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PHYSIOLOGICAL STUDIES FOR KEEPING QULITY OF SOLIDAGO CUT FLOWER

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ABSTRACT

The present investigation was carried out during 2006 and 2007 seasons to study the effect of some preservative solution treatments, packaging materials and cold storage periods in keeping quality of *Solidago canadensis*. The obtained results indicated that, spraying flowers with 5 ppm BA +1ml/L Voporgard then placed in 2% sucrose+200 ppm 8-HQS solution, significantly increased the vase life, maximum increase of fresh weight %, decreased bacterial counts on vase solution, increased chlorophyll content, carotenoid, total, reducing, non-reducing sugar and decrease proline. While spraying with 5 ppm BA +1ml/L Voporgard then placed in 200 ppm 8-HQS solution recorded the highest water uptake.

Packaging with Kraft paper and storage at 3 °C for I week increased vase life, maximum increase of fresh weight %, and recorded the highest water uptake. The treatment of interaction between packaging with Tissue paper and storage at 3 °C for I week recorded the longest vase life, the highest value of maximum increase of fresh weight % and highest amount of water uptake. The treatment of interaction between packaging with Kraft paper and storage at 3 °C for I week resulted decreased in bacterial counts on vase solution, increased chlorophyll content, carotenoid, total, reducing, non-reducing sugar and decrease proline.

INTRODUCTION

Solidago (*Solidago canadensis, L)* belongs to family *Asteraceae and* grows as wild flower in North America, Asia, and Europe. Being appreciated as a landscaping plant for years, solidago is an excellent cut flower commonly used for indoor decoration in vases and bowls. Demand for solidago has been rising dramatically over the past three years. Solidago is a new crop that is among the top 25 most popular cut flower around the world. This new crop could be adopted to be produced under the natural Egyptian conditions, with minimum environmental control, for export to the European markets during the off-season winter and early spring months, (Flower Council Of Holland, In 1999).

The best treatment was 8-HQS at 400 ppm without sucrose, which resulted in the longest vase life of leaves and inflorescences, and the lowest loss of initial fresh weight (Hassan *et al* 2003 on *Solidago canadensis)*. Uniform S*olidago canadensis* flower stems were placed on conical flasks containing 150 mL of tap water, sucrose (0.1 or 0.2%) and found that all the solutions increased vase life compared with tap water (Ryagi *et al* 1996). Sucrose 2% + 8.HQ 0.03% showed significantly enhanced floret opening and vase life.The treatment combination of unopened stage

and 25% opened stage with sucrose 2% + 8-HQ (0.03%) exhibited excellent flower quality with excellent flower colour maintenance, turgidity and freshness. Both the treatments showed 100% flower opening in panicle as well as the highest useful vase life (10.66 and 8.77 day, respectively and total vase life 13.33 day in both seasons (Brahmankar *et al* 2005 On cut *Solidago Canadensis*). Treatment of pulsing solution containing 1mg/L BA improved water status of chrysanthemum (Guo et al 1997). Sucrose 1% and BA 50 mg/L delayed the loss of chlorophyll in "Tara" and had no effect in "Boaldi" (Reyes *et al* 2000 on chrysanthemum). The vase life of *Anthurium andraeanum* and *Heliconia pstlacorum* cv. "Andromeda" were increased by BA 10 mg/L applied as a dip or as a spray (Paull and Chantrachit 2001). Treating with BA at 5, 10, 15 and 20 ppm gave maximum vase life at 15 ppm 11.6 days, during marketing (Chikkasubbanna and Suma 2002 On cut alstromaria). Packing should protect flowers against physical damage, water loss, and external conditions detrimental to the transported flowers. Nowak and Rudnicki (1990). Pulsing some cut foliage bases in DW+ storage period at 5ºC + held in DW with packaging in Kraft paper recorded highly significant increases in longevity. Holding in 8-HQS with package treatments enhanced the fresh weight percentage (Amin 2006). Stems stored at 2ºC either wet or dry had no difference in vase life or percent flowers opened, however, flowers stored dry had a slightly greater percentage of senesced flowers at termination. Increasing storage duration from 1 to 3 weeks decreased vase life of *Campanula medium* flowers Thersa and Dole 2002).Gladiolus cut flower which stored at 4± 1ºC for 0 or 8 days recorded highly significant increase in water uptake, water loss, improvement water balance, sugar contents and reduce bacterial counts as compared to storage at 4± 1ºC for 16 days Gendy (2007).

MATERIALS AND METHODS

This study was carried out at Post Harvest Laboratory of Ornamental Plants Horticulture Department, Faculty of Agriculture, Mansoura University, Egypt, during 2005 and 2006.

I - Plant Material:

The plant materials in this research were following:

Solidago canadensis,L cv. "Tara", family: *Asteraceae*. Cut solidago was harvested from cultivated plants in Kanater Farm.

Spikes were cut early in the morning and transported to the Laboratory, then 5cm from the bases of stems were removed and the leaves on the third lower part of stem were removed. Cut stems of different species were precooled by placing in cold water for 15 min, and the stems end were recut under running water to prevent air bubbles getting into the cut end of the stem resulting plugging the conducting cells. Cut solidago was placed individually in graduated cylinder(100 mL) filled with designated solutions and left in the Laboratory conditions for 24 hours lighted with fluorescent lamps (1500-2000 Lux)at 22 ± 2°c and 60 ± 5% RH(relative humidity).

1- First experiment:

The effect of chemical preservatives treatments on keeping quality of *Solidago canadensis, L.*

This experiment consists of 8 treatments as following:

1- Control as distilled water (D.w)

The following treatments spraying with 5 ppm BA then held in 200 mg/L (8-HQS).

2- + 20 g/L sucrose.

3- + 1 ml/L Voporgard.

4- + 1 ml/L Tween 20.

5- held in 0.5% glycerol.

6- + 1 ml/L Voporgard and held in sucrose 20 g/L.

7- +1 ml/L Tween 20 and held in sucrose 20 g/ L.

8- + 1 ml/L Voporgard + 1 ml/L Tween 20 and held in 0.5% glycerol .

2- Second experiment 3: The effect of packaging materials and cold storage periods at 3C° on keeping quality of *Solidago canadensis*, L .

In this experiment, all cut stems were sprayed with 5 ppm BA and 1 ml/L Voporgard then held in20 g/L sucrose +200 mg/L (8-HQS) for 24h before cold storage.

Then the previous plant materials were divided into 4 groups:

1- First without packaging in any material.

2- Second packed in Kraft paper bag (20 x 80 cm).

3- Third packed in polyethylene bag (20 x 80 cm).

4- Fourth packed in tissue paper bag (20 x 80 cm).

In all groups solidago were placed in carton boxes (120 x 30 x 12cm) and transported to storage room of 3°c and 50±5% RH (relative humidity). For different periods (1, 2 and 3 weeks),After the end of storage periods, all the stems were held in vase solution which contain 20 g/L sucrose +200 mg/L(8-HQS), under ambient environmental lab.

Data recorded

A- Post harvest studies:

1- The vase life (days).

2- Maximum increase of fresh weight (%).

3- Water uptake (mL /cut spikes).

B – Averages of bacterial counts (colonies/ml) described by Marousky (1969).

C- Chemical analysis:

1. Photosynthetic pigments:
   Chlorophyll (a & b) for leaves and carotenoid for florets in solidago were calorimetrically determined as described by Mackinney (1941).
2. Total, reducing and non-reducing sugars (mg/g dry weight) determined according to James (1995).
3. Determined of proline (mg/g dry weight) according to (Magne and Larher 1993).

Experimental design:

Treatments were arranged in randomized complete block design for first experiment but second experiment was arranged in factorial experiment as complete randomized block design according to Gomez and Gomez (1984).

RESULTS AND DISCUSSION

First experiment:

The effect of chemical preservatives treatments on keeping quality of *Solidago canadensis*, L.

The vase life (days):-

Data presented in table (1) showed that, using 2% sucrose + 5 ppm BA + 1mL/L Voporgard had significantly increase on the vase life period of solidago cut spikes when compared with other treatments. Using 5 ppm BA + 2% sucrose +1ml/ L Voporgard recorded the highest vase life (14 and 16 days) in the first and second seasons, respectively. These obtained results were in harmony with these reported by Patil and Reddy (2005) on solidago and Brahmankar *et al.* (2005) on solidago.

Maximum increase of fresh weight %:-

The effect of the preservative solutions treatments on maximum increase of fresh weight (%) were studied and shown in table (1). It should be mentioned that the highest value of maximum increase of fresh weight (14.90 and 14.70%) were when using 5 ppm BA + 2% sucrose + 1mL/L Voporgard on Solidago cut spikes in the first and second seasons, respectively. These results coincided with results obtained by Vindo *et al.* (2002) on roses and Mwangi and Bhattachrjee (2003) on roses.

Total water uptake ml/ flower:-

Data presented in table (1) indicated that, the highest water uptakes (153.17 and 195.33 ml/ flower) were recorded when using 5 ppm BA + 1ml/ L Voporgard in both seasons, respectively. Similar results were obtained by Patil and Reddy (1997) on solidago and Mwangi and Bhattacharjee (2003) on roses.

Table (1): The effect of chemical preservatives treatments on vase life(days), maximum increase of fresh weight % and total water uptake (ml/ flower) of *Solidago canadensis*, L, at 2005 and 2006 seasons.

Treatments		Character					
		Vase life		Maximum increase of fresh weight		Total water uptake	
		2005	2006	2005	2006	2005	2006
Distilled water (control)		10.67	13.33	10.90	13.90	102.67	140.67
5ppmBA +	2% Sucrose	11.33	14.33	14.18	14.23	99.00	129.33
	1 ml/L Voporgard	12.00	14.67	11.60	13.70	153.17	195.33
	1 ml/L Tween20	12.00	14.00	10.87	11.73	146.83	176.17
	+ 0.5% Glycerol	14.00	16.00	14.70	14.90	141.50	135.33
5ppmBA+2% Sucrose+	1 ml/L Voporgard	11.33	9.33	11.60	12.90	124.00	81.67
	1 ml/L Tween 20	6.00	6.00	10.07	5.57	67.67	59.83
5ppmBA+ 0.5%Glycerol+	1ml/Lvoporgard+1ml/Ltween 20	4.00	5.00	5.63	3.85	46.83	58.67
L.S.D 5%		1.19	1.48	1.71	2.32	6.60	7.19

I. 4. Bacterial counts (colonies/ ml):-

Inclusion of a high number of bacteria in the vase solution was found to reduce the longevity of cut flowers, Bacteria apparently led to xylem occlusion which resulted in a decrease of water uptake and low water potential (Van Doorn and Reid, 1995).

The results tabulated in table (2) revealed that all pulsing solution treatments decreased the bacterial counts of cut solidago spikes when compared with control.

Treatment of 5 ppm BA + 2% sucrose + 1ml/ L Voporgard had the least average (360.60 and 332.10 colonies/ ml) of bacterial count compared with other treatments. However, maximum average (460.00 and 400.00 colonies/ mL) of bacterial count was recorded with control treatment.

Similar results were stated by Sacalis (1993) on cut flower, Xia *et al.* (1997) on cut roses and El- Hindi (1999) on dahlia.

Chemical constituents:-

Chlorophyll content (mg/ g. F.W):-

Results of the present study in table (2) showed that treated solidago cut spikes with 5 ppm BA + 1ml/ L Voporgard gave a maximum value (1.16 and 1.26 mg/g. F.W) of chlorophyll, a compared with other treatments in the first and second seasons, respectively.

Data in the same table showed that using 5 ppm BA + 1ml/ L Voporgard increased chlorophyll, b compared with all treatments.

Maximum values (1.47 and 1.68 mg/ g. F.W) were recorded when solidago cut spikes treated with 5 ppm BA +1ml/ L Voporgard but, minimum value (0.76 and 0.91 mg/gm F.W) were obtained by using 5 ppm BA + 2% sucrose + 1ml/ L Tween 20.

The highest number of total chlorophyll (1.74 and 1.97 mg/ g. F.W) were recorded when treated solidago cut spikes with 5 ppm BA + 1mL/L Voporgard. Such results were also found by Reyes *et al.* (2000) on chrysanthemum, Han (2001) on liliy and Byum *et al.* (2004) on lilium.

I. 5. 2. Carotenoids content (mg/gm F.W):-

From the recorded data in table (2) it can be concluded that using preservative solution contained 5 ppm BA + 2% sucrose + 1ml/ L Voporgard recorded the highest values (1.56 and 1.57 mg/gm F.W) of crotenoids in floret of solidago cut spikes compared with other treatments in the first and second seasons, respectively. This results in agreement with Khenizy (2000) on carnation and Amin (2006) on some cut foliage.

The total sugars content (mg/ g. D.W):

Concerning total sugars under effect of holding chemical preservative solutions the data in table (3) showed that using preservative solutions increased total sugars content in leaves of solidago cut spikes when compared with control.

Moreover, using 5 ppm BA + 2% sucrose + 1ml/ L Voporgard recorded highest value (7.80 and 7.60 mg/ g. D.W) in total sugar in leaves as compared to other treatments in the first and second seasons, respectively. These results were in similar to those reported by El-Saka (1992) on tuberose and birds of paradise, El-Zohairy (1999) on *Rosa hybrida* and Bhattacharjee (2002) on roses.

Table (2):The effect of chemical preservatives treatments on bacterial counts (colonies/ ml),chl (a, & b, total) and carotenoied (mg/ g. F.W) of *Solidago canadensis*, at 2005 and 2006 seasons.

Treatments		Character									
		Bacterial counts		Chlorophyll						Carotenoid	
				a		b		Total			
		2005	2006	2005	2006	2005	2006	2005	2006	2005	2006
Distilled Water (control)		460.00	400.00	0.67	0.78	0.80	0.89	1.00	1.05	1.27	1.24
5ppmBA +	2% Sucrose	378.40	348.40	o.85	0.91	0.91	1.07	1.13	1.30	1.51	1.54
	1ml/L Voporgard	446.70	365.33	0.84	0.94	0.94	1.15	1.16	1.38	1.42	1.43
	1 ml/L Tween20	458.30	379.70	0.82	0.91	0.95	1.13	1.16	1.35	1.41	1.44
	0.5% Glycerol	392.33	386.20	0.99	1.05	1.20	1.30	1.44	1.56	1.48	1.49
5ppmBA + 2% Sucrose	1ml/L Voporgard	360.60	332.10	1.16	1.26	1.47	1.68	1.74	1.97	1.56	1.57
	1 ml/L Tween 20	386.20	353.60	0.69	0.75	0.76	0.91	0.94	1.10	1.49	1.47
5ppmBA+ 0.5%Glycerol+	1ml/L oporgard+ 1ml/ LTween20	401.60	392.70	0.85	0.87	1.08	1.10	1.28	1.31	1.51	1.51

The reducing sugars content (mg/ g. D.W):-

Data in table (3) demonstrate that, using preservative solutions increased reducing sugars percentage in the leaves of solidago cut spikes when compared to the control.

Furthermore, using 5 ppm BA + 2% sucrose + 1ml/ L Voporgard as preservative solutions recorded the highest values (4.30 and 4.40/ g. D.W) of reducing sugars in leaves.

The non-reducing sugars (mg/ g. D.W):-

Data of both seasons in table (3) revealed that, holding solution treatments increased non-reducing sugars in leaves of solidago cut spikes when compared to control. Moreover, solidago cut spikes treated with 5 ppm BA + 2% sucrose + 1m/ L Voporgard recorded the highest values (3.50 and 3.20 mg/ g. D.W) in this respect in the leaves as compared to other treatments under study. These results are in similar to those reported by El-Zohairy (1999**)** on roses.

Proline content (mg/ g. D.W):-

Data recorded in table (3) clearly indicate that using preservative solution decreased prolin content in the leaves of solidago cut spikes when compared with the control treatment. However, the lowest values (0.57 and 0.48 mg/ g. D.W) in leaves were obtained by using 5 ppm BA + 2% sucrose + 1m/ L Voporgard but, the highest values (4.38 and 4.23 mg/ g. D.W) were recorded in the control treatment in two seasons, respectively.

The effect of packaging a materials, cold storage periods at 3°c and interaction between them on keeping quality of solidago cut flowers:-

The vase life (days):-

It could be pointed out from the data in table (4) that, The longest vase life (18. 66 and 18.92 day) was of solidago cut spikes packaging in Kraft paper, in the first and second seasons, respectively.

Close attention to cold storage periods at 3°c, it could be pointed out from the data in table (4) that , solidago cut spikes stored at 3°c for 1 week recorded highly significant increase in vase life as compared to the other

storage periods in both seasons. The highest values (25.69 and 25.92 day) in two seasons, respectively.

Table (3):- Effect of the preservative solution treatments on sugar (reducing, non-reducing, total) and proline (mg/ g. D.w) of *Solidago canadensis*, at 2005 and 2006 seasons.

Character / Treatments		Sugar						Proline	
		Total		Reducing		Non- reducing			
		2005	2006	2005	2006	2005	2006	2005	2006
Distilled water (control)		2.80	2.90	1.60	1.80	1.20	1.10	4.38	4.23
5ppmBA +	2% Sucrose	6.50	6.20	3.70	3.60	2.80	2.60	1.92	1.85
	1 ml/L Voporgard	4.90	4.30	2.80	2.20	2.10	2.10	1.17	0.97
	1 ml/L Tween20	5.20	5.70	2.50	2.90	2.70	2.80	2.25	1.97
	0.5% Glycerol	6.80	6.30	4.00	3.50	2.80	2.80	2.85	2.52
5ppmBA + 2% Sucrose +	1 ml/L Voporgard	7.80	7.60	4.30	4.40	3.50	3.20	0.57	0.48
5 ppm BA + 2% Sucrose +	1 ml/L Tween 20	5.90	6.50	3.20	3.50	2.70	3.00	1.98	1.71
5ppmBA+ 0.5%Glycerol+	1ml/ L Voporgard+ 1ml/ L Tween20	6.50	6.20	4.20	4.00	2.30	2.20	3.58	3.01

Second Experiment:

As regard to, the effect of the interaction between packaging materials and storage periods were reported in table (4) that, solidago cut spikes which packaging in tissue paper and stored at 3°c for one week gave the maximum value in vase life (27.57 and 27.00 day) as compared with other treatments in both seasons, respectively.

These results with in agreement with El-Saka (1996, a) on narcissus, Palanikumar et al. (1999) on roses and Diab (2007) found that, storage period up two weeks decrease significantly the longevity of tuberose.

Table (4):- Effect of packaging materials, cold storage periods and their interaction on vase life (days) of *Solidago canadensis*, at 2005 and 2006 seasons.

Packaging materials(A)	Vase life (days)							
	2005				2006			
	Weeks (B)			Mean	Weeks (B)			Mean
	1	2	3		1	2	3	
Non- packaging	23.33	14.10	-	12.48	24.00	14.00	-	12.67
Kraft paper	25.67	18.20	12.10	18.66	27.10	18.67	12.00	18.92
polyethylene	26.20	15.57	-	14.92	26.57	18.23	-	14.93
Tissue paper	27.57	17.43	-	15.00	27.00	17.00	-	14.67
Mean of B	25.44	17.08	3.025		25.67	16.98	3.000	
L.S.D 5% A	0.94				1.07			
B	0.88				0.99			
A x B	1.24				1.41			

The maximum increase of fresh weight % during shelf life:-

According the data in table (5) attracted the attention to the advantageous effect of Kraft paper application giving the highest value of maximum increase of fresh weight (27.84 and 29.54%) comparing to other treatments.

The effect of storage periods on maximum increase of fresh weight % were studied and shown in table (5). It was quite clear that was significant increase between the different periods 1, 2 and 3 weeks in both seasons. The highest values of maximum increase of fresh weight (33.94 and 32.07 %) when solidago cut spikes stored at 3°c for 1 weeks in both seasons, respectively.

With regard to the interaction between packaging materials and period treatments point of view, relevant data in table (5) show clearly that the highest maximum increase of fresh weight (38.37 and 36.47%) during vase life of solidago cut spikes were achieved by packaging in tissue paper and stored at 3°c for 1 week in the two seasons, respectively. Moreover, the differences were significant between most treatments under this study. These results are in harmony with those found by Amin (2006) on some cut foliage.

Table (5):- Effect of packaging materials, cold storage periods and their interaction on maximum increase of fresh weight % of *Solidago canadensis*, at 2005 and 2006 seasons.

Packaging materials (A)	Maximum increase of fresh weight %							
	Weeks (B)							
	1	2	3	Mean	1	2	3	Mean
	2005				2005			
Non- packaging	26.07	27.33	-	17.80	28.00	26.40	-	18.13
Kraft paper	29.00	27.00	27.53	27.84	31.20	29.00	28.43	29.54
polyethylene	38.33	11.00	-	16.44	32.60	12.33	-	14.97
Tissue paper	38.37	21.59	-	19.99	36.47	22.10	-	19.52
Mean of B	33.94	21.73	6.88		32.07	22.46	7.11	
L.S.D 5% A	2.34				2.59			
B	2.26				2.41			
A x B	3.20				3.40			

Total water up take (ml/ flower):-

Data shown in table (6) reveal that water up take was increase significantly by using packaging materials compared to non-packaging. Flowers were packaging in Kraft paper recorded the highest value of total water up take (147.44 and 144.33 ml/ flower) in the two seasons, respectively.

Water up take on solidago cut spikes affected by some treatments with different storage periods 1, 2 and 3 weeks in both seasons are presented in table (6) cleared that the highest total water up take values (253.30 and 252.88 ml/ flower) were recorded when solidago cut spikes stored at 3°c for 1 week.

With regard to the interaction between packaging materials and storage periods at 3°c, it is clear from the results listed in table (6) show that, the highest total water up take during shelf life of solidago cut spikes

was achieved due to packaging with tissue paper and stored at 3°c for 1 week, the highest total water up take (295.33 and 314.83 ml/ flower) in both seasons, respectively. This results in agreement with Sivasamy and Bhattacharjiee (1999) on roses, Dumber *et al.* (2002) on roses and Abd El-Sadek (2005) on gypsophila cut flowers.

Table (6):- Effect of packaging materials, cold storage periods and their interaction on total water up take (ml/ flower) of *Solidago Canadensis*,at 2005 and 2006 seasons.

Packaging materials(A)	Total water up take (ml/ flower)							
	Weeks(B)							
	1	2	3	Mean	1	2	3	Mean
	2005				2006			
Non- packaging	214.17	99.67	-	104.61	195.50	83.500	-	93.00
Kraft paper	231.17	142.33	68.83	147.44	230.83	118.167	66.33	144.44
polyethylene	272.67	146.33	-	139.67	266.33	152.167	-	139.50
Tissue paper	295.33	117.33	-	137.76	314.83	116.834	-	143.89
Mean of B	253.33	126.42	17.21		252.88	112.67	15.58	
L.S.D 5% A	6.14				6.19			
B	5.72				5.76			
A x B	8.08				8.14			

Bacterial counts (colonies/ ml):-

Data in table (7) demonstrated that, the interaction treatments between all packaging materials and storage at 3°c for 1, 2 weeks had decreased number of bacteria in vase solution as compared to storage at 3°c for 3 weeks. Moreover, there were gradual increase in number of bacteria in vase solution of solidago cut spikes with extending storage periods at 3°c for different periods (1, 2 and 3 weeks). However, the treatment of interaction between packaging with Kraft paper and stored at 3°c for 1 week decreased number of bacteria in vase solution as compared to other treatments under study, such effect could be attributed to that dry storage treatments did not result in a detectable number of bacteria in the xylem, at the end of the period of dry storage (Melanic and Wouter (2004)).

Table (7):- Effect of interaction between packaging materials and cold storage periods on Bacterial counts (colonies/ ml) of *Solidago Canadensis*, at 2005 and 2006 seasons

Treatments	Bacterial counts (colonies/ ml)					
	Weeks					
Packaging materials	1		2		3	
	2005	2006	2005	2006	2005	2006
Non- packaging	99.66	102.33	210.13	250.00	-	-
Kraft paper	86.33	89.00	197.97	200.00	350.00	360.33
polyethylene	129.02	140.82	270.82	290.42	-	-
Tissue paper	110.44	115.52	240.37	260.03	-	-

Chemical constituents:-

Chlorophyll content (mg/ g. F.W):-

It was observed from data in table (8) that, the interaction between packaging with Kraft paper and storage at 3°c for 1 week on solidago cut spikes gave a maximum value of chl a (0.86 and 0.78 mg/ g. F.W) n the first and second seasons, respectively, compared with other treatments.

As regard to the interaction between packaging material and cold storage periods in the same table, it could be observed that solidago cut spikes which packed with Kraft paper and stored at 3°c for 1 week increased chl b when compared with other treatments under study. Moreover, maximum values were (1.42 and 1.07 mg/ g. F.W) in the both seasons, respectively.

Data in the same table indicated that the highest number of total chlorophyll (1.58 and 1.27 mg/ g. F.W) when using Kraft paper and stored at 3°c for 1 week in both seasons, respectively.

Moreover, chlorophyll content (a, b and total) were decrease with extending storage periods 1, 2 and 3 weeks in the two seasons. These obtained results were in harmony with those reported by Byum *et al.* (2001) on carnation, Ferrante *et al.* (2002) on eucalyptus and Amin (2006) on cut foliage.

Carotenoids content (mg/gm F.W):-

Carotenoids content of floret of solidago demonstrated in table (8) that, the effect of interaction between cold storage periods and packaging materials, it was found that the highest carotenoids content (1.57 and 1.58 mg/ g. F.W) were obtained when solidago cut spikes packaging with Kraft paper and stored at 3°c for 1 week as compared with other treatments in the first and second seasons, respectively.

Generally, there were gradual decreases in carotenoids content in floret of solidago cut spikes with extending storage periods at 3°c.

Table (8):- Effect of interaction between packaging materials and cold storage periods on chlorophyll (a, b, total) and carotenoied (mg/ g./ F.W) of *Solidago canadensis*, at 2005 and 2006 seasons.

character / Treatments		Chlorophyll						Carotenoied	
		a		b		Total			
Weeks	packaging	2005	2006	2005	2006	2005	2006	2005	2006
1	Non- packaging	0.81	0.71	1.21	0.98	1.38	1.14	1.48	1.47
	Kraft paper	0.86	0.78	1.42	1.07	1.58	1.23	1.57	1.58
	polyethylene	0.86	0.73	1.38	1.05	1.50	1.22	1.50	1.49
	Tissue paper	0.84	0.72	1.37	0.92	1.53	1.09	1.55	1.57
2	Non- packaging	0.72	0.65	0.98	0.69	1.14	0.86	1.48	1.46
	Kraft paper	0.81	0.70	1.05	0.92	1.24	1.08	1.51	1.50
	polyethylene	0.73	0.69	1.03	0.99	1.19	1.15	1.48	1.47
	Tissue paper	0.73	0.66	0.97	0.85	1.14	1.00	1.50	1.49
3	Non- packaging	-	-	-	-	-	-	-	-
	Kraft paper	0.69	0.64	0.88	0.79	1.03	0.95	1.35	1.33
	polyethylene	-	-	-	-	-	-	-	-
	Tissue paper	-	-	-	-	-	-	-	-

The total sugar content (mg/ g. D.W):-

Data in table (9) reveal that the interaction between storage at 3°c for 1 week and all packaging materials treatments increased total sugars as compared to other treatments. Moreover, there were gradual decrease in total sugars in leaves of solidago cut spikes with extending storage periods at 3°c for different periods (1, 2 and 3 weeks). The highest values (8.30 and 7.7 0 mg/ g. D.W) were obtained when solidago cut spikes were packed in Kraft paper and stored for 1 week treatments in both seasons, respectively.

This agreement with Abd El- Sadek (2005) on gypsoplia, Amin (2006) on cut foliage and Diab (2007) on tuberose.

The reducing sugars content (mg/ g. D.W):-

Results presented in table (9) show that there were gradual decrease in reducing sugars content in leaves of solidago cut spikes with extending storage periods at 3°c for different periods 1, 2 and 3 weeks. However, the interaction between packaging with polyethylene and storage at 3°c for 1 week gave the highest value of reducing sugars (4.40 and 4.10 mg/ g. D.W) as compared with other treatments in both seasons, respectively.

The non-reducing sugar content (mg/ g. D.W):-

Data in table (9) reveal that the interaction between packaging with Kraft paper and storage at 3°c for 1 week increased non-reducing sugar as compared to other treatments. Moreover, the highest value of non-reducing sugar (4.00 and 3.07 mg/ g. D.W) in two seasons, respectively.

Table (9):- Effect of interaction between packaging materials and cold storage periods on sugar, (reducing, non- reducing, total) and proline (mg/ g. D.w) of *Solidago canadensis*, at 2005 and 2006 seasons.

character / Treatments		Sugar						Proline	
		Reducing		Non- reducing		Total			
Weeks	packaging	2005	2006	2005	2006	2005	2006	2005	2006
1	Non- packaging	4.00	3.70	3.20	2.80	7.20	6.50	2.12	2.00
	Kraft paper	4.30	4.00	4.00	3.70	8.30	7.70	1.15	1.13
	polyethylene	4.40	4.10	3.20	3.10	7.60	7.20	1.81	1.62
	Tissue paper	3.50	3.20	3.80	3.60	7.30	6.80	1.55	1.31
2	Non- packaging	3.20	2.70	1.70	1.50	4.90	4.20	4.13	3.54
	Kraft paper	3.60	3.40	2.40	2.80	6.00	6.20	2.79	2.83
	polyethylene	3.70	3.50	2.40	2.00	6.10	5.50	3.75	3.06
	Tissue paper	2.10	2.50	3.10	3.70	5.50	6.00	3.92	3.46
3	Non- packaging	-	-	-	-	-	-	-	-
	Kraft paper	2.00	1.90	1.70	1.40	3.70	3.30	4.79	4.187
	polyethylene	-	-	-	-	-	-	-	-
	Tissue paper	-	-	-	-	-	-	-	-

Proline content (mg/ g. D.W):-

Results under discussion in table (9) show that the treatments of interaction between all packaging material treatments and storage at 3°c for 1 week decreased prolin content compared with other treatments. Moreover, there were gradual increase in prolin content in leaves of solidago cut spikes with extending storage periods at 3°c for different periods (1, 2 and 3 weeks).

The lowest value (1.15 and 1.12 mg/ g. D.W) were obtained when solidago cut spikes were packaging with Kraft paper and stored at 3°c for 1 week in the first and second seasons, respectively. These results coincided with results obtained by Lukaszewska (1989) on roses.

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دراسات فسيولجية للحفاظ على جودة أزهار السوليداجوا خلال فترة التداول

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أجـرى هـذا البحـث خـلال موسـمة ٢٠٠٦و٢٠٠٧ لدراسـة تـأثير محاليـل الحفـظ ،مـواد التغليف و فترات التخزين البارد للحفاظ على جودة أزهار السوليداجوا لأطول فترة ممكنة حتى تصل إلى المستهلك بجودة عالية.

أوضحت النتائج ما يلي:-

-عند رش أزهار السوليداجوا بالبنزيل أدينين بتركيز ٥ جزء فى المليون والفوبرجارد بتركيز ١ مل \ لتر ثم وضع الأزهار قى محلول يحتوى علي ٢ حم/ لتر سكروز بالإضافة إلـى الهيدروكسـى كينولين سلفات بتركيز ٢٠٠ جزء فى المليون أدى نلك إلى زيادة عمر الأزهار، الوزن الطازج للزهـرة، كمـا أدى إلـى نقـص عـدد البكتريـا فـى محلـول الفـازة و زيـادة محتـوى الأوراق مـن الكلوروفيـل، السـكريات الكليـةو المختزلـة والغير مختزلـة ونقص كميـة البـرولين فـى الأوراق وزيادة الكاروتين فى الزهيرات .

- عند رش أزهار السوليداجوا بالبنزيل أدينين بتركيز ٥ جزء فـى المليـون و الفوبرجـارد بتركيـز ١ مل/ لتر أدى نلك إلى زيادة كمية الماء الممتص.
- عند التغليف بـورق الكرفت و التخـزين علـى درجـة ٣ مْ لمـدة إسبوع أدى ذلـك إلـى زيـادة عمـر الأزهار، الوزن الطازج للزهرة و كمية الماء الممتص.
- أدت معاملة التفاعل بين التغليف بورق الزبدة والتخزين على درجـة ٣ مْ لمـدة إسبوع إلـى زيـادة عمر الأزهار، الوزن الطازج للزهرة وكمية الماء الممتص.
- عند تغليف أزهار السوليداجوا بورق الكرفت والتخزين على درجة ٣ مْ لمدة إسبوع أدى ذلك إلى نقص عدد البكتريا فى محلول الفازة وزيادة محتوى الأوراق من الكلوروفيل، السكريات الكليةو المختزلة والغير مختزلة ونقص كمية البرولين فى الأوراق وزيادة الكاروتين فى الزهيرات .