PHYSIOLOGICAL CHANGE ASSOCIATED WITH TUBEROSE CUT FLOWERS SENESCENCE IN RESPONSE TO ANTI ETHYLENE AND HOLDING SOLUTIONS

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Abstract

Various postharvest treatments were evaluated for their effect on longevity and quality of cut *Polianthus tuberosa* cv. Double, spikes which were harvested when the basal 4 flowers were opened. Spikes were pulsed in silver thiosulfate (STS) 1:4 mM, for 10 minutes at 24 °C. They were treated for 24 hours at 24°C with control (without treatment), 10 and 100 nl/L^{-1} 1-MCP. The flowers were stored for 0,3 and 5 days at 5°C then were placed in jars of a holding solution (500 ml) containing 30 g/l sucrose, 200 mg/l 8-hydroxyquinoline citrate and 150 mg/l citric acid until the end of experiment. The results indicated that all pretreatments increased vase life compared with the control. The highest percentage of fully opened florets, fresh weight and water uptake were obtained in 100 nl/L^{-1} 1-MCP compared with the other treatments. The life of the flowers was significantly increased by inhibiting ethylene action using pretreatment with either 1-MCP or silver thiosulfate (STS). 1-MCP was more effective than STS in maintaining flower quality. Increasing storage duration from 3 up to 5 days decreased vase life and flower quality. The flowers pretreated with 1-MCP at 100 nl/L^{-1} then stored for 0 or 3 days produced the highest longevity and flower quality.

INTRODUCTION

Specialty cut flowers have been growing in popularity with the industry and consumer for the last several years (U.S. Dept. of Agriculture USDA, 2000). Tuberose is an important flowering crop in Egypt after gladiolus, rose and carnation which is mainly planted for cut flowers.

Cold storing cut tuberose benefits the grower, wholesaler and florists by extending the production season, improving production efficiency and enabling long-term shipment (Goszczynska and Rudnicki, 1988). Generally, recommended storage temperatures for cut flowers depend on the particular species and cultivar but vary between 0 and 4°C (Nowak and Rudnicki, 1990). Cut tuberose stems could either be stored wet in water, preservative solution or, dry in a polyethylene plastic or wax-lined box (Nowak and Rudnicki, 1990).

Vase life can be extended by pretreatments and pulses which are short-term treatments (24 h or less) conducted just after harvest. A pretreatment may consist of applying an antiethylene compound, such as silver thiosulfate (STS) or 1-Methylecyclopropane (1-MCP) (Serek *et al.*, 1995). The use of silver thiosulfate (STS) is the most common method of preservation for ethylene sensitive cut flowers. However, the use of STS (a possible environmental pollutant) has been banned in several countries. It is shown that 1-MCP is effective and safe alternative to STS (Cross, 1996). Cut tuberose stems are sensitive to ethylene, which causes open petals to be brown, shrivel, buds to discolor and die and anti-ethylene compounds may prevent the ethylene damage (Hunter *et al.*, 2001, Woltering and Van Doorn, 1988). In this screening study, the efficacy of 1-MCP and silver thiosulfate in preventing ethylene damage was examined for cut tuberose spikes.

MATERIALS AND METHODS

This research was carried out at Horticultural Research Institute, Giza for two successive seasons (2005 and 2006).

The following chemicals and solutions were used:

1- Silver thiosulfate (STS) solutions was prepared in a ratio 1 $AgNO_3$ to 4 millimolar sodium thiosulfate according to Ried *et al.*, (1980b).

2- 1-Methylcyclopropene (1-MCP) was provided of Agrofresh, PA, USA.

3- Holding solution (preservative solution) which contains 30 g/L sucrose, 200 mg/L 8-hydroxyquinoline citrate and 150 mg/L citric acid.

Plant material

Tuberose spikes (*Polianthes tuberosa* L.) cv. Double were harvested when the basal 4 florets were really opened. They were obtained from a commercial growing nursery in El-Mansouria which is located in the vicinity of Cairo, Egypt.

Procedures

Similar spikes at the stem length of 85 cm and bearing two pairs of leaves on each were cut in the early morning and wrapped in kraft paper in groups and were translocated under dry condition to the laboratory within one hour. They were then treated with cool temperature (precooling) by placing in ice cold water for two hours to remove the effect of high field heat. Stem base was recut in air by removing about 3 cm from it. The treatments were conducted by enclosing the flowers in glass chambers of 100x15x20 cm. Accurate amount of 1-MCP was dissolved in 60 ml tap water enclosing the chamber. Thirty six flowers were treated in each chamber and

they were placed in holding solutions during the treatment. In this experiment flowers were divided into four groups as follow:

1- Stems were dipped in silver thiosulfate (STS) 1:4 mM solutions for 10 minutes at 24°C.

2- 1-MCP treatment (gas phase) as stems were placed in sealed glass chambers at room temperature for 24 hours at 24°C by inject 1-MCP (100 ml) into the glass chamber.

3- Stems were placed in sealed glass chambers at room temperature for 24 hours at 24°C by inject 1-MCP (10 nl) into the glass chambers.

4- Control (without 1-MCP and STS treatments): the stems were placed in sealed glass chambers in room temperature for 24 hours at 24°C. Each group was divided into three sub groups:

   1- The flowers were placed in a jar of holding solution (500 ml) under laboratory conditions at 24°C and continuous white light fluorescent (0-days).

   2- Flowers were stored at 5°C for 3 days.

   3- Flowers were stored at 5°C for 5 days.

As for the second and third sub groups, flowers were packaged in tightly sealed polyethylene film (30 thickness). Flower bags were packed in carton boxes (20x40x100 cm) and translocated to storage room at 5°C and RH 80-90% for 3 and 5 days. After the end of storage period, flower boxes were kept at 8-10°C for 3 hrs, as preconditioning treatment to avoid temperature stress of the normal atmosphere. Flowers were kept in a holding solution under laboratory conditions at 24°C, and continuous white light fluorescent.

Measurements

1- Flowers weight loss percentage at the end of all storage periods.

2- Flower longevity (vase life) was defined as the number of days between fully open of flowers to wilting of the petals(days).

3- Flowers opening percentage was determined as the percentage of opened florets on the spike.

4- Water uptake: was measured and calculated. The rate of water uptake on fresh weight unit was determined by weighing the jars with and without the flowers and correcting for evaporation. The water uptake (cm^3) was recorded every two days.

5- Percent change in flower fresh weight was determined by weighing the flowers at the beginning of the treatment and at 2-days interval.

6- Biochemical analysis: It was determined in fresh petals and leaves at the beginning of the experiment and at the end of flower longevity as follows.

A- Total sugars in petals and leaves (percentage) were determined colorimetrically according to the method described by Dubois *et al.*, (1956).

B- Chlorophyll and carotenoids(mg/100g) were determined in leaves colorimetraically according to Saric *et al.*, (1967).

Layout of the experiment and statistical analysis: The experimental design in factorial experiment in completely randomized design containing 12 treatments. Each treatment was repeated three times. The jar contained 500 ml of a holding solution and four flowers, i.e. 12 flowers per treatment.

Statistical analysis:. All data were subjected to analysis of variance according to the procedure reported by Snedecor and Cochran (1982) and means were compared by Duncan's multiple range test at the 5% level of probability in the two seasons.

RESULTS AND DISCUSSION

1-The percentage (%) loss in fresh weight of spikes during storage: data in Table (1) showed that the flowers pretreated with STS or 1-MCP showed lower percentage of loss in fresh weight of spikes than control flowers. 1-MCP was more effective than STS for decreasing the percentage of loss in fresh weight of spikes. In this regard Sisler and Serek (1997) reported that 1-MCP completely protects carnation and banana from ethylene by a 24 h exposure at 0.5 nl.l-1.

The results of this work cleared that storage of tuberose spikes showed more weight loss when stored more than 3 days in both seasons. This loss was due to flowers respiration and transpiration. These results are in agreement with Khenizy (2000) on *Dianthus caryphyllus* who stated that weight loss percentage increased with extending storage period up to 40 days.

The results of interaction (postharvest treatment x storage periods) cleared that the highest percentage of weight loss was obtained with control along storage periods with its maximum of 5 days (88 and 76% in the first and second seasons, respectively), followed by STS then 1-MCP (10nl or 100 nl) which produced the least percentage of weight loss. 1-MCP at 100 nl and storage for 5 days recorded 18 and 17% in the first and second seasons, respectively.

2- Flower longevity: data in Table (2) showed the effect of postharvest treatments and storage periods and their interaction on flower longevity (days). Pretreatments of flowers with 1-MCP and STS significantly increased flowers longevity

more than control flowers. 1-MCP treated flowers at 100 nl remained for 17.08 - 17.06 days in the first and second seasons, respectively compared to 14.45-15.49 days in the first and second seasons, respectively for STS and 10.65-11.58 days in the first and second seasons, respectively for control. 1-MCP was more effective than STS in maintaining display quality of the flowers, the difference in display quality was due to earlier enrolling and wilting of florets on the control and STS treated spikes.

Regarding the effect of storage period, it may be noticed that storage for 0 time gave the longest vase life 15.94 -17.23 days in the first and second seasons, respectively followed by 3 days storage 14.83 -15.51 days in the first and second seasons, respectively compared to 5 days storage 12.86 -13.39 days during the two seasons, respectively.

Concerning the effect of the interaction (postharvest treatments x storage periods) the results cleared that all postharvest treatments with storage for 0 time or 3 days significantly surpassed the storage for 5 days. However, the most effective treatment in this regard, the treatment pulsed in 1-MCP at 100 nl x 0 time storage 18.25 and 19.00 days during the two seasons, respectively followed by 1-MCP at 100 nl x 3 days storage 17.35 and 17.80 days during the two seasons, respectively.

These results were in accordance with those of Sisler, *et al.* (1996) who stated that the display life of *Campanula carpatica* flowers was increased from 3.3 to 9 days by 1-MCP (20 nl/liter) and Menguce, *et al.* (1994) who mentioned that the cold storage decreased vase life of carnation cv Astor flowers.

3. Floral opening %: data shown in Table (3) revealed the effect of postharvest treatments, storage periods and their interaction on floral opening percentage. The highest floral opening 82.23 and 83.27% in both seasons, respectively was found in flowers pretreated with the highest level of 1-MCP, whereas, the least floral opening 63.13 and 64.37% in both seasons, respectively was recorded in control.

Data concerning the effect of storage periods indicate that 5 days storage recorded less opening percentage compared with 0 time or 3 days storage in both seasons, respectively.

Table 1. Effect of post- harvest treatments, storage period and their interaction on the loss percentage in fresh weight spikes of *Polianthus tuberosa* L. *as Double* during 2005 and 2006.

Storage period (Days)	Treatments				
	Control	STS	10 nl 1-MCP	100 nl 1-MCP	Mean
1st Season (2005)					
3	0.66	0.29	0.09	0.07	0.2775
5	0.88	0.59	0.28	0.18	0.4825
Mean	0.77	0.44	0.185	0.125	------
2nd Season (2006)					
3	0.54	0.2	0.08	0.05	0.2175
5	0.76	0.56	0.24	0.17	0.4325
Mean	0.65	0.38	0.16	0.11	------

Control : without treatment
STS : silver thiosulfate
1- MCP : methyl cyclopropane

Table 2. Effect of post- harvest treatments, storage period and their interaction on flower longevity (No. days) of *Polianthus tuberosa* L.as Double during 2005 and 2006.

Storage period (Days)	Treatments				
	Control	STS	10 nl 1-MCP	100 nl 1-MCP	Mean
1st Season (2005)					
0	12.95 f	15.55 cde	17.00 abc	18.25 a	15.94 A
3	10.8 g	14.80 de	16.37 bcd	17.35 ab	14.83 B
5	8.20 h	13.00 f	14.60 e	15.65 cde	12.86 C
Mean	10.65 D	14.45 C	15.99 B	17.08 A	------
2nd Season (2006)					
0	13.75 fg	17.50 abc	18.65 ab	19.00 a	17.23 A
3	12.00 g	15.37 def	16.85 bcd	17.80 abc	15.51 B
5	9.00h	13.60 fg	14.95 ef	16.00 cde	13.39 C
Mean	11.58 C	15.49 B	16.82 A	17.60 A	------

Means within each column followed by different letters are significantly different according to Duncan's multiple range at 5 %.

Control : without treatment

STS : silver thiosulfate

1- MCP : methyl cyclopropane

Table 3. Effect of post- harvest treatments, storage period and their interaction on florets opening percentage of *Polianthus tuberosa* L.as Double during 2005 and 2006.

Storage period (Days)	Treatments				
	Control	STS	10 nl 1-MCP	100 nl 1-MCP	Mean
1st Season (2005)					
0	72.00 h	80.16 d	81.60 c	89.00 a	80.69 A
3	63.60 j	74.08 f	76.20 e	84.50 b	74.60 B
5	53.80 l	60.16 k	67.50 i	73.20 g	63.67 C
Mean	63.13 D	71.47 C	75.10 B	82.23 A	------
2nd Season (2006)					
0	72.75 g	80.95 d	83.20 c	89.60 a	81.63 A
3	64.00 i	75.20 f	77.00 e	85.20 b	75.35 B
5	56.37 k	61.00 g	67.60 h	75.00 f	64.99 C
Mean	64.37 D	72.38 C	75.93 B	83.27 A	------

Means within each column followed by different letters are significantly different according to Duncan's multiple range at 5 %

Control : without treatment

STS : silver thiosulfate

1- MCP : methyl cyclopropane

The interaction between postharvest treatments x storage periods indicated that 1-MCP at 100 nl was the best treatment for obtaining the highest floral opening percentage in the different storage periods as compared with the other treatments and control in both seasons and the differences were significant.

The above mentioned results are in agreement with those of many workers Newman *et al.* (1998) on *Gypsophila paniculata* showed that 1-MCP pretreatment helped to prevent the effect of ethylene on flowers that were open at the time of pretreatment. El-Saka and Auda (1997) on *Hippeastrum vittatum* mentioned that four weeks storage was of less efficiency than the two weeks for spike opening.

4. Water uptake: the data concerning the effect of postharvest treatments and storage periods on water uptake are presented in Table (4). These data revealed that 1-MCP (10 or 100 nl) was more effective 86.68- 90.13 and 90.03- 92.40 cm3 in the first and second seasons, respectively than STS 85.06 and 88.12 cm3 during the two seasons, respectively and the difference was significant. Generally all pretreatments significantly increased the water uptake compared to control in both seasons. Among 1-MCP concentrations, the level of 100nl produced the highest water uptake and the differences were significant compared with the level of 10nl in both seasons.

Regarding the effect of storage period, it can be observed from Table (4) that storage periods had a significant effect on the water uptake 0 day and 3 days were the best storage periods for water uptake compared with 5 days storage and the differences were significant in both seasons.

The interaction between postharvest treatments and storage period as shown in Table (4) indicated that 1-MCP at 100nl followed by 10nl led to the highest increase in water uptake from vases along storage period with its maximum at 0 day 93.60-91.0 and 95.0-93.0 in the first and second seasons, respectivelycompared to the other treatments and the differences were significant in both seasons.

Table 4. Effect of post-harvest treatments, storage period and their interaction on water uptake (cm^3) of *Polianthus tuberosa* L. as Double during 2005 and 2006.

Storage period (Days)	Treatments				
	Control	STS	10 nl 1-MCP	100 nl 1-MCP	Mean
1st Season (2005)					
0	76.38 j	89.13 d	91.00 b	93.60 a	87.53 A
3	72.95 k	83.08 h	85.13 f	89.90 c	82.76 B
5	70.25 l	82.98 i	83.90 g	86.88 e	81.00 C
Mean	73.19 D	85.06 C	86.68 B	90.13 A	------
2nd Season (2006)					
0	79.37 j	91.65 d	93.00 b	95.00 a	89.75 A
3	76.75 k	87.50 h	89.30 f	92.20 c	86.44 B
5	72.90 l	85.20 i	87.80 g	90.00 e	83.97 C
Mean	76.34 D	88.12 C	90.03 B	92.40 A	------

Means within each column followed by different letters are significantly different according to Duncan's multiple range at 5 %

Control : without treatment

STS : silver thiosulfate

1- MCP : methyl cyclopropane

These results coincided with the findings of El-Saka and Auda (1997) on *Hippeastrum vittatum* who found that four weeks storage was less efficient than the two weeks for absorbed water.

5. The flowers fresh weight percentage: it can be indicated from Table (5) that the postharvest treatments, storage periods and their interaction between them had a marked effect on the flowers fresh weight percentage.

The effect of postharvest treatments proved that all postharvest treatments (i.e. 1-MCP (10 or 100 nl) and STS) significantly enhanced the percentage of flower fresh weight placed in vases more than those in control in both seasons. However, 1-MCP at 100 nl gained more weight 4.65 and 4.82% in both seasons, respectively than those treated with 1-MCP at 10nl 3.81 and 4.43% in both seasons, respectively and STS 3.31 and 3.57% in both seasons, respectively and the differences were significant. Concerning the effect of storage periods, it can be observed from Table (5) that storage for 0 and 3 days significantly enhanced the fresh weight of spikes placed in vases after storage compared with 5 days storage. This decrease in the percentage of flower fresh weight may be due to water loss by increasing storage period. So 3 days storage was preferential than 5 days storage.

Regarding the interaction between postharvest treatments and storage period, it can be noticed that all postharvest treatments with spike stored for 0 day followed by 3 days significantly increased the percentage of flower fresh weight compared to 5 days storage. However, the most efficacious treatment in this regard was the treatment of 1-MCP (100nl) x storage for 0 days 6.37 and 6.45% in the first and second seasons, respectively followed by 1-MCP (100 nl)x storage for 3 days 4.6 and 5.0% in the first and second seasons, respectively compared with the other treatments.

These results are in harmony with the findings of Celikel and Reid (2002) who found that cut *Matthiola incana* flowers that had been pretreated with STS or 1-MCP showed greater increase in fresh weight than control flowers.

Table 5. Effect of post-harvest treatments, storage period and their interaction on flower fresh weight percentage of *Polianthus tuberosa* L.as Double during 2005 and 2006.

Storage period (Days)	Treatments				
	Control	STS	10 nl 1-MCP	100 nl 1-MCP	Mean
1st Season (2005)					
0	3.35 f	5.13 c	5 78 b	6.37 a	5.16 A
3	2.05 h	3.00 g	3.80 e	4.60 d	3.36 B
5	1.33 i	1.80 h	1.85 h	2.98 g	1.99 C
Mean	2.24 D	3.31 C	3.81 B	4.65 A	------
2nd Season (2006)					
0	3.55 f	5.20 c	5.95 b	6.45 a	5.29 A
3	2.65 i	3.50 f	4.56 e	5.00 d	3.93 B
5	1.89 k	2.00 j	2.79 h	3.00 g	2.42 C
Mean	2.70 D	3.57 C	4.43 B	4.82 A	------

Means within each column followed by different letters are significantly different according to Duncan's multiple range at 5 %

Control : without treatment

STS : silver thiosulfate

1- MCP : methyl cyclopropane

El-Saka and Auda (1997) on *Hippeastrum vittatum* stated that four weeks storage were less efficient than two weeks for fresh weight increment.

6-The percentage of total sugars in leaves: data in Table (6) indicated that the percentage of total sugars was decreased in control and at initial treatment compared with the other treatments in both seasons. In general, the treatment of 1-MCP at 100nl recorded the highest increase in total sugars % in leaves compared to the other treatments and at initial treatment in both seasons.

The effect of storage period treatments for the 0, 3 and 5 days decreased total sugars% with prolonging storage periods in the two seasons. The storage for 0 day followed by 3 days was better than 5 days storage in total sugars % in leaves in both seasons.

The interaction effects (postharvest treatments x storage periods) showed that 1-MCP at 100 nl followed by 10 nl then storage for 0 or 3 days were the best treatments for obtaining the highest percentage of total sugars in leaves compared with the other treatments in the two seasons.

The above mentioned results coincided with Sacolis and Chin (1976) who pointed out that depletion of available carbohydrates was an important factor influencing the vase life of cut flowers.

7- The percentage of total sugars in florets: the data in Table (7) demonstrated that a similar trend as those mentioned before in data of total sugars content in leaves was obtained.

8-Chlorophyll content in the leaves: data in Table (8) illustrated that all postharvest treatments recorded a decrease in chlorophyll a and b and an increase in carotenoids in the leaves as compared to that of the initial treatment in the two seasons. The level of chlorophyll a recorded more increase than that of the level of chlorophyll b in all treatments in both seasons. The different postharvest treatments increased the level of chlorophyll a and b as over control in both seasons. On the other hand, control and STS treatments increased only the level of carotenoids as compared to the other treatments in the two seasons.

The effect of storage periods: data in Table (8 & 9) revealed that tuberose spikes stored for different periods (0, 3 and 5 days) recorded a continuous decrease in chlorophyll a and b and an increase in carotenoids content with prolonging of the storage period. Also, the same result was obtained as compared with chlorophyll content in the leaves at initial treatments.

The interaction between postharvest treatments and storage period: it can be recorded that chlorophyll a and b were decreased while carotenoids increased with extending storage period up to 5 days in all postharvest treatments in both seasons. Treatment of 1-MCP at 100 nl and storing for 0 day or 3 days improved chlorophyll contents when compared to the other treatments in the two seasons.

Table 6. Effect of post- harvest treatments, storage period and their interaction on total sugars percentage in leaves of *Polianthus tuberosa* L. as Double during 2005 and 2006.

Storage period (Days)	Treatments			
	Control	STS	10 nl 1-MCP	100 nl 1-MCP
1st Season (2005)				
Initial Value = 3.10				
0	3.05	3.77	4.04	4.15
3	2.97	3.68	3.95	4.05
5	2.35	3.39	3.65	3.72
2nd Season (2006)				
Initial Value = 3.15				
0	3.12	3.65	4.12	4.20
3	3.00	3.55	4.02	4.10
5	2.60	3.10	3.57	3.69

Control : without treatment
STS : silver thiosulfate
1- MCP : methyl cyclopropane

Table 7. Effect of post- harvest treatments, storage period and their interaction on total sugars percentage in florets of *Polianthus tuberosa* L. as Double during 2005 and 2006.

Storage period (Days)	Treatments			
	Control	STS	10 nl 1-MCP	100 nl 1-MCP
1st Season (2005)				
Initial Value = 3.02				
0	3.0	3.6	3.9	4.0
3	2.7	3.2	3.6	3.9
5	2.0	3.0	3.2	3.4
2nd Season (2006)				
Initial Value = 3.05				
0	2.9	3.5	4.0	4.1
3	2.8	3.2	3.8	4.0
5	2.3	3.0	3.3	3.6

Control : without treatment
STS : silver thiosulfate
1-MCP : methyl cyclopro

Table 8. Effect of post-harvest treatments, storage period and their interaction at 5° C on chlorophyll a and b in the leaves (mg / 100 g f.w.) of *Polianthus tuberosa* L. as Double during the two seasons 2005 and 2006.

Chlorophyll a					
Treatments	Control	STS	10 nl 1-MCP	100 nl 1-MCP	Mean
Storage periods(Days)		First season			
At initial value		4.65			
0	3.04	3.50	3.95	4.01	3.63
3	2.74	3.39	3.80	3.85	3.45
5	2.05	3.09	3.42	3.50	3.02
Mean	2.61	3.33	3.72	3.79	----
Storage periods(Days)		Second season			
At initial value		4.35			
0	3.10	3.55	3.96	4.10	3.68
3	2.80	3.45	3.85	3.89	3.50
5	2.10	3.12	3.45	3.55	3.06
Mean	2.67	3.37	3.75	3.85	----
Chlorophyll b					
Treatments	Control	STS	10 nl 1-MCP	100 nl 1-MCP	Mean
Storage periods(Days)		First season			
At initial value		3.88			
0	2.25	2.35	2.50	3.00	2.53
3	1.98	2.12	2.40	2.73	2.31
5	1.15	2.01	2.29	2.38	1.96
Mean	1.79	2.16	2.40	2.70	----
Storage periods(Days)		Second season			
At initial value		3.45			
0	2.30	2.37	2.57	3.20	2.61
3	1.97	2.15	2.50	2.74	2.34
5	1.17	2.08	2.32	2.40	1.99
Mean	1.81	2.20	2.46	2.78	----

Table 9. Effect of post-harvest treatments, storage period and their interaction at 5° C on carotenoids in the leaves (mg / 100 g f.w.) of *Polianthus tuberosa* L. during the two seasons 2005 and 2006.

Treatments	Control	STS	10 nl 1-MCP	100 nl 1-MCP	Mean
Storage periods(Days)		First season			
At initial value		1			
0	2.26	1.50	1.10	1.05	1.48
3	2.40	1.59	1.15	1.10	1.56
5	2.59	1.80	1.19	1.14	1.68
Mean	2.42	1.63	1.15	1.10	----
Storage periods(Days)		Second season			
At initial value		0.9			
0	2.25	1.52	1.11	1.09	1.49
3	2.41	1.58	1.13	1.10	1.56
5	2.58	1.75	1.16	1.13	1.66
Mean	2.41	1.62	1.13	1.11	----

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التغيرات الفسيولوجية المصاحبة لشيخوخة ازهار الزنبق(التيوبروز) المقطوفة واستجابتها لمضادات الايثلين ومحاليل الحفظ

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اجرى هذا البحث فى معهد بحوث البساتين بالجيزة خلال موسمى ٢٠٠٥ ، ٢٠٠٦ على ازهار التيوبروز المقطوفة (عند تفتح ٤ زهيرات قاعدية). قسمت الأزهار إلى ٣ أقسام: القسم الأول تم إنباتـه بغمس قواعده فى محلول ثيوسلفات الفضة (٤:١ مللى مول) لمدة ١٠ دقائق على درجة ٢٤°م والقسم الثانى تم معاملته لمدة ٢٤ ساعة على درجة ٢٤°م بـ ١- ميثيل سيكلوبروبان بتركيزين (١٠ ، ١٠٠ نانولتر) والقسم الثالث بدون معاملة، ثم قسمت الأزهار الى ازهار الغرفة (بدون تخزين) تم وضعها فى محلول الفازة وأزهار تم تخزينها تخزيناً جافا على درجة ٥°م لمدة ٣ ، ٥ أيام وبعد انتهاء فترة التخزين وضعت الأزهار فى محلول الحفظ بالفازه الذى يتكون من ٣٠جم/لتر سكروز ، ٢٠٠ مجم/لتر ٨-هيدروكسى كينولين سترات ، ١٥٠ مجم/لتر حمض ستريك.

واهم النتائج التى تم الحصول عليها كانت كالأتى:

١- كل المعاملات زودت فترة حياة الأزهار بالمقارنة بالكنترول.

٢- المعاملة بـ ١- ميثيل سيكلوبروبان بتركيز ١٠٠ نانولتر اعطت اعلى نسبة تفتح وزودت الوزن الطازج للأزهار و إمتصاصها للماء بالمقارنة بالمعاملات الأخرى.

٣- فترة حياة الأزهار زادت عن طريق تثبيط عمل الايثلين باستخدام ١- ميثيل سيكلوبروبان او ثيوسلفات الفضة ولكن الميثيل سيكلوبروبان كان اكثر فاعلية من ثيوسلفات الفضة فى الحفاظ على جودة الازهار.

٤- زيادة فترة التخزين من ٣ الى ٥ ايام قللت فترة حياة الأزهار وكذلك جودتها.

٥- الأزهار التى تم معاملتها بـ ١- ميثيل سيكلوبروبان بتركيز ١٠٠ نانولتر (ازهار الغرفة) او الأزهار المخزنة لمدة ٣ أيام أعطت أعلى زيادة فى عمر الأزهار وكذلك حسنت من جودة الازهار.