While treatment of silver nitrate at 10 ppm showed positive significant differences compared to the control during the first season only. Moreover, the control treatment (distilled water), significantly recorded the lowest vase life value (10.67 and 10.33 days) in both seasons, respectively. In general, it could be concluded that all the natural extracts preservative solutions significantly extend the vase life period when compared with the control (Distilled water).

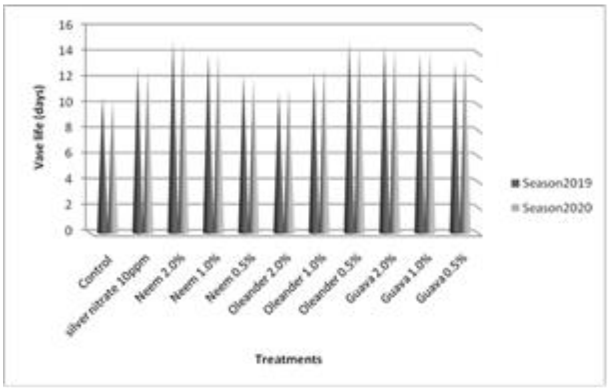

Chart 1. Impact of silver nitrate and some natural extracts on vase life (days) of solidago cut spikes during 2019 and 2020 seasons.

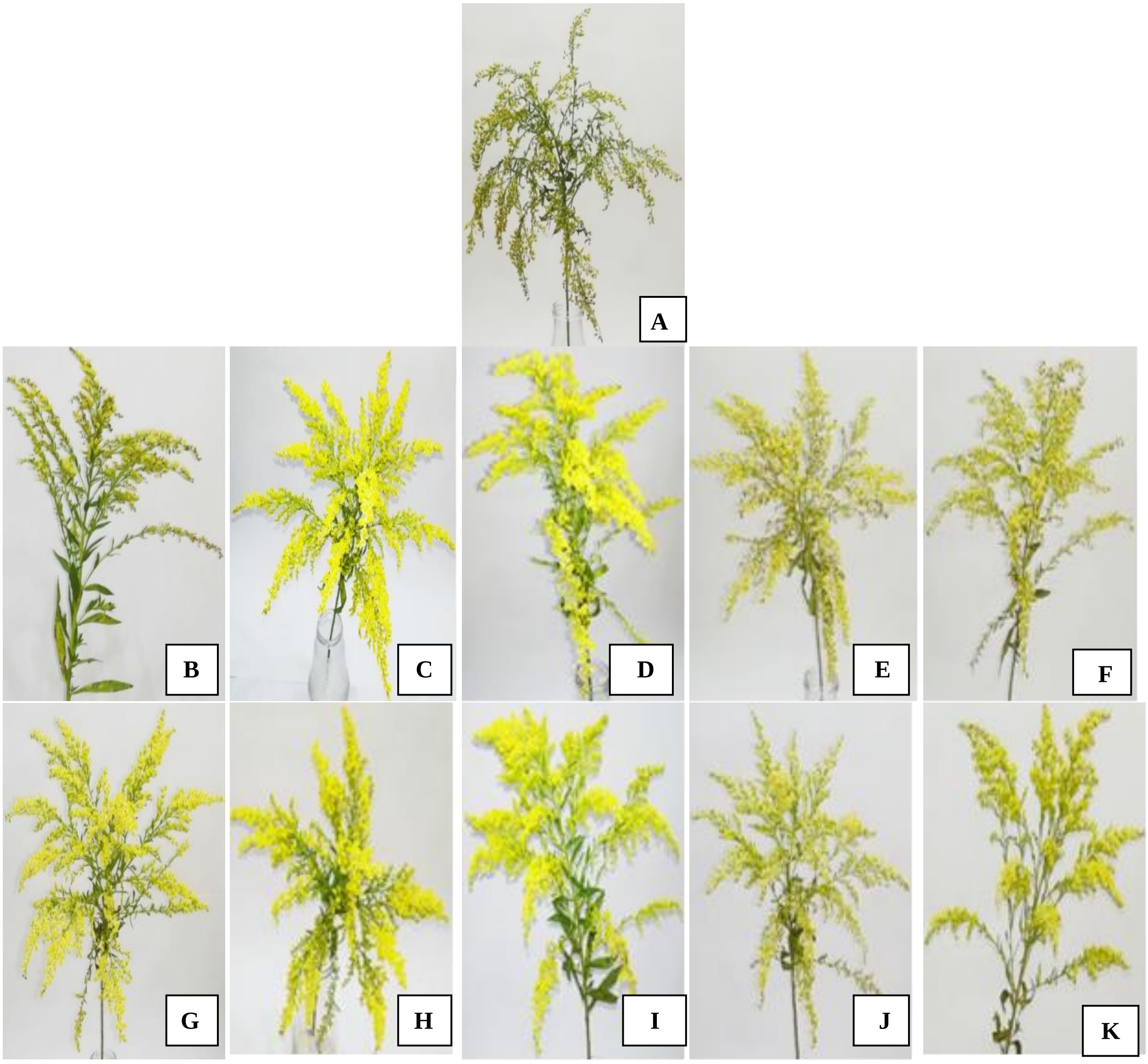

Photo 1. Shows the different preservative solution influence on (Vase Life) at 13th day during 2020 season. (A= distilled water), B= (silver nitrate 10 ppm), (C, D, E= neem extract at 2.0, 1.0 and 0.5%), (F, G, H= oleander extract at 2.0, 1.0 and 0.5%), (I, J, K= guava extract at 2.0, 1.0 and 0.5%).

Change in fresh weights (CFW) g/100g cut spike/2days:

Concerning change in fresh weights of solidago, data recorded in Table (2) cleared that among all preservative solutions neem extract 2.0%, oleander 0.5% and guava 2.0%, significantly increased the change in fresh weight of solidago cut spikes until the fifteenth day (the last day) in both seasons, respectively comparing with the control and the other treatments of study. Whereas all concentrations of the natural extracts maintained an increment in the change in fresh weight of cut spikes until the eleventh day and then began to decrease compared with silver nitrate at 10 ppm and the control in both seasons. Also, cut spikes which held in treatments with 1.0% or 0.5% of neem extracts and 2.0% of oleander extracts gradually decreased after day 11 in the first season in that respect. Whereas in the second season, the beginning of a gradually decrease in change of fresh weight was observed after the eleventh day for 2.0% or 1.0% oleander extract, while the control increased slightly in that respect until the fifth day in the first season then began to decrease thenceforth compared with the other studied treatments. Additionally, the control began to descend from the third day of the vase life recorded lower values than the other studied treatments in the second season. Moreover, there were no statistically significant differences between the control and the treatment with 10 ppm silver nitrate during the fifth day of the vase life in the second season.

Table 2. Impact of silver nitrate and some natural extracts on change in fresh weights (g/100g F.W./ 2days) of solidago cut spikes during 2019 and 2020 seasons.

Treatments	1st season						
	Shelf life (days)						
	3rd	5th	7th	9th	11th	13th	15th
Control	5.99^{a}	1.16^{d}	-7.68^{e}	-19.62^{d}	-14.19^{d}	----	----
Silver nitrate 10 ppm	4.63^{ab}	5.57^{abcd}	0.13^{d}	-4.96^{c}	-11.37^{d}	-19.04^{e}	----
Neem 2.0%	5.54^{a}	9.12^{ab}	8.95^{abc}	10.13^{ab}	7.62^{abc}	6.18^{abc}	3.24^{bc}
Neem 1.0%	5.21^{ab}	7.41^{abc}	10.29^{ab}	10.29^{ab}	7.41^{abc}	-1.10^{cd}	-2.08^{d}
Neem 0.5%	3.13^{ab}	1.04^{cd}	2.43^{cd}	5.49^{ab}	1.42^{bc}	-5.56^{d}	----
Oleander 2.0%	0.18^{b}	5.51^{abcd}	4.04^{bcd}	1.96^{bc}	1.89^{c}	-1.75^{cd}	----
Oleander 1.0%	3.57^{ab}	2.26^{bcd}	3.54^{bcd}	4.92^{ab}	6.67^{abc}	2.02^{abcd}	----
Oleander 0.5%	6.38^{a}	12.09^{a}	13.38^{a}	13.24^{a}	13.24^{a}	10.71^{a}	9.29^{a}
Guava 2.0%	3.11^{ab}	3.76^{bcd}	6.02^{bcd}	8.43^{ab}	9.35^{ab}	8.17^{ab}	4.27^{b}
Guava 1.0%	2.04^{ab}	0.00^{cd}	4.06^{bcd}	7.80^{ab}	7.80^{abc}	4.06^{abc}	----
Guava 0.5%	2.87^{ab}	4.53^{bcd}	5.57^{bcd}	7.15^{ab}	7.15^{abc}	2.87^{abcd}	----
	2nd season						
Control	-0.02^{c}	-2.52^{c}	-11.33^{d}	-7.77^{c}	-18.15^{b}	-8.89^{bc}	----
Silver nitrate 10 ppm	9.38^{a}	3.25^{bc}	-1.85^{c}	-7.53^{c}	-13.88^{b}	-12.81^{c}	----
Neem 2.0%	6.34^{ab}	7.28^{ab}	10.12^{ab}	11.83^{ab}	7.28^{a}	7.44^{a}	5.29^{ab}
Neem 1.0%	5.30^{b}	6.04^{ab}	8.52^{ab}	8.62^{ab}	10.14^{a}	3.88^{ab}	3.18^{ab}
Neem 0.5%	4.87^{b}	4.87^{abc}	3.53^{bc}	4.48^{b}	1.58^{a}	----	----
Oleander 2.0%	3.50^{bc}	3.35^{bc}	3.56^{bc}	2.90^{b}	2.90^{a}	-1.45^{abc}	----
Oleander 1.0%	5.09^{b}	4.08^{abc}	4.16^{bc}	4.31^{b}	2.57^{a}	-2.58^{abc}	----
Oleander 0.5%	5.49^{b}	7.95^{ab}	10.28^{ab}	10.28^{ab}	10.04^{a}	10.04^{a}	7.38^{a}
Guava 2.0%	4.22^{b}	12.22^{a}	14.64^{a}	14.96^{a}	13.71^{a}	10.95^{a}	6.07^{a}
Guava 1.0%	3.11^{bc}	6.00^{ab}	6.00^{abc}	8.69^{ab}	10.91^{a}	5.51^{a}	1.96^{ab}
Guava 0.5%	2.80^{bc}	3.45^{bc}	7.28^{abc}	6.67^{ab}	6.67^{a}	2.38^{ab}	----

Means within columns followed by different letters are significantly different ($p< 0.05$).

Maximum increasing in fresh weight %:

As regarding data in Chart (2) it was cleared that the maximum increasing of fresh weight % for most treated solidago cut spikes with different preservative solutions were higher in both seasons than control treatment.

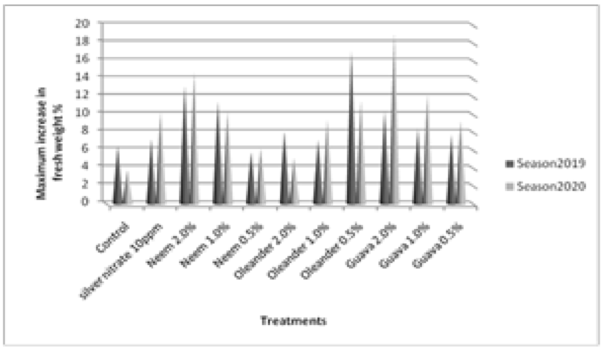

Chart 2. Impact of silver nitrate and some natural extracts on maximum increasing in fresh weight % of solidago cut spikes during 2019 and 2020 seasons.

Also, it is obvious that the maximum increase in fresh weight values obvious in some studied natural extracts treatments compared with the control in both seasons. Moreover, the oleander extract at 0.5% followed by neem extract at 2.0% treatments recorded the highest value of maximum increasing in fresh weight (17.22% and 13.26 %), respectively among other treatments in the first seasons. While guava extract at 2.0% followed by neem extract at 2.0% and guava extract at 1.0% then oleander extract at 0.5% recorded the highest value of maximum increasing in fresh weight (19.25%, 14.82%, 12.29% and 11.57%), respectively in the second season. Whereas the control gave the lowest values in that respect (6.51% and 3.78%) in both seasons, respectively and there was insignificant difference between control and silver nitrate at 10 ppm in these characteristics of the trait under study.

Relative fresh weight%:

As shown in Table (3) data obvious that changing in relative fresh weight percentage (RFW%) were affected in all studied natural extracts and silver nitrate treatments compared with the control during shelf-life period in the first season. Where, they were more successful than control till the thirteenth day. On the other hand, the preservative solutions which contained 0.5% of oleander extract or 2.0% of neem extract or 2.0% of guava extract were determined more successful than other preservative solutions in preserve to RFW during all shelf-life period in both seasons. Moreover, the highest percentages of RFW were obtained with using oleander extract at 0.5% in the first season, neem extract at 2.0%, oleander extract at 0.5% and guava extract at 2.0% in the second season compared with control. On the other hand, cut spikes held in a preservative solution containing 10 ppm of silver nitrate gave good results for this characteristic until 13th day in the vase.

Table 3. Impact of silver nitrate and some natural extracts on change in relative fresh weight % of solidago cut spikes during 2019 and 2020 seasons.

Treatments	1st season						
	Shelf life (days)						
	3rd	5th	7th	9th	11th	13th	15th
Control	106.51^{a}	99.23^{d}	93.12^{e}	83.83^{e}	54.98^{bc}	----	----
Silver nitrate 10 ppm	104.91^{ab}	105.96^{abcd}	100.25^{d}	96.12^{d}	90.04^{ab}	84.48^{ab}	----
Neem 2.0%	105.91^{a}	110.30^{ab}	109.85^{abc}	111.30^{ab}	108.34^{a}	73.49^{abc}	70.08^{ab}
Neem 1.0%	105.50^{ab}	108.02^{abc}	111.50^{ab}	111.50^{ab}	108.02^{a}	99.05^{ab}	31.37^{bc}
Neem 0.5%	103.30^{ab}	101.08^{cd}	102.52^{cd}	105.82^{bc}	101.08^{a}	31.11^{bc}	----
Oleander 2.0%	100.03^{b}	106.11^{abcd}	104.31^{bcd}	102.08^{cd}	31.67^{c}	31.67^{bc}	----
Oleander 1.0%	103.72^{ab}	102.35^{bcd}	103.74^{cd}	105.33^{bc}	107.18^{a}	35.48^{abc}	----
Oleander 0.5%	106.88^{a}	113.85^{a}	115.70^{a}	115.46^{a}	115.46^{a}	112.09^{a}	110.24^{a}
Guava 2.0%	103.22^{ab}	103.91^{bcd}	106.44^{bcd}	109.28^{abc}	110.35^{a}	108.90^{a}	71.28^{ab}
Guava 1.0%	102.12^{ab}	100.12^{cd}	104.35^{bcd}	108.46^{abc}	108.46^{a}	104.23^{ab}	----
Guava 0.5%	102.95^{ab}	104.76^{bcd}	105.91^{bcd}	107.76^{abc}	107.76^{a}	69.67^{abc}	----
	2nd season						
Control	100.09^{c}	98.11^{c}	90.43^{d}	59.95^{b}	52.40^{b}	26.32^{bc}	----
Silver nitrate 10 ppm	110.35^{a}	103.42^{bc}	98.25^{cd}	93.07^{a}	87.89^{ab}	56.14^{abc}	----
Neem 2.0%	106.71^{ab}	107.91^{ab}	111.05^{ab}	114.82^{a}	109.29^{a}	107.91^{a}	102.38^{a}
Neem 1.0%	105.60^{b}	106.44^{abc}	109.33^{ab}	109.54^{a}	107.87^{ab}	68.75^{ab}	66.67^{ab}
Neem 0.5%	105.13^{b}	105.13^{abc}	103.74^{bc}	104.85^{a}	68.61^{ab}	----	----
Oleander 2.0%	103.63^{bc}	103.53^{bc}	103.70^{bc}	103.04^{a}	69.84^{ab}	31.94^{bc}	----
Oleander 1.0%	105.38^{b}	104.67^{bc}	104.79^{bc}	105.42^{a}	103.34^{ab}	64.75^{abc}	----
Oleander 0.5%	105.89^{b}	108.79^{ab}	111.57^{ab}	111.57^{a}	111.23^{a}	111.23^{a}	75.00^{a}
Guava 2.0%	104.43^{b}	113.95^{a}	117.29^{a}	117.66^{a}	115.90^{a}	112.36^{a}	73.35^{a}
Guava 1.0%	103.23^{bc}	106.46^{abc}	106.46^{bc}	109.58^{a}	112.29^{a}	105.83^{a}	35.41^{ab}
Guava 0.5%	102.88^{bc}	103.58^{bc}	107.98^{b}	107.15^{a}	107.15^{ab}	102.46^{a}	----

Means within columns followed by different letters are significantly different ($p< 0.05$).

Total water uptake g/cut spike:

Data in Chart (3) indicated that total water uptake which recorded from cut spikes held in preservative solution consist of guava at 2.0% and 2.0% neem extracts, gained the highest values (150.33and 114.33 g/cut spike), respectively in the first season,

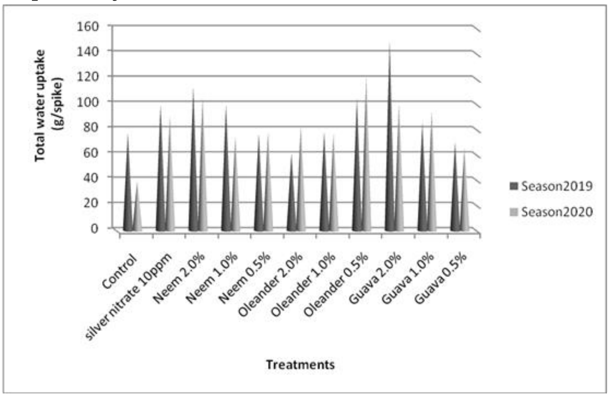

Chart 3. Impact of silver nitrate and some natural extracts on total water uptake (g/cut spike) of solidago cut spikes during 2019 and 2020 seasons.

while the cut spikes which held in solution with 0.5% of oleander produced the highest values followed by 2.0% of neem extract and 2.0% of guava extract as (122.67, 106.00 and 100.67 g/cut spike), respectively in the second season.

Change in water uptake (g/100g F.W./ 2days):

As shown in Table (4) it is obvious that change in water uptake gained higher values with using the oleander extract at 0.5%, neem extract at 2.0% and guava extract at 2.0% during the shelf life until the last day (15th) during both seasons. Neem extract at 1.0% came in the second order, as it gave higher change in water uptake values than most of the other treatments and the control during the shelf-life period in both seasons. As well as silver nitrate at 10 ppm gave higher values of the above-mentioned character until the 13thday. Whereas the lowest change of water uptake values resulted from the control especially in second season of study.

Change in water loss (g/100g F.W./ 2days):

As shown in Table (5) it is obvious that change in water loss values did not record any significant differences between the control and most of the other treatments during the shelf-life period in both seasons, but some of treatments maintained stable than most until the final day of study. Among them was oleander extract at 0.5%, neem extract at 2.0%, guava extract at 2.0% in both seasons. Moreover, the use of silver nitrate 10 ppm recorded higher values for this trait, until the end of the optimal postharvest characters of spikes on the 13th day. In addition, the control represented the highest values of water loss from the third day during shelf life in 1st season comparing with most of the other treatments.

Table 4. Impact of silver nitrate and some natural extracts on change in water uptake (g/100g F.W./ 2days) of solidago cut spikes during 2019 and 2020 seasons.

Treatments	1st season						
	Shelf life (days)						
	3rd	5th	7th	9th	11th	13th	15th
Control	89.01^{a}	78.82^{a}	63.88^{bc}	62.55^{abcd}	43.42^{c}	----	----
Silver nitrate 10 ppm	78.51^{abc}	72.50^{abc}	68.08^{ab}	73.02^{ab}	69.75^{ab}	72.54^{a}	----
Neem 2.0%	77.08^{abc}	74.42^{ab}	77.18^{ab}	70.18^{abc}	73.74^{a}	47.65^{abc}	48.15^{a}
Neem 1.0%	62.51^{bcd}	57.49^{bcd}	51.65^{cd}	54.34^{cd}	50.46^{abc}	60.71^{ab}	20.83^{ab}
Neem 0.5%	54.26^{cd}	55.56^{bcd}	48.68^{cd}	45.83^{d}	50.53^{abc}	43.92^{abcd}	----
Oleander 2.0%	49.01^{d}	55.46^{bcd}	49.44^{cd}	57.39^{bcd}	56.29^{abc}	19.30^{cd}	----
Oleander 1.0%	61.89^{bcd}	53.48^{cd}	52.52^{cd}	46.41^{d}	40.25^{c}	24.75^{bcd}	----
Oleander 0.5%	90.45^{a}	78.81^{a}	74.75^{ab}	69.02^{abc}	75.48^{abc}	54.56^{abc}	50.79^{a}
Guava 2.0%	83.11^{ab}	84.36^{a}	81.62^{a}	76.62^{a}	73.23^{a}	72.97^{a}	44.86^{a}
Guava 1.0%	59.42^{bcd}	54.95^{bcd}	50.06^{cd}	49.48^{d}	48.25^{abc}	43.16^{abc}	----
Guava 0.5%	49.56^{d}	50.79^{d}	42.93^{d}	44.57^{d}	45.16^{bc}	25.15^{bcd}	----
	2nd season						
Control	31.42^{d}	40.33^{d}	42.31^{b}	28.52^{c}	31.11^{b}	22.22^{ab}	----
Silver nitrate 10 ppm	68.69^{b}	68.76^{ab}	62.26^{ab}	54.75^{abc}	82.76^{a}	66.67^{a}	----
Neem 2.0%	80.77^{a}	73.83^{a}	69.51^{a}	76.30^{a}	76.83^{a}	72.67^{a}	74.37^{a}
Neem 1.0%	63.26^{b}	58.65^{abcd}	51.21^{ab}	56.16^{abc}	55.19^{ab}	35.98^{ab}	35.42^{bc}
Neem 0.5%	47.57^{c}	48.72^{bcd}	42.96^{ab}	42.84^{bc}	28.06^{b}	----	----
Oleander 2.0%	46.84^{c}	47.26^{bcd}	57.59^{ab}	63.00^{abc}	41.06^{b}	21.74^{ab}	----
Oleander 1.0%	69.51^{b}	67.17^{abc}	60.65^{ab}	55.21^{abc}	52.89^{ab}	30.84^{ab}	----
Oleander 0.5%	86.10^{a}	78.43^{a}	69.39^{a}	69.15^{ab}	60.14^{ab}	50^{ab}	28.63^{bc}
Guava 2.0%	78.70^{a}	68.91^{ab}	68.05^{ab}	71.68^{ab}	58.59^{ab}	65.32^{a}	39.34^{b}
Guava 1.0%	60.89^{b}	65.45^{abc}	62.86^{ab}	57.80^{abc}	56.30^{ab}	54.95^{a}	17.65^{bc}
Guava 0.5%	44.28^{c}	45.94^{cd}	42.40^{b}	40.86^{bc}	40.92^{b}	18.71^{ab}	----

Means within columns followed by different letters are significantly different ($p < 0.05$).

Table 5. Impact of silver nitrate and some natural extracts on change in water loss (g/ 100g F.W./ 2days) of solidago cut spikes during 2019 and 2020 seasons.

Treatments	1st season						
	Shelf life (days)						
	3rd	5th	7th	9th	11th	13th	15th
Control	90.18^{a}	80.28^{a}	67.10^{a}	71.61^{a}	50.07^{abc}	----	----
Silver nitrate 10 ppm	77.75^{abc}	71.27^{abc}	68.09^{a}	74.88^{a}	74.14^{a}	79.84^{a}	----
Neem 2.0%	76.23^{abc}	73.23^{ab}	75.91^{a}	67.85^{ab}	72.25^{a}	72.18^{ab}	71.64^{a}
Neem 1.0%	60.75^{bc}	52.55^{bcd}	47.20^{b}	50.17^{bc}	47.11^{abc}	61.05^{abc}	21.69^{bc}
Neem 0.5%	52.92^{c}	55.03^{bcd}	47.42^{b}	43.05^{c}	49.95^{abc}	20.16^{def}	----
Oleander 2.0%	49.06^{c}	51.02^{cd}	47.62^{b}	56.65^{abc}	18.42^{c}	20.09^{def}	----
Oleander 1.0%	60.71^{bc}	56.42^{bcd}	50.64^{b}	43.66^{c}	36.37^{bc}	9.81^{ef}	----
Oleander 0.5%	90.11^{a}	77.43^{a}	72.77^{a}	66.28^{ab}	53.01^{ab}	50.41^{abcd}	46.71^{ab}
Guava 2.0%	82.68^{ab}	83.92^{a}	80.97^{a}	74.84^{a}	71.52^{a}	71.31^{ab}	43.75^{ab}
Guava 1.0%	58.65^{bc}	55.01^{bcd}	48.18^{b}	45.88^{c}	44.55^{abc}	40.93^{bcde}	----
Guava 0.5%	48.14^{c}	48.67^{d}	39.88^{b}	40.95^{c}	41.56^{abc}	39.23^{cde}	----
	2nd season						
Control	31.54^{d}	41.96^{c}	49.56^{a}	37.21^{b}	42.63^{bc}	26.43^{a}	----
Silver nitrate 10 ppm	65.14^{b}	66.84^{ab}	61.92^{a}	57.40^{ab}	85.55^{a}	68.95^{a}	----
Neem 2.0%	80.06^{a}	72.83^{a}	67.25^{a}	75.96^{a}	76.74^{ab}	71.33^{a}	70.83^{a}
Neem 1.0%	61.50^{b}	56.41^{abc}	47.50^{a}	53.00^{ab}	49.21^{bc}	35.12^{a}	32.22^{bc}
Neem 0.5%	45.13^{c}	46.37^{bc}	41.06^{a}	40.27^{b}	43.70^{bc}	----	----
Oleander 2.0%	45.04^{c}	45.88^{bc}	56.16^{a}	61.91^{ab}	39.96^{bc}	20.83^{a}	----
Oleander 1.0%	68.18^{b}	66.41^{ab}	59.61^{a}	54.09^{ab}	52.41^{abc}	32.58^{a}	----
Oleander 0.5%	85.62^{a}	77.72^{a}	66.94^{a}	66.61^{ab}	56.60^{abc}	45.46^{a}	24.84^{bc}
Guava 2.0%	77.91^{a}	66.36^{ab}	64.90^{a}	69.17^{ab}	54.10^{abc}	62.20^{a}	37.20^{b}
Guava 1.0%	59.81^{b}	63.79^{abc}	61.08^{a}	54.85^{ab}	52.42^{abc}	52.61^{a}	16.79^{bc}
Guava 0.5%	42.78^{c}	44.10^{bc}	38.96^{a}	37.03^{b}	37.10^{c}	37.02^{a}	----

Means within columns followed by different letters are significantly different ($p<0.05$).

Change in water balance g/100g F.W./ 2days:

The results presented in Table (6) showed that cut spikes held in most of natural extracts solutions understudy maintained higher water balance values compared with the control until the thirteenth days in both seasons. Moreover, cut spikes held in preservative solution with 10 ppm silver nitrate showed higher values in water balance until the ninth and seventh days, in both seasons, respectively, then started to decline thereafter.

2- Impact of silver nitrate and some natural extracts on postharvest chemical analysis:

chlorophyll a, b and total (mg/g F.W.):

Data in Table (7) revealed that leaves of solidago cut spikes held in any natural extract's concentration or 10 ppm of silver nitrate significantly gave higher values for chlorophylls pigments compared with the control in both seasons. In this regard, solidago cut spikes which held in preservative solution fortified with 2.0% neem extract or 2.0% guava extract gave the maximum values of chl. a, chl. b and total chlorophylls as (0.645, 0.398 and 1.043 mg/g F.W.) and (0.637, 0.401 and 1.038 mg/g F.W.), generally in both seasons, respectively. In addition, preservative solution fortified with 2.0% oleander extract also recorded higher values without significant differences and the previous superior treatments. Moreover, the lowest values of chl. a, chl. b and total recorded for the control (0.360, 0.221 and 0.581 mg/g F.W.) and (0.330, 0.208 and 0.538 mg/g F.W.), in both seasons, respectively.

Table 6. Impact of silver nitrate and some natural extracts on change in water balance (g/100g F.W./2days) of solidago cut spikes during 2019 and 2020 seasons.

Treatments	1st season						
	Shelf life (days)						
	3rd	5th	7th	9th	11th	13th	15th
Control	-1.17^{a}	-1.46^{d}	-3.23^{d}	-9.06^{c}	-6.65^{d}	----	----
Silver nitrate 10 ppm	0.76^{a}	1.23^{abc}	-0.01^{c}	-1.86^{b}	-4.39^{cd}	-7.30^{c}	----
Neem 2.0%	0.85^{a}	1.19^{abc}	1.27^{bc}	2.34^{a}	1.49^{ab}	1.22^{ab}	0.75^{b}
Neem 1.0%	1.76^{a}	3.01^{a}	4.45^{a}	4.16^{a}	3.35^{ab}	-0.35^{b}	-0.86^{c}
Neem 0.5%	1.34^{a}	0.44^{bcd}	1.26^{bc}	2.78^{a}	0.57^{ab}	-1.11^{b}	----
Oleander 2.0%	-0.05^{a}	2.46^{ab}	1.81^{abc}	0.74^{ab}	-0.88^{bc}	-0.79^{b}	----
Oleander 1.0%	1.19^{a}	1.07^{abc}	1.89^{abc}	2.75^{a}	3.88^{a}	1.30^{ab}	----
Oleander 0.5%	0.33^{a}	1.37^{abc}	1.98^{abc}	2.74^{a}	4.48^{a}	4.16^{a}	4.08^{a}
Guava 2.0%	0.43^{a}	0.45^{bcd}	0.64^{bc}	1.42^{ab}	1.71^{ab}	1.66^{ab}	1.11^{b}
Guava 1.0%	0.77^{a}	-0.06^{cd}	1.88^{abc}	3.60^{a}	3.70^{a}	2.24^{ab}	----
Guava 0.5%	1.42^{a}	2.12^{abc}	3.05^{ab}	3.62^{a}	3.61^{ab}	1.70^{ab}	----
	2nd season						
Control	-0.12^{c}	-1.62^{a}	-7.24^{b}	-3.69^{c}	-11.52^{c}	-4.21^{ab}	----
Silver nitrate 10 ppm	3.55^{a}	1.94^{a}	0.34^{a}	-2.65^{bc}	-2.79^{b}	-2.28^{ab}	----
Neem 2.0%	0.71^{bc}	1.00^{a}	2.26^{a}	0.35^{abc}	0.09^{ab}	1.34^{a}	3.54^{a}
Neem 1.0%	1.75^{abc}	2.24^{a}	3.72^{a}	3.17^{a}	5.98^{a}	0.86^{a}	3.19^{a}
Neem 0.5%	2.43^{ab}	2.35^{a}	1.90^{a}	2.57^{a}	1.03^{ab}	----	----
Oleander 2.0%	1.79^{abc}	1.37^{a}	1.44^{a}	1.10^{ab}	1.10^{ab}	-20.83^{b}	----
Oleander 1.0%	1.32^{bc}	0.76^{a}	1.04^{a}	1.12^{ab}	0.47^{ab}	-1.75^{ab}	----
Oleander 0.5%	0.48^{bc}	0.71^{a}	2.44^{a}	2.54^{a}	3.55^{ab}	4.55^{a}	3.79^{a}
Guava 2.0%	0.79^{bc}	2.54^{a}	3.16^{a}	2.51^{a}	4.49^{ab}	3.12^{a}	2.14^{ab}
Guava 1.0%	1.08^{bc}	1.66^{a}	1.78^{a}	2.96^{a}	3.88^{ab}	2.33^{a}	0.86^{ab}
Guava 0.5%	1.51^{abc}	1.83^{a}	3.43^{a}	3.82^{a}	3.81^{ab}	1.68^{a}	----

Means within columns followed by different letters are significantly different ($p < 0.05$).

Table 7. Impact of silver nitrate and some natural extracts on chlorophyll a, b and total (mg/g F.W.) of solidago cut spikes during 2019 and 2020 seasons.

Treatments	Chlorophyll (mg/g F.W.)					
	1st season			2nd season		
	Chl. a	Chl. b	Total Chl.	Chl. a	Chl. b	Total Chl.
Control	0.360^{f}	0.221^{g}	0.581^{f}	0.330^{e}	0.208^{e}	0.538^{f}
Silver nitrate 10 ppm	0.562^{cd}	0.349^{c}	0.911^{cd}	0.557^{bc}	0.340^{b}	0.897^{c}
Neem 2.0%	0.645^{a}	0.398^{ab}	1.043^{a}	0.629^{a}	0.405^{a}	1.035^{a}
Neem 1.0%	0.593^{bc}	0.366^{bc}	0.959^{b}	0.592^{b}	0.382^{a}	0.974^{b}
Neem 0.5%	0.547^{de}	0.331^{cde}	0.878^{d}	0.535^{cd}	0.308^{c}	0.843^{d}
Oleander 2.0%	0.615^{ab}	0.338^{cd}	0.953^{bc}	0.637^{a}	0.390^{a}	1.027^{a}
Oleander 1.0%	0.584^{bc}	0.297^{ef}	0.881^{d}	0.591^{b}	0.299^{c}	0.890^{c}
Oleander 0.5%	0.529^{e}	0.282^{f}	0.810^{e}	0.507^{d}	0.269^{d}	0.776^{e}
Guava 2.0%	0.637^{a}	0.401^{a}	1.038^{a}	0.644^{a}	0.397^{a}	1.041^{a}
Guava 1.0%	0.582^{c}	0.339^{cd}	0.921^{bcd}	0.585^{b}	0.344^{b}	0.928^{c}
Guava 0.5%	0.523^{e}	0.309^{def}	0.831^{e}	0.523^{cd}	0.314^{bc}	0.837^{d}

Means within columns followed by different letters are significantly different ($p < 0.05$).

Carotenoids content (mg/g F.W.):

As regard to the effect of natural extracts and silver nitrate on carotenoids content (mg/g F.W.) in solidago cut spikes, data presented in Table (8) cleared that the highest values of carotenoids content (0.204 and 0.203 mg/g F.W.), in both seasons, respectively resulted from cut spikes held in preservative solution fortified with guava extract 2.0%, followed by spikes held in preservative solutions supplemented with neem extract 2.0% (0.194 mg/g F.W.). Followed by silver nitrate 10 ppm (0.186 mg/g F.W.) in 1st season, whereas treatment of 10 ppm silver nitrate (0.190 mg/g F.W.), 1.0% of guava extract as well as 2.0% of neem extract gave higher values in that respect during the second season (0.183 and 0.182 mg/g F.W.), respectively comparing to most of the other treatments. Moreover, the lowest values recorded from the control (0.136 and 0.140 mg/g F.W.) in both seasons, respectively.

Table 8. Impact of silver nitrate and some natural extracts on total carotenoids (mg/g F.W.) of solidago cut spikes during 2019 and 2020 seasons.

Treatments	Total carotenoids (mg/g F.W.)	
	1st season	2nd season
Control	0.136^{f}	0.140^{e}
Silver nitrate 10 ppm	0.186^{bc}	0.190^{ab}
Neem 2.0%	0.194^{ab}	0.182^{bc}
Neem 1.0%	0.177^{bcd}	0.168^{cd}
Neem 0.5%	0.153^{e}	0.156^{de}
Oleander 2.0%	0.179^{bcd}	0.168^{cd}
Oleander 1.0%	0.165^{de}	0.167^{cd}
Oleander 0.5%	0.149^{ef}	0.149^{de}
Guava 2.0%	0.204^{a}	0.203^{a}
Guava 1.0%	0.175^{cd}	0.183^{bc}
Guava 0.5%	0.154^{e}	0.155^{de}

Means within columns followed by different letters are significantly different ($p < 0.05$).

Total sugar %:

Concerning total sugars under effects of holding preservative solutions, Data in Table (9) showed that using most concentrations of natural extracts increased the total sugars percentage in dried leaves of solidago cut spikes when compared with control and silver nitrate 10 ppm in the two seasons. Where, cut spikes held in preservative solutions containing 2.0% guava extracts had significantly an increasing effect compared with other treatments in the 1st season, as (18.45%). While, using preservative solution contained 2.0% neem extract recorded the highest value as (17.56%) in the second season. The least values (12.98 and 13.40 %) resulted from the control treatment in both seasons, respectively.

Table 9. Impact of silver nitrate and some natural extracts on total sugar percentage of solidago cut spikes during 2019 and 2020 seasons.

Treatments	Total sugar (%)	
	1st season	2nd season
Control	12.98^{f}	13.40^{f}
Silver nitrate 10 ppm	13.95^{ef}	14.32^{ef}
Neem 2.0%	17.17^{b}	17.56^{a}
Neem 1.0%	16.09^{c}	17.20^{ab}
Neem 0.5%	15.12^{cd}	16.34^{bc}
Oleander 2.0%	15.63^{c}	16.72^{abc}
Oleander 1.0%	15.47^{cd}	15.05^{de}
Oleander 0.5%	13.45^{ef}	13.95^{ef}
Guava 2.0%	18.45^{a}	17.23^{ab}
Guava 1.0%	17.24^{b}	15.94^{cd}
Guava 0.5%	14.37^{de}	14.99^{de}

Means within columns followed by different letters are significantly different ($p < 0.05$).

N, P and K percentages:

The N, P and K percentages in dried leaves of solidago cut spikes in the first season is presented in **Table (10)**. It can be noticed that there were statistically significant differences in N, P and K percentages in leaves of solidago spikes held in preservative solutions fortified with 2.0% guava leaf extract highly recorded N, P and K % as (3.73% N), (0.79 %P) and (3.63 % K), followed by 2.0% neem extract (3.62% N), (0.78% P) and (3.55% K). Also, the treatments of 10 ppm silver nitrate gave a higher value of N% (3.67%) and K % (3.54%) compared with the control. Moreover, the lowest values of N, P and K % in solidago cut spikes (3.07% N), (0.71%P) and (3.02% K) resulted from the control.

Table 10. Impact of silver nitrate and some natural extracts on N, P and K percentage of solidago cut spikes during 2019 season.

Treatments	1st season		
	N (%)	P (%)	K (%)
Control	3.07^{h}	0.71^{h}	3.02^{g}
Silver nitrate 10 ppm	3.67^{b}	0.72^{g}	3.54^{b}
Neem 2.0%	3.62^{b}	0.78^{b}	3.55^{b}
Neem 1.0%	3.41^{d}	0.77^{c}	3.35^{d}
Neem 0.5%	3.18^{g}	0.74^{e}	3.13^{f}
Oleander 2.0%	3.46^{d}	0.75^{d}	3.39^{d}
Oleander 1.0%	3.33^{e}	0.74^{ef}	3.26^{e}
Oleander 0.5%	3.12^{h}	0.71^{h}	3.07^{fg}
Guava 2.0%	3.73^{a}	0.79^{a}	3.63^{a}
Guava 1.0%	3.55^{c}	0.76^{d}	3.45^{c}
Guava 0.5%	3.26^{f}	0.73^{f}	3.22^{e}

Means within columns followed by different letters are significantly different ($p < 0.05$).

3- Impact of silver nitrate and some natural extracts on microbial growth:

The results tabulated in Table (11) revealed that using distilled water as holding solution were contained the maximum average of bacterial count (3540.00 × 10^2cfu/ml and 2880.00 × 10^2cfu/ml) in both seasons, respectively compared to the holding solutions containing 10 ppm silver nitrate or all extracts of neem, oleander and guava after three days from holding the cut spikes in the preservative solutions. In holding solution containing oleander extract 2.0% recorded zero bacterial count in both seasons as well as neem extract 2.0% in 2nd season. While, holding solutions containing oleander extract 0.5% or guava extract 0.5% had higher average (36.00× 10^2cfu/ml and 29.00× 10^2cfu/ml) (29.9 × 10^2cfu/ml and 25.3 × 10^2cfu/ml) of bacterial count compared with silver nitrate and all concentrations of other extracts in both seasons, respectively. Moreover, other treatments gave results that are somewhat close to each other in this studied characteristic.

Table 11. Impact of silver nitrate and some natural extracts on total bacterial counts (cfu/ml) of solidago cut spikes during 2019 and 2020 seasons.

Treatments	Total bacterial counts (cfu/ml x10^2)	
	1st season	2nd season
Control	3540.00	2880.00
Silver nitrate 10 ppm	0.02	0.01
Neem 2.0%	0.02	0.00
Neem 1.0%	0.03	0.02
Neem 0.5%	0.60	0.40
Oleander 2.0%	0.00	0.00
Oleander 1.0%	1.75	2.32
Oleander 0.5%	36.00	29.00
Guava 2.0%	0.70	0.50
Guava 1.0%	1.30	0.90
Guava 0.5	29.90	25.30

Discussion

Most preservative solutions contain carbohydrates, germicides, ethylene inhibitors, growth regulators, and some mineral compounds. Vase life termination for most cut flowers is portrayed by wilting. The longevity of cut flowers is impacted by water uptake, water loss and balance amidst these two processes. The importance of plant extracts is highly recognized as botanical pesticides in the field of agriculture because they are cheap, safe and sound, hazardless, non-residual, and highly effective against various insect pests Yousufzai *et al.* (2015).The major objective of this present investigation was to evaluate effects of some natural extracts from plant origin as additives to preservative solutions of cut solidago spikes, promptly accessible, costly low, safer, environment friendly, biodegradable, and effective to extend solidago vase life and postharvest quality. Obviously, preservative solutions with source of carbohydrates and a fitting antimicrobial created the longest vase life for solidago cut spikes.

There are numerous elements associated with fruitful presentation of a new material. Our preliminary findings indicate that the tested natural extracts gave good results in most characteristics studied on solidago cut spikes during shelf life. Overall, all extracts concentrations that were applied led to an improvement in vase life, fresh weight, water relations and cut spikes quality during shelf life in both seasons comparing to the control. Mean comparison showed that the highest vase life, maximum increase in fresh weight and water relations in solidagos was found in the following concentrations: 2.0 % neem extract, 0.5% oleander extract and 2.0% guava extract comparing to the control.

This investigation proposed that the holding application of these preservative solutions was insufficient to permit adequate microbial development to blockage of xylem vessels, although permitted take-up of the nutrients and carbohydrates, hence extending the vase life and maintained water relations compared to distilled water. In this regard, Elaigwu *et al.* (2019) showed that ethanolic extracts of *Azadirachta indica* has constituents that have been severally reported to have antioxidant properties including phytol and palmitic acid and other important phytochemicals. In the same trend Bokhari *et al.* (2014) reported that neem (*A. indica* L.) leaf and fruit extracts of aqueous, methanol, n-hexane and chloroform exhibited the highest inhibitory effect against the growth of the fungal pathogen followed by stembark. Moreover, Pandey *et al.* (2014) suggested that leaves of *A. indica* possess significant antioxidant and antibacterial properties and contain phytoconstituents that may contribute to its medicinal properties. Similarly, Biswas *et al.* (2013) suggested that guava leaves possess compounds containing antibacterial properties that can effectively suppress the growth when extracted using methanol or ethanol as solvents. Also, Ali *et al.* (2020) found that the aqueous extract of the guava leaves showed inhibitory activity against the gram-negative bacteria and the methanolic extract showed greatest bacterial inhibition. In addition, Kakade and Thorat (2017) found that the ethanolic leaf extract of *Nerium oleander* has antibacterial activity against bacterial strains i.e., *E. coli*, *P. aeruginosa*, *S. aureus* and shows more effectiveness than that of standard ciprofloxacin, they confirm that the oleander leaves and roots have several active ingredients with glycosides, steroids and other compounds. The phytoconstituents i.e., alkaloids, glycosides, flavonoids and saponins are antibiotic principles of plants and these antibiotic principles are the defensive mechanism of the plants against different pathogens Hafiza (2000). All the above confirms what we have reached through microbiological analysis of the bacterial count of 1 ml of preservatives solutions fortified by the different concentrations from extracts under study after 3 days of holding the cut spikes, which had a great effect in reducing total plate count (cfu/ml) compared to the control.

Ordinary physiological case of plant need possesses water balance; higher transpiration of plant consistently leads to water loss from plant cell. It must be necessary to maintain water balance to support physiological metabolism for keeping quality of cut flowers. Interestingly, vase solutions with effective mentioned concentrates of extracts used until termination had high values of water loss but did not accelerate the senescence rate. These results might be due to the high-water uptake and the high levels of carbohydrates and components available in these solutions, in addition to what has been monitored from the results of Ramadass and Subramanian (2018) whose revealed that *A. indica* ethanolic leaf extract contain several phytochemicals such as alkaloids, tannins, phenolic compounds, flavonoids, terpenoids, steroids, saponins, glycoside and reducing sugar). Besides, Chetwani *et al.*(2017) whose reported that oleander leaves are the important part of this plant, which is rich in bioactive compounds such as glycoside, oleandrin, flavonoid, tannin, neriin, phytosterin and l-strophnathin, rosaginin and nerlin, volatile oil, fixed oil, neriodorin and neriodorein). Moreover, Biswas *et al*. (2013) revealed that methanolic or ethanolic guava leaves extracts contained several phytochemical constituents (glycosides, terpenoids, flavonoids, phenols and tannins), We can expect that a combination of this components and phenolic compounds found in *A. indica* or *N. oleander* and *P. guajava* should give confidence to the use of this plant as suitable antioxidant and antibacterial. Also, the chemical analysis of these extracts (Table 1) cleared that it contains (nitrogen, phosphorous, and potassium as well as total sugars). As the results obtained from the dried leaves of cut spikes preserved in solutions with neem extract (2.0%, 1.0% and 0.5%), guava extract (2.0%, 1.0% and 0.5%) or oleander extract (2.0% and 1.0%) showed higher values for the contents of the same components compared to the control. Our findings can be strengthened based on what has been explained by Ahmad *et al.* (2014) whose revealed that cut flowers of tulip '*Tulipa gesneriana* L.' held in a vase preservative solution containing (75 ml/L humic acid + 10 g/L NPK) had the highest values for quality parameters like scape length, tepal diameter, water uptake, fresh weight and minimum stem curvature percentage as compared to control (distilled water). Moreover, Rahman *et al*. (2019) reported that the preservative solutions of double combination of *Psidium guajava and Andrographis paniculata* leaf extracts escorted 5 mg/L Ag-NPs gave high values of water uptake and meager amounts of bacterial suspension, which were mean reason for extending of ‘Mokara Red’ orchid cut flowers vase life compared to the 8-HQC control treatment. Also, Rahman *et al.*(2012), showed that carnation cut flowers held in a vase solution containing sprite, leaf extracts of *P. guajava* and 8-HQC, or a copper coin) had longer vase life and a higher rate of water uptake compared to control (tap water). In addition, Rahman *et al.*(2013) suggested that leaf extracts of *Jatropha curcas* in combination with *Psidium guajava* has the potential to extend the vase life of the ‘Mokara Red’ orchid flowers because of minimizing the microbial populations in cut flower preservative solution. Moreover, our results showed that cut spikes held with 2.0 % neem extract or 2.0% guava extract or 2.0% oleander extract gave the maximum content of pigments specially chl. a, b and total chlorophyll in leaves. Also, cut spikes held with 1.0% of neem, guava or oleander and 0.5% of neem, guava or oleander extracts gave high values of chlorophylls content compared to the control. Also, 2.0%, 1.0% concentrations of neem, guava or oleander extracts gave high values from carotenoids content comparing with control. Our findings harmonize with Murthy *et al*. (2015) whose revealed that using the vase solution of neem extract at 1% coupled with 4% sucrose significantly improved vase life of cut gerbera cv. Savannah., maintained water relations, gave the highest anthocyanin content in ligules, and recorded lowest microbial count comparing to the control treatment.

CONCLUSION

Depending on what previously are mentioned, this study showed that the better treatments that gave significant affects in most studied characteristics was addition of 0.5% oleander leaf extract, 2.0 % neem leaf extract or 2.0% guava leaf extract individually with 2.0% sucrose as holding solutions for extending the vase life of solidago cut spikes and keeping quality. Besides, these natural extracts are very cheap and biodegradable environmentally friendly.

REFERENCES

Ahmad, A.; R. S. Ur Rehman; R. Hussain; S. Raza.; M. Sarwar; M. A. Bashir and M. A. Khan (2014). Enhancing the vase life of tulip (*Tulipa gesneriana* L.) using various pulsing solutions of humic acid and NPK. International Journal of Plant, Animal and Environmental Sciences. 4(2):193-200.

Ahmad, I.; M. Saleem; J. M. Dole and A. G. Matthysse (2016). Bio-control activity of bacterial strains on postharvest performance of gladiolus hybrids 'Mammoth'. Pakistan Journal of Agriculture Sciences. 53(3): 593-598.

Ali, M. A.; W. T. Mohammed; A. M. Abd El-Rahim; Y. M. Hassan and I. Kahwa (2020). Antimicrobial activities of leaf extracts of both guava *(Psidium guajava)* and kafour *(Eucalyptus camaldulensis)* against *Escherichia coli*. Journal of Pharmacognosy and Phytochemistry. 9(2):1935-1939.

American Public Health Association. (1984). Compendium of methods for the microbiological examination of foods, 2nd ed. APHA, Washington, DC.

Asif, M. (2012). Antimicrobial potential of *Azadirachta Indica* against pathogenic bacteria and fungi. Journal of Pharmacognosy and Phytochemistry. 1(4): 78–83

Biswas, B.; K. Rogers; F. McLaughlin; D. Daniels and A. Yadav (2013). Antimicrobial activities of leaf extracts of guava (*Psidium guajava* L.) on two gram-negative and gram-positive bacteria. International journal of Microbiology. 13,1-7.

Bokhari, N. A.; I. Siddiqui; K. Perveen; I. Siddique; M. S. Alwahibi; D. W. Soliman; and M. Al-Subeie (2014). Potential of different parts of neem (*Azadirachta indica*) extracts in controlling *Rhizoctonia solani* infestation. International Journal of Agriculture and Biology. 16(3):639-643.

Carrillo-López, L. M.; A. M. González and A. M. González (2016). Biosynthesized silver nanoparticles used in preservative solutions for chrysanthemum cv. Puma. Journal of Nanomaterials. 16,1-10.

Chapman, H. D. and P. F. Pratt (1978). Methods of analysis for soils, plants and waters, 309 p., Division of Agric. Sci., Univ. California, Berkeley, USA.

Chetwani, K.; R. K. Agnihotri and P. Chaturvedi (2017). Aqueous, acetone and ethanolic extract of *Nerium indicum* L. as potential antibacterial agent against *Pseudomonosa aeruginosa*. International Journal of Applied Environmental Sciences. 12(9):1721-1732.

Costat, (1986). Software program for the design and analysis of agronomic research experiments. Chort.

Dubois, M.; K. A. Gilles; J. K. Hamilton; P. A. Rebers and F. Smith (1956). Colorimetric method for determination of sugars and related substances. Analytical Chemistry. 28(3):350-356.

Elaigwu, E. D.; O. A. Ogo; E. Efiongand G. Oche (2019). Effects of ethanolic leaf extracts of neem (*Azadirachta indica*) on oxidative stability of palm oil. Research Journal of Phytochemistry. 13(1):1-10.

Elgimabi, M. E. N. E. (2011). Vase life extension of rose cut flowers (*Rosa hybrida*) as influenced by silver nitrate and sucrose pulsing. American Journal of Agricultural and Biological Sciences. 6(1):128-133.

Ghale-Shahi, G. Z; M. Babarabie; H. Zarei and A. Danyaei (2015). Investigating the potential of increasing the vase life of cut flower of Narcissus by using sour orange fruit extract and sucrose in the storage conditions. Journal of Ornamental Plants. 5(1):21-28.

Hadizadeh, I.; B. Peivastegan and M. Kolahi (2009). Antifungal activity of Nettle (*Urtica dioica* L.) Colocynth (*Citrullus colocynthis* L. Schrad) oleander (*Nerium oleander* L.) and Konar (*Ziziphus spina-christi* L.) Extracts of plants pathogenic fungi. Pakistan Journal of Biological Science. 12(1):58-63.

Hafiza, R.E. (2000). Peptides antibiotics. Lancet. 349, 418-422.

Hassan, F.; T. Tar and Z. Dorogi (2003). Extending the vase life of *Solidago canadensis* cut flowers by using different chemical treatments. International Journal of Horticultural Science. 9(2):83-86.

Hatamzadeh, A.; S. Rezvanypour and M. H. Asil (2012). Postharvest life of alstroemeria cut flowers is extended by thidiazuron and benzyl adenine. South Western Journal of Horticulture, Biology and Environment. 3(1):41-53.

He, S.; D. C. Joyce; D. E. Irving and J. D. Faraghar (2006). Stem end blockage in cut grevillea 'crimson Yul-10' inflorescences. Postharvest Biology and Technology. 41(1):78-84.

Jackson, M. L. (1967). Soil chemical analysis. Prentica Hall Inc, Engleweed Cliffs, N. J (C.F. computer Search).

Kakade, H. R. and S. R. Thorat (2017). Studies on *Nerium oleander* leaf extract for antimicrobial activity from soil microfauna in faizpur area of North Maharashtra region (M.Sc.) India. Biological Science. 7(5): 79-96.

Mahmoud, D. A.; M. N. Hassanein; A. K. Youssef and A. M. Abou Zeid (2011). Antifungal activity of different neem leaf extracts and the nimonol against some important human pathogens. Brazilian Journal of Microbiology. 42(3): 1007–1016

Morisaki, N.; S. Watanab; M. Tezeka; M. Zenikaya; R. Shina; N. Koyema; T. Kanzaki and Y. Saitto (1995). Mechanism of angiogenic effects of saponin from *Ginseng Radix rubra* in human umbilical vein: Endothelial cells. British Journal of Pharmacology. 115(7): 1188-1193.

Murthy, K. C.; P. Prashanth and R. Chandrasekhar (2015). Extending the vase life of cut gerbera (*Gerbera jamesonii* Bolus ex. Hook) cv. Savannah by using locally available floral preservatives under ambient storage. International Journal of Bio-resource and Stress Management. 6(3):402-406.

Nelson, D. W. and L. E. Sommers (1980). Total nitrogen analysis of soil and plants tissues. Journal Association of Official Analytical Chemists. 63(4): 770-778.

Pandey, G.; K. K. Verma and M. Singh (2014). Evaluation of phytochemical, antibacterial and free radical scavenging properties of *Azadirachta indica* (Neem) leaves. International Journal of Pharmacy and Pharmaceutical Sciences. 6(2):444-447.

Phalisteen, S.; S. Ishaq; K. amardeep; J. Arif and S. Sami (2008). Evalution studies of some medicinal plant extracts and fungicides against *Alternaria solani*. African Journal of Clinical Experimental Microbiology. 9(1)19-25.

Rahman, M. M.; S. H. Ahmad and K. S. Lgu (2012). *Psidium guajava* and *Piper betle* leaf extracts prolong vase life of cut carnation (*Dianthus caryophyllus*) flowers. The Scientific World Journal. 12,1-9

Rahman, M. M.; S.H. Ahmad; M. T. M. Mohamed and M. Z. Ab Rahman (2019). Improving the vase life of cut Mokara red orchid flower using leaf extracts with silver nanoparticles. Proceedings of the National Academy of Sciences. Biological Sciences. 89(4):1343-1350.

Rahman, M.M.; S. H. Ahmad; M. T. M. Mohamed, and M. Z. Ab -Rahman (2013). Leaf extracts of *Jatropha curcas, Psidium guajava* and *Andrographis paniculata* control microbial population in the vase solution of cut 'Mokara Red' orchid flower. Acta Horticulturae. (1012):593-598.

Ramadass, N. and N. Subramanian (2018). Study of phytochemical screening of neem (*Azadirachta indica*). International Journal of Zoology Studies. 3(1): 209-212.

Reid, M. S. and C.Z. Jiang (2012). Postharvest biology and technology of cut flowers and potted. Horticultural Reviews. 40,1-54.

Snedecor, G. W. and W. G. Cochran (1968). Statistical methods. sixth edition. The Iowa State University. Press, Ames, Iowa, U.S.A.

Sumanta, N.; C. I. Haque; J. Nishika and R. Suprakash (2014). Spectrophotometric analysis of chlorophylls and carotenoids from commonly grown fern Species by using various extracting solvents. Research Journal of Chemical Sciences. 4(9):63-69.

Taha, L. S; F. E. M. El-Quesni; M. A. Darwish and E. A. El-Shereef (2015). Vase life of *Solidago canadensis* L. cut flowers as affected by some chemical preservatives. International Journal of Chem Tech Research. 8(9):204-212.

Yousufzai, M. S.; I. A. Rajput; T. A. Khuhro; M. A. Rustamani; B. Z. Yousufzai; A. Ali and S. A. Rasool (2015). Effect of plant extracts on nymphal development of jassid, *Amrasca devastans* dist. on sunflower under Laboratory Conditions. European Academic Research. 2(10):13872-13888.

العلاقات المائية وعمر وجودة الشماريخ الزهرية المقطوفة للسوليداجو كنتيجة لتأثرها ببعض المستخلصات الطبيعية بمحاليل التثبيت

محمود مكرم قاسم ،هشام هاشم عبد القادر و نرمين مجاهد البنهاوى
[1]قسم الخضر والزينة - كلية الزراعة – جامعة المنصورة- مصر

تعتبر الشماريخ الزهرية لنبات السوليداجو (*Solidago canadensis* L.) أحد أزهار القطف التجارية والتى تستخدم بأعمال التنسيق الداخلى وتنسيق الفازات والبوكيهات فى صورتها الطازجة أو الجافة. ولكن احد اهم المشاكل الرئيسية لتقليل عمر الازهار بعد القطف هو وجود الكائنات الدقيقة وخصوصا البكتريا بمحاليل الحفظ ، الأمر الذى يتسبب فى انسداد اوعية الخشب للشماريخ الزهرية وبالتالى عدم القدرة على امتصاص الماء ومكونات المحاليل وزيادة فقد الماء مما يؤدى الى موت الأزهار. من أجل التغلب على تلك المشكلة أجريت هذه الدراسة علي الشماريخ الزهرية المقطوفة لنبات السوليداجو بقسم الخضر والزينة - بكلية الزراعة- جامعة المنصورة - مصر. وذلك خلال الموسمين المعمليين المتتاليين 2019 و2020. بهدف دراسة العلاقات المائية وعمر وجودة الشماريخ الزهرية المقطوفة للسوليداجو كنتيجة لتأثرها ببعض المستخلصات الطبيعية.تمت التجربة بإضافة واحد من المستخلصات الكحولية لأوراق (النيم, الدفلة, الجوافة) بتركيزات 2.0٪,1.0٪,0.5٪ لكل مستخلص لمحاليل التثبيت بالإضافة لمعاملة نترات الفضة بتركيز 10 جزء بالمليون والمقارنة (الماء المقطر) كل معاملة على حده. وأضيف السكروز بتركيز 2.0٪ لجميع محاليل التثبيت. وكانت اهم الصفات المدروسة هى عمر الأزهار (باليوم)، التغير بالوزن الطازج (جرام/100جم وزن طازج/2يوم)، اقصى زيادة فى الوزن الطازج (٪)، الوزن الطازج النسبى (٪)، الماء الكلى الممتص (جرام للشمراخ الزهرى)، التغير بالماء الممتص (جرام/100جم وزن طازج/2 يوم)، التغير بالماء المفقود (جرام/100جم وزن طازج/2 يوم)، التغير بالإتزان المائى (جرام/100جم وزن طازج/2 يوم)، محتوى الكلوروفيل a ، b ،الكلى والكاروتينيدات، والنسبة المئوية للسكريات الكلية، والنيتروجين والفوسفور والبوتاسيوم وكذلك العد البكتيرى (cfu/ml).أظهرت النتائج أن معظم التركيزات المختبرة للمستخلصات الطبيعية أعطت نتائج تفوقت في كثير من الأحيان على المقارنة وكذلك معاملة نترات الفضة، خاصة فيما يتعلق بكل من (عمر المزهرية ، الوزن الطازج، الامتصاص، الاتزان المائي، محتوي الكلوروفيل، محتوي NPK ،السكريات الكلية). بالإضافة إلى تفوقها ايضا في تثبيط تعداد البكتيريا في محاليل الزهرية عن المقارنة.حيث اظهرت معاملة مستخلصات أوراق الدفلة بنسبة 0.5٪ والنيم بنسبة 2.0٪ والجوافة بنسبة 2.0٪ لكل منها على حدة مع 2.0٪ سكروز اطول عمر للشماريخ الزهرية المقطوفة لنبات السوليداجو وافضل اتزان مائي بالاضافة الي اقل عدد بكتيرى بمحاليل الحفظ.