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Prolonging the vase life of cut *Asparagus densiflorus* shoots by using some antibacterial preservative solutions

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ABSTRACT

The present study was done at Antoniades Research Branch, Horticulture Research Institute, A.R.C. Alexandria, Egypt, during the two successive seasons of 2018 and 2019. The bacterial studies were done at Ornamental, Medicinal and Aromatic Plant Diseases Research Department, Plant Pathology Research Institute**.** The aim of this work was to evaluate the ability to use citric acid at (100,200 and 300 ppm) , hydrogen peroxide (H_2O_2) at (5, 10 and 20 ppm) , 8-hydroxyquinoline sulphate (8-HQS) at (50,100 and 200 ppm) and tricloroisocyanuric acid (TICA) at (5, 10 and 20 ppm) as holding solution on reducing bacterial decay and prolonging the vase life of cut *Asparagus densiflorus* shoots. The highest significant increase in vase life was obtained after application of TICA at 5 ppm which was 15.78 and 15.56 days in the first and second season respectively while the vase life of control treatment was 7.11 and 7 days in both seasons respectively. Also this treatment recorded the highest significant increase in final water uptake, shoot fresh weight/ shoot dry weight ratio and chlorophyll a & b content. On the other hand, this treatment caused decrease in the loss of shoots fresh weight and the number of bacterial colonies.

KEYWORDS: *Asparagus densiflorus*, vase life, citric acid, hydrogen peroxide, 8-hydroxyquinoline sulphate and tricloroisocyanuric acid

1. INTRODUCTION

One of the important components of the floricultural industry is cut foliage. They are used widely as filler in flower arrangement and bouquet making. (Schlosser and Blatner,1997). The cut foliage commercial value is determining by the longevity of its vase life (Shabanian *et al.*, 2018)

Asparagus *densiflorus* is an interesting cut filler foliage for flower arrangements that belongs family Liliaceae. Its common name is Asparagus fern because of its finely divided foliage which is modified stems or branches. *A. densiflorus* 'Myers' "foxtail fern" is valuable for its linear cone-shaped stems. (Jane and Garaham, 1997)

Extension the vase life of cut flowers can be done by using flower preservative solutions, with both surfactant and antimicrobial effects, particularly in cases where flowers cannot be kept at low temperature during storage and transportation. Surfactants help to quickly rehydrate flowers because a reduction of the surface tension of water improves water uptake (Seyed *et al.*, 2012).

Bacterial growth in vase solution and stems of cut flowers lead to welting and water uptake problems (Van Doorn, 1997). Also, yeasts and filamentous fungi can lead to vascular blockage (Put and Clerkx, 1988).

Citric acid is one of the most widely and commercially acidifying agents which inhibit the generation of the bacteria through the stem (Nowak & Rudnicki, 1990). Citric acid is commercially advised for a number of cut flowers like chrysanthemum (Dole *et al.*, 1999) and (Rida *et al.*, 2016) on calla lily.

Hydrogen peroxide is a strong oxidizing and disinfectant agent and it has a positive effect on the vase life of cut rose "Candy" (Hamdollahi *et al.*,2014). Also, It has a powerful effect on controlling bacteria at the end of cut rose stems (Shadbash and Keshavarzshal , 2018)

8-hydroxyquinoline sulphate (8-HQS) may act as an antimicrobial agent and hence, reduce stem plugging and preventing the accumulation of microorganism in xylem vessels (Larsen and Cromarty, 1967).

Trichloroisocyanuric acid [1,3,5-trichloro-1,3,5-triazine-2,4,6-(1H,3H,5H)-trione], TICA is extensively used as bleaching agents, disinfectants, and bactericides due to their chlorinating and oxidizing properties. (Tilstam and Weinmann , 2002)

The aim of this work is to evaluate the ability to use different concentrations of citric acid, hydrogen peroxide (H_2O_2), 8-hydroxyquinoline sulphate (8-HQS) and triclolorisocyanuric acid (TICA) on reducing bacterial decay and pronging the vase life of cut *Asparagus densiflorus* shoots.

2. MATERIALS AND METHODS

The present study was done at Antoniades Research Branch, Horticulture Research Institute, during the two successive seasons of 2018 and 2019. The bacterial studies were done at Ornamental, Medicinal and Aromatic Plant Diseases Research Department, Plant Pathology Research Institute.

2.1. Source of the cut asparagus shoots:

Two years asparagus shoots were obtained from a well-known commercial nursery in Alexandria. On the 15th of October 2018 and 2019 (in the first and second seasons, respectively) shoots were transplanted to the laboratory under dry conditions, they were re-cut before treatments to the length of 50 cm.

2.2. The following treatment were applied

Thirteen treatments were applied in this experiment. Shoots were held in glass jars containing 275 ml of the following solutions. Sucrose at 20 g/ L was added to all solutions during the shelf life period.

- Tap water (control)
- Tricloroisocyanuric acid (TICA) at 5, 10 and 20 ppm
- Hydrogen peroxide (H_2O_2) at 5, 10 and 20 ppm
- Citric acid at 100, 200 and 300 ppm
- 8-hydroxyquinoline sulphate (8-HQS) at 50, 100 and 200 ppm.

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

2.3. Experimental layout and statistical analysis

The experimental layout was a completely randomized design (CRD). It consists of thirteen treatments with three replicates each replicate contains three shoots. The means of the individual factors were compared by Bayesian L.S.D. (B.L.S.D.) test at 5% level of probability. The data were statistically analyzed according to the method described by (Snedecor and Cochran ,1989).

2.4. Data were recorded as the following:

2.4.1. The postharvest characters:

2.4.1.1. Vase life (days):

Asparagus shoots were discarded when one-third of the foliage was brown or wilted. This stage was considered to be the end of potential useful longevity of the shoot (Safeena, 2013).

2.4.1.2. Loss of shoot fresh weight percentage (LSFW):

It was determined at the fading stage as the flowing formula

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

2.4.1.3. Final water uptake (g):

It was calculated at the end of the experiment as the following formula

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

2.4.1.4. Shoot fresh weight / Shoot dry weight ratio (SWR):

At the fading stage the shoots were oven dried at 75°c for 48 hours to get the shoots dry weight (S.D.W.) Then the fresh weight was divided by the dry weight as below.

$$\textbf{SWR} = \frac{\text{Fresh weight per shoot (g)}}{\text{Dry weight per shoot (g)}} \times 100$$

2.4.1.5. Relative fresh weight (RFW):

Fresh weight of the shoots was determined just before the immersion of the shoots into the solutions and collected every two days until the vase life of the shoots was terminated. The fresh weight of each shoot was expressed relative to the initial weight to represent the water status of the shoot

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

Where *Wt* is the weight of shoot (g) at 17th of October (2 days), 19th of October (4 days) and 21st of October (6 days).W0 is the initial fresh weight of the same shoot (g)

2.4.1.6. Vase Solution Uptake Rate:

The VSU rate was measured according to the formula below

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

Where (St) is weight of vase solution (g) at 17th of October (2 days), 19th of October (4 days) and 21st of October (6 days),(St-1) is weight of the vase solution (g) on the previous day and (IFW) is the initial fresh weight (g) .

2.4.2. Chemical analysis

2.4.2.1. Chlorophyll a and b content (mg/100 g fresh weight) was determined in leaves at according to Moran, (1982) and carotene (mg /100 g fresh weight) according to Wellburn (1994) and reducing sugars content (ppm) according to Miller (1959) at the end of the vase life of the control .

2.4.2.2. Number of bacterial colonies

Ten ml of vase solution of each treatment were collected after seven days of the experiment started. Three replicate for each treatment were used for

bacterial count detection. The number of total examined samples was thirty nine samples.

Serial of dilutions was done to the vase solution according to Reynolds (2015) method to get a solution of 10^{-5} fold dilution.

NA media preparation was done according to the method of Fung (2009) (1 liter Nutrient Agar: 1 liter distilled water, 20 g Agar, 5 g peptone, 3 g meat extract, autoclaved three times at 121° C and 1.5 pressure for 20 minutes).

One ml of each diluted sample was inoculated on a plate contains 10 ml of NA. The plates were incubated at 36°C ± 1 for one day The number of formed colonies of bacteria was counted and expressed as Colony Forming Units/ml (CFU/ml) (Jowkar *et al*., 2012)

2.4.2.3. Characterization and identification of bacteria

Bacteria was identified according to their morphological characteristics confirmed by Agricultural Laboratories Company (Agro Lab) Sadat City, Egypt according to the methods of Bartholomew (1962) , Staley *et al*.(1989) and Benson (2002).

3. RESULTS

3.1. The postharvest characters:

3.1.1. Vase life

Data in Table (1) showed that application of Trichloroisocyanuric acid (TICA) at 5 ppm in vase solution caused the highest significant vase life of asparagus shoots which was 15.78 days in the first season while in the second season application of TICA at 5 ppm and citric acid at 300 ppm caused the highest significant vase life which recorded (15.56 and 13.67), respectively. Moreover, the shortest vase life compared to control was obtained after the application of H_2O_2 at 20 ppm which recorded 6.04 days in both seasons.

3.1.2. Loss of shoots fresh weight (LSFW)

Results in Table (1) cleared that the lowest significant decrease in LSFW ratio was obtained after TICA at 5 ppm, the final fresh weight of this treatment was more than the initial fresh weight by (3.00% and 1.90 %) in the first and second season, respectively. On the other hand, the highest increase in LSFW was obtained after application of H_2O_2 at 20 ppm which recorded (32.20 % and 37.10 %) less than the initial fresh weight in both seasons.

3.1.3. Final water uptake (g/plant)

Table (1) indicated that using TICA at 5 ppm resulted in the highest increase in final water uptake which recorded (28.42 g and 29.32 g) in the first and second season respectively. Moreover, the same Table cleared that the smallest amount of water uptake was obtained after H_2O_2 at 20 ppm which was (8.22 g and 8.37g) in the first and second season, respectively.

3.1.4. Shoot fresh weight / shoot dry weight ratio (SWR) %

Table (1) showed that the highest increase in shoot fresh weight / shoot dry weight ratio was obtained after applying TICA at 5 ppm treatment in both seasons. This value was (361.43 % and 384,98%) in the first and second seasons, respectively. On the other hand, the treatment of H_2O_2 at 20 caused the smallest shoot fresh weight/ shoot dry weight ratio which was (294.77 % and 285.27%) in the first and second seasons, respectively.

3.1.5. Relative fresh weight (RFW) %

Data in Table (2) cleared that there was a significant difference after application of different treatments on RFW value after two, four and six days from the experiment start. The Table cleared that application of TICA at 5 ppm and citric acid at 300 ppm resulted in the highest RFW value after two, four and six days from the experiment start in the first and second season with the same level of significance. On the other hand application of H_2O_2 at 20 ppm recorded the smallest RFW after two, four and six days from the experiment start in both seasons.

3.1.6. Vase Solution Uptake Rate (VSU %):

Table (3) showed that there was a significant different after application of different treatments on VSU value after two, four and six days from the experiment start. On the 2nd day the highest significant VSU value was obtained after control , 8 HQS at 50 ppm , Citric acid at 200 ppm , Citric acid at 300 ppm and TICA at 50 ppm ,in the first season , while in the second season the highest significant value was obtained from control , 8 HQS at 50 ppm treatments , Citric acid at 100ppm, Citric acid at 200ppm , Citric acid 300 ppm and TICA at 5ppm . On the 4th day the highest significant increase in VSU was obtained after application of 8 HQS at 50 ppm in both seasons. On the 6th day the highest VSU value was recorded after application of 8 HQS at 50 ppm, 8 HQS at 100 ppm, TICA at 5 ppm, TICA at 10 ppm and citric acid at 200 ppm in both seasons. On contrary, the lowest significant VSU value was obtained after application of H_2O_2 at 20 ppm after two, four and six days from the experiment start in both seasons.

Table 1. Means of vase life (days), loss of shoot fresh weight (LSFW) (%), Final water uptake and shoot fresh weight/shoot dry weight ratio (SWR) of *Asparagus densiflorus* shoots as affected by different concentrations of some bacterial preservative solutions during 2018 and 2019 seasons.

Treatments	Vase life days		Loss of shoot fresh weight LSFW (%)		Final water uptake (g/plant)		Shoot fresh weight/Shoot dry weight ratio SWR (%)	
	2018	2019	2018	2019	2018	2019	2018	2019
Control	7.11 de	7.00 cd	25.6 ab	23.6 abc	19.18 bc	19.91 bc	296.05 bc	303.03 bc
TICA (5 ppm)	15.78 a	15.56 a	-3.00 c	-1.90 d	28.42 a	29.32 a	361.43 a	348.98 a
TICA (10 ppm)	7.72 de	8.59 cd	13.3 b	15.3 bc	12.66 cde	13.63 cde	330.83 ab	323.30 abc
TICA (20 ppm)	6.08 e	7.10 cd	19.1 ab	19.6 bc	11.14 de	10.14 de	319.61 abc	321.99 abc
H_2O_2 (5 ppm)	8.11 de	8.33 cd	18.5 ab	16.6 bc	16.08 bcd	17.14 bcd	321.69 ab	305.80 bc
H_2O_2 (10 ppm)	7.00 de	6.56 cd	23.5 ab	25.6 ab	15.86 bcde	13.71cde	274.65 c	284.57 bc
H_2O_2 (20 ppm)	6.04 e	6.04 d	32.2 a	37.1 a	8.22 e	8.37 e	294.77 bc	285.27 c
Citric acid (100 ppm)	9.21 cd	9.26 cd	20.5 ab	23.6 abc	8.29 de	10.25 de	333.61 ab	324.77 abc
Citric acid (200 ppm)	9.54 cd	9.67 cd	19.8 ab	21.7 abc	19.89 bc	17.79 bcd	291.17 bc	295.37 bc
Citric acid (300 ppm)	12.33 b	13.67 ab	10.9 b	8.4 c	15.26 bcde	15.60 bcde	336.11 ab	326.89 ab
8HQS (50 ppm)	11.56 bc	10.08 bc	11.2 b	10.8 bc	21.04 ab	21.73 ab	316.77 abc	317.87 abc
8HQS (100 ppm)	9.13 cd	9.27 cd	15.1 ab	13.7 bc	22.08 ab	16.50 bcd	319.76 abc	292.92 bc
8HQS (200 ppm)	9.25 cd	9.33 cd	15.1 ab	20.1 bc	15.05 bcde	15.45 bcde	319.76 abc	310.88 abc
B. L.S.D. at 0.05	2.58	3.99	17.32	15.97	7.79	7.85	45.88	41.70

Means of treatments in the column have the same letters, are not significantly different at 5% level.

Table 2. Means of Relative fresh weight (%), of *Asparagus densiflorus* shoots as affected by different concentrations of some bacterial preservative solutions during 2018 and 2019 seasons.

Treatments	Relative fresh weight (RFW) %					
	2018			2019		
	2nd day	4th day	6th day	2nd day	4th day	6th day
Control	103.59 ab	96.49 ab	85.85 bc	105.35 ab	100.62 ab	94.20 bc
TICA (5 ppm)	109.75 a	112.77 a	108.44 a	111.26 ab	112.37 a	112.03 a
TICA (10 ppm)	105.29 ab	102.12 ab	97.49 abc	101.95 abc	98.70 abc	93.53 bc
TICA (20 ppm)	101.43 ab	99.13 ab	90.73 abc	96.06 bc	94.03 bc	87.02 cd
H_2O_2 (5 ppm)	100.72 ab	96.08 ab	90.02 abc	101.25 abc	98.03 abc	92.46 bc
H_2O_2 (10 ppm)	98.66 ab	92.06 b	85.62 bc	96.75 bc	93.19 bc	87.50 cd
H_2O_2 (20 ppm)	92.26 b	88.70 b	81.02 c	89.05 c	84.29 c	75.61 d
Citric acid (100 ppm)	104.25 ab	97.21 ab	83.20 c	101.27 abc	96.05 bc	84.76 cd
Citric acid (200 ppm)	103.02 ab	99.21 ab	91.63 abc	100.73 abc	96.64 bc	88.13 cd
Citric acid (300 ppm)	112.72 a	112.00 a	104.42 ab	115.10 a	111.64 a	106.74 ab
8HQS (50 ppm)	106.71 ab	103.02 ab	95.53 abc	110.54 ab	106.59 ab	101.16 abc
8HQS (100 ppm)	107.83 ab	100.23 ab	90.24 abc	105.96 ab	101.53 ab	95.15 bc
8HQS (200 ppm)	105.63 ab	103.19 ab	97.07 abc	106.14 ab	100.76 ab	92.24 bc
B.L.S.D. at 0.05	16.49	18.05	20.79	15.80	14.51	16.64

Means of treatments in the column have the same letters, are not significantly different at 5% level.

3.2. Chemical analysis

3.2.1. Chlorophyll a, chlorophyll b and carotenoids content :

Data in Table (4) showed that there was a significant difference after applying different treatments on chlorophyll a, chlorophyll b and carotenoids content. The highest chlorophyll a, chlorophyll b and carotenoids content was obtained after applying TICA at 5 ppm., while control plants recorded the lowest chlorophyll a, chlorophyll b and carotenoids content in both seasons.

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Table 3. Means of Vase solution uptake rate (%) , of *Asparagus densiflorus* shoots as affected by different concentrations of some bacterial preservative solutions during 2018 and 2019 seasons .

Treatments	Vase solution uptake rate (VSU) %					
	2018			2019		
	2nd day	4th day	6th day	2nd day	4th day	6th day
Control	104.66 a	48.53 b	43.50 bcd	102.14 a	45.93 bcd	41.90 bc
TICA (5 ppm)	84.29 abcd	48.77 b	53.00 a	82.48 abc	46.63 bcd	52.93 a
TICA (10 ppm)	69.12 bcd	44.94 bc	47.57 abc	71.24 bcd	44.99 cde	46.84 ab
TICA (20 ppm)	55.91 d	34.01 ef	33.48 ef	56.45 de	32.71 h	32.38 de
H_2O_2 (5 ppm)	69.88 bcd	37.50 def	36.57 de	75.49 bcd	38.57 fg	38.25 cd
H_2O_2 (10 ppm)	63.08 cd	30.90 fg	34.32 def	62.86 cde	31.64 h	33.28 d
H_2O_2 (20 ppm)	48.66 e	25.22 g	26.81 f	46.84 e	24.49 i	25.82 e
Citric acid (100 ppm)	72.89 bcd	39.54 cde	36.76 de	81.70 abc	39.84 efg	36.71 cd
Citric acid (200 ppm)	83.51abcd	47.56 b	46.27 abc	88.56 ab	50.46 b	48.99 a
Citric acid (300 ppm)	87.57 abc	41.84 bcd	38.85 cde	91.12 ab	42.39 def	39.02 cd
8HQS (50 ppm)	94.65 ab	56.81 a	49.16 ab	95.32 ab	57.10 a	49.39 a
8HQS (100 ppm)	72.71 b	48.51 b	48.26 abc	74.73 bcd	48.79 bc	48.66 ab
8HQS (200 ppm)	60.37 cd	35.47 def	33.01 ef	58.94 cde	35.15 gh	32.61 de
B.L.S.D.$_{at\ 0.05}$	31.27	7.19	9.36	24.14	5.30	6.93

Means of treatments in the column have the same letters, are not significantly different at 5% level.

3.2.2. Reducing sugars content

Table (4) cleared that there was a significant difference after using different treatments on reducing sugars content and the highest reducing sugar content (218.77 and 226.38 ppm) in the first and second season respectively was obtained from using TICA at 5 ppm. While, the lowest reducing sugars content was obtained after using TICA at 20 ppm (120.82 ppm) in the first season and 8 HQS at 200 ppm (127.42 ppm) in the second one.

Table 4. Means of Chlorophyll a, Chlorophyll b, Carotenoids and reducing sugars of *Asparagus densiflorus* shoots as affected by different concentrations of some bacterial preservative solutions during 2018 and 2019 seasons .

Treatments	Chlorophyll a (mg/ 100g fresh weight)		Chlorophyll b (mg/ 100 g fresh weight)		Carotenoids (mg/ 100 g fresh weight)		Reducing sugars ppm	
	2018	2019	2018	2019	2018	2019	2018	2019
Control	17.97 f	16.58 f	5.69 e	5.29 f	5.41 f	4.63 f	125.22 e	130.72d
TICA (5 ppm)	44.31a	45.48 a	13.75 a	14.64 a	9.79 a	9.55 a	218.77 a	226.38 a
TICA (10 ppm)	26.44 e	26.19 de	8.44 d	8.21 cde	7.01 de	7.21cde	124.12 e	147.23 cd
TICA (20 ppm)	25.29 e	24.62 de	8.58 d	8.04 cde	6.89 de	6.63 de	120.82 e	134.03 d
H_2O_2 (5 ppm)	26.77 e	26.47 de	8.14 d	8.26 cde	7.04 de	6.89 de	208.34 b	216.81 a
H_2O_2 (10 ppm)	30.87 cd	29.67cde	10.21 c	10.22 bc	8.34 bc	8.34 b	190.22abc	194.32 ab
H_2O_2 (20 ppm)	23.25 e	22.06 e	8.43 d	7.62 de	6.51 e	6.39 e	170.35c d	157.14 bcd
Citric acid (100 ppm)	36.71 b	37.28 bc	10.12 c	10.05 bcd	8.22 bc	8.36 b	170.35 cd	150.53 cd
Citric acid (200 ppm)	32.67 c	30.78 cd	10.13 c	9.60 bcde	7.22 de	6.79 de	176.95bc d	176.95 abc
Citric acid (300 ppm)	41.91 a	41.17 ab	12.25 b	11.18 b	9.06 ab	8.46 b	188.77abc	186.83 abc
8HQS (50 ppm)	40.68 a	40.38 ab	11.51 b	10.79 b	8.80 b	8.22 bc	203.52 abc	213.11 a
8HQS (100 ppm)	31.62 c	32.27 cd	9.58 cd	9.64 bcde	7.60 cd	7.73 bc	140.63de	147.23 cd
8HQS (200 ppm)	27.02 de	26.70 de	7.71 d	7.36 ef	6.56 e	6.54 e	124.12 e	127.42 d
B.L.S.D.$_{at\ 0.05}$	3.88	7.99	1.00	2.43	0.86	1.06	38.48	41.50

Means of treatments in the column have the same letters, are not significantly different at 5% level.

3.2.3. Number of bacterial colonies

Data in Table (5) showed that there was a significant difference in the number of bacterial colonies after application of different treatments. Control treatment recorded the highest number of bacterial colonies. All treatments caused significant decrease in the number and the highest significant reduction in bacterial colonies number was obtained by application of H_2O_2 at 20 ppm which recorded (5.77 x $10^{5)}$ CFU/ml in the first season and the treatments H_2O_2 at 20 ppm (5.70 x 10^5 CFU/ml) and

Table 5. Means of number of bacterial colonies (CFU/ ml) in vase solution of *Asparagus densiflorus* as affected by different concentrations of some bacterial preservative solutions during 2018 and 2019 seasons .

Treatments	Number of bacterial colonies X 10^5 (CFU/ml)	
	2018	2019
Control	28.90 a	28.80 a
TICA (5 ppm)	6.63 g	6.60 h
TICA (10 ppm)	6.47 g	6.50 h
TICA (20 ppm)	5.87 h	5.83 i
H_2O_2 (5 ppm)asel	10.57 e	10.53 d
H_2O_2 (10 ppm)	7.03 g	7.57 g
H_2O_2 (20 ppm)	5.77 i	5.70 i
Citric acid (100 ppm)	9.90 e	9.87 e
Citric acid (200 ppm)	8.73 f	8.83 f
Citric acid (300 ppm)	6.90 g	7.03 g
8HQS (50 ppm)	18.63 b	19.00 b
8HQS (100 ppm)	14.20 c	13.90 c
8HQS (200 ppm)	13.47 d	13.50 c
B.L.S.D.$_{at\ 0.05}$	0.67	0.56

CFU/ml = Colony Forming Unit/ milliliter.

* Means followed with the same letter (s) are not significantly different at 5% level.

Control **TICA at 5 ppm**

Fig 1. Pattern of bacterial abundance in vase solution on NA media treated with TICA at 5 ppm as compared to the control (Tap water).

TICA at 20 ppm (5.83 x 105 CFU/ml) in the second one.

Although, the treatments TICA at 20 ppm and H_2O_2 at 20 ppm recorded the lowest significant number of bacterial colonies they recorded the lowest significant decrease in vase life (Table 1). Also , this Table cleared that the treatment TICA at 5 ppm caused the highest significant increase in vase life (15.78 and 15.56 days) in the first and second season ,respectively .This treatment caused a significant reduction in number of bacterial colonies (6.63 x 105 CFU/ml) and (6.60 x 105 CFU/ml) in the first and second seasons (Table 5) .

Figure (1) show the pattern of bacterial abundance in NA media treated with TICA at 5 ppm as compared to control plants.

3.2.4. Characterization and identification of bacteria

For the identification of bacterial type in vase solution Figure (2) illustrated that there were five identified dominant bacterial species after control and 8 HQS treatments, these species were (***Bacillus* Spp., *Desulfococcus* Spp., *Pseudomonas* Spp., *Streptococcus* Spp. and *Streptobacillus* Spp**,) ,all these species were identified after application of H_2O_2 treatments except ***Desulfococcus* Spp.** Moreover, there were four bacterial types identified

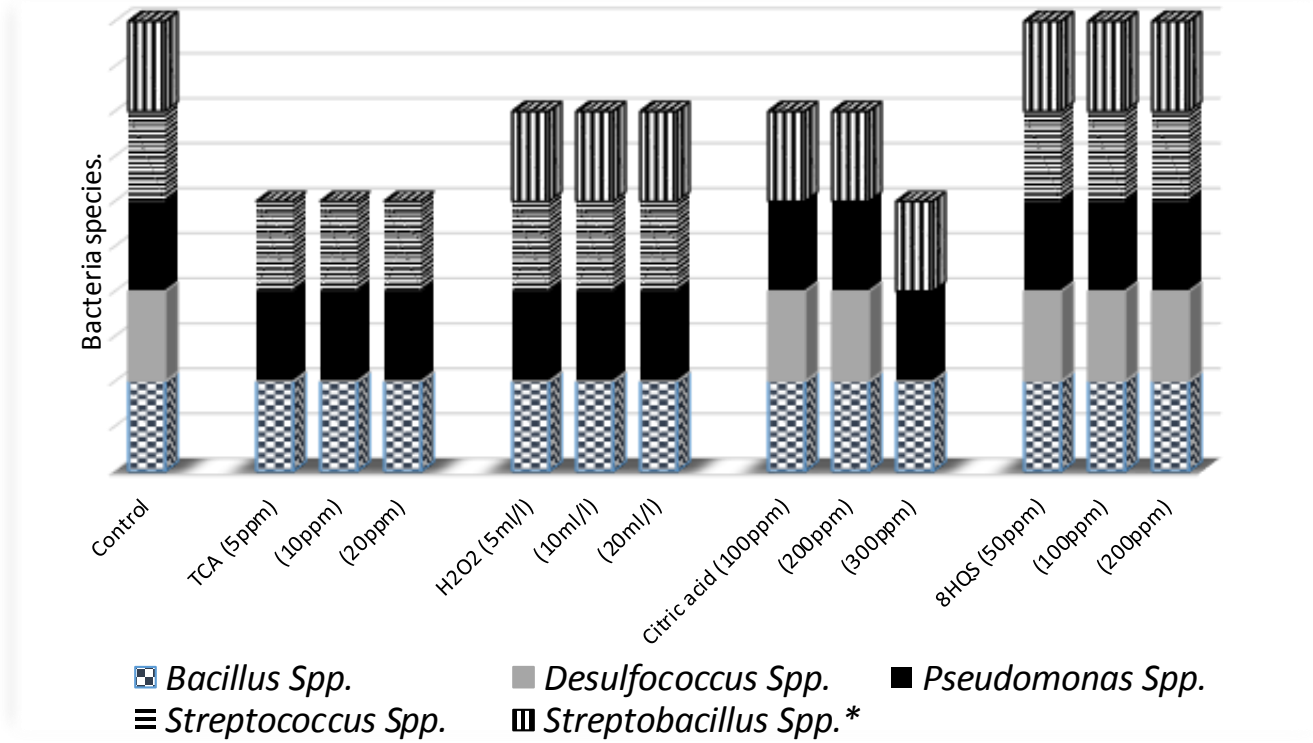

Fig 2. Type of bacteria isolated from preservative water collected from vase during the seasons of 2018 and 2019

*All detected Bacteria are Gram positive except Desulfococcus Spp. was Gram negative.

after application of citric acid at 100 and 200 ppm these species were (Bacillus Spp., Desulfococcus Spp., Pseudomonas Spp., and Streptobacillus Spp,), this number reduced to three identified bacteria which were (Bacillus Spp., Pseudomonas Spp., and Streptobacillus Spp) after using citric acid at 300 ppm . Also, the Figure cleared that there were three identified bacterial types (Bacillus Spp., Pseudomonas Spp., and Streptococcus Spp.) after application of TICA treatments.

4. DISCUSSION

The results cleared that application of TICA at 5 ppm resulted in the highest significant vase life and decrement of number of bacterial colonies. These results can be construed to the oxidative action of the chlorine compound on cellular components of microorganisms, including essential enzymes in cell membranes and protoplasm (Bloomfield and Arthur, 1989; Dychdala, 1983). The reduction growth of the microorganisms caused decrement in stem blockage and increase final water uptake, decrement of LSFW and increment of SWR which resulted in increment of flower longevity. On the other hand, the highest significant decrease in number of bacterial colonies was observed after the treatment TICA at 20 ppm and H_2O_2 at 20 ppm, this treatment caused a high reduction of asparagus shoots vase life. This reduction may be due to the phytotoxic effects of the concentration of these treatments (Van Doorn *et al*., 1990).

When flowers are cut from the plant, water loss continues. The perfect flower preservative is that which allows water absorption in flower tissues or water absorption from the preservative solution maintains a better water balance and flower which enhancing vase-life. (Salunkhe *et al.*, 1990). Our study cleared that a high value of RFW and VSU along the first six days from the experiment start was recorded after application of TICA at 5 ppm which may illustrate the freshness and longevity of stems after this treatment.

The highest significant value of chlorophyll a and b content at the end of the vase life of control plants was observed after application of TICA at 5 ppm which explain the greenish and longevity of the shoots after this treatment.

The highest significant increase in reducing sugar content at the end of vase life of control plant was observed after application of TICA at 5 ppm. This

increment may increase the osmotic potential of the flowers, thus improving their ability to absorb nutrients and maintain their turgidity, which may explain the increase of flower longevity in this study (Prathamesh and John. 2013).

Finally it could be recommended to use TICA at 5 ppm as holding solution in the case of cut *Asparagus densiflorus* shoots. This treatment caused increment of the shoots vase life by 122 % more than control plants, increase in final water uptake, chlorophyll a and b and decrease of number of bacterial colonies

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الملخص العربى

إطالة عمر الافرع الخضرية لنبات الأسبرجس ذيل القط المقطوفة بإستخدام بعض المحاليل المضادة للبكتريا

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أجريت هذه الدراسة في فرع بحوث نباتات الزينة –حديقة انطونيادس – معهد بحوث البساتين – الأسكندرية –جمهورية مصر العربية – خلال موسمي ٢٠١٨-٢٠١٩ – الدراسة البكتيرية اجريت في قسم بحوث امراض نباتات الزينة والطبية والعطرية – معهد بحوث امراض النبات. تهدف الدراسة الي تقييم مدى امكانية استخدام حامض الستريك بتركيز ١٠٠ ، ٢٠٠و ٣٠٠ جزء في المليون – فوق اكسيد الهيدروجين بتركيز ٥، ١٠و ٢٠ جزء في المليون–٨ هيدروكسي كينولين سلفات بتركيز ٥٠ ، ١٠٠و ٢٠٠ جزء في المليون وحامض تراي كلورو ايزوسيانريك بتركيز ٥، ١٠و ٢٠ جزء في المليون في ماء الفاز لتقليل المحتوى البكتيري وزيادة عمر الافرع الخضرية لنبات اسبرجس ذيل القط المقطوفة – اظهرت النتائج ان استخدام حامض التراي كلورو ايزوسيانريك بتركيز ٥ جزء في المليون ادى إلى اعلى زيادة معنوية في عمر الأفرع الخضرية حيث سجلت ١٥,٧٨ و ١٥,٥٦ يوم في الموسم الأول والثاني على التوالي بينما سجل النباتات الغير معاملة (الكنترول) ٧ و ٧,١١ يوم في الموسمين الأول والثاني على التوالي . أيضا سجلت هذه المعاملة اعلى زيادة معنوية في – كمية الماء الممتص–النسبة بين الوزن الطازج والجاف للسيقان ومحتوى السيقان من كلورفيل أ و ب وايضا ادت هذه المعاملة إلى تقليل الفقد في الوزن الخضري وعدد المستعمرات البكتيرية في ماء الفاز .