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INFLUENCE OF SOME ANTI-TRANSPIRANTS ON THE LONGEVITY, QUALITY AND COLD DRY TRANSPORTATION OF *THAUMATOPHYLLUM BIPINNATIFIDUM* (SELLOUM) CUT LEAVES

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ABSTRACT: Speed desiccation after detaching cut foliage from mother plants is one of the main problems that faces cut foliage producers. *Thaumatophyllum bipinnatifidum* (selloum) leaves have a large surface area, allowing for much water loss through transpiration and that can be reduced by using anti-transpiration agents. Inferior temperature during shipment of cut flowers and foliage causes a negative effect on their vase life. Two experiments were carried out. The first one was to investigate the effect of spraying the cut selloum leaves with Na_2CO_3 at 5 and 10%, *Aloe vera* extract at 5 and 10%, sweet almond oil at 5 and 10%, glycerol at 5 and 10% and tap water as a control on its longevity and quality. The second one was to study the effects of *Aloe vera* extract at 10%, sweet almond oil at 5% and glycerol at 5% on the quality of selloum cut leaves during cold dry storage. In the first experiment, the highest increase in vase life was obtained after the application of glycerol at 5% and *Aloe vera* extract at 10%. In the second experiment, the results showed that all treatments caused a significant increase in survival rate and vase life after storage as compared to control without significant differences in between. Cooling conditions caused a significant increase in all studied parameters. Using *Aloe vera* extract at 10% or sweet almond oil at 5% under cooling conditions caused the highest significant increase in chlorophyll content as compared to other treatments.

Keywords: *Thaumatophyllum bipinnatifidum*, selloum leaves, anti-transpiration, dry transportation, cooling conditions.

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INTRODUCTION

Flower arrangements of every kind are enhanced by foliage. Cut foliage is a natural partner to any style collection of flower arrangement. Speed desiccation and loss of leaf quality in a short time after detaching from mother plants is one of the main problems that faces cut foliage producers.

Thaumatophyllum bipinnatifidum is a plant that belongs to family Araceae and the genus *Thaumatophyllum* (common names: lacy tree philodendron, selloum, horsehead philodendron). The plant has large deep glossy green leaves. When young, they are more or less heart-shaped, with indented margins. As they develop, the indentations become more deeply cut until the leaf appears to be divided into many slender leaflets and takes on an overall arrowhead shape. The leaves are carried on long thick stalks arising in a rosette formation from the crown (Jane and Graham 1997). It is used as an indoor shrub specimen, the leaves are used as cut foliage.

Transpiration may be considered as the major cause of water loss from plant through the stomatal opening. Gas exchange between the plant and its environment is done when the stomata are opened. In the course of

stomatal opening, CO_2 can go into the plant and water can be missed as a vapor. Hence to alleviate dryness and eventual senescence, it is important to have the balance between carbon dioxide gain and water loss through stomatal movements (Atwell *et al.,* 1999). Selloum leaves have a large surface area, allowing for much water loss through transpiration and that can be reduced by using anti-transpiration agents. Anti-transpiration agents can be classified into three groups (Prakash and Ramachandran, 2000), first film-forming types that create a physical barrier between the leaf and the surrounding (e.g. glycerol). Second, reflecting the radiation falling on the surface of the leaves to reduce leaf temperature and the light needed for signaling during stomatal opening (e.g. kaolin), and third stomatal closing types such as $MgCO_3$ and Na_2CO_3 which affect the metabolic processes in leaf tissues (Osswald *et al.,* 1984).

Aloe vera gel is an edible coating which acts as a barrier to moisture and gases which decreases the transpiration, respiration, senescence and enzymatic oxidation (Riva *et al.,* 2020). Also, Singh *et al*., 2017 mentioned that using almond oil alone or in combination with other ingredients to coat fruits has the ability to prevent water loss and reduce respiration of guava fruits.

Inferior temperature during shipment of cut flowers and foliage caused negative effect on their vase life (Cevallos and Reid, 2001).

This study was done to investigate the effects of some natural and chemical anti-transpirants on the longevity and quality of *Thaumatophyllum bipinnatifidum* (selloum) cut leaves and study the effects of the anti-transpiration treatments which let the longest vase life on the quality of selloum cut leaves during dry transportation with or without cooling.

MATERIALS AND METHODS

Two experiments were carried out at Antoniades Research Branch, Horticulture Research Institute, A.R.C., Alexandria, Egypt in the years of 2020 and 2021.

The first experiment:

Effect of some natural and chemical anti-transpirants on the longevity and quality of *Thaumatophyllum bipinnatifidum* cut leaves (selloum cut leaves).

Source of selloum cut leaves:

On the 14th of December 2020 and 10th of January 2021 in the first and second seasons, respectively, leaves of selloum plant were obtained from a well-known commercial nursery. The leaves were transplanted to the laboratory under dry conditions, the leaf stalks were re-cut before treatments to the length of 30 cm.

The following treatments were applied: nine treatments were applied in this experiment i.e. tap water (control), Na_2CO_3 (5 and 10%), *Aloe vera* extract (5 and 10%), sweet almond oil (5 and 10%) and glycerol (5 and 10%).

Preparation of the *Aloe vera* extarct: leaves of *Aloe vera* that were taken from Antoniades Research Branch nursery were washed up, peeled with a sharp knife and the gel was removed with a tablespoon into the blender directly. The obtained gel was filtrated and used to prepare different extract concentrations.

The leaves of selloum were sprayed with different treatments by hand sprayer until the run off point. After that, the leaves were transferred to glass jars containing 500 ml of tap water to supplement their shelf-life period.

Lab conditions: the cut leaves have been maintained at an average temperature of 21-22 °C, average humidity (63-65%) and 24 hours of fluorescent light (about 450-500 lux).

Experimental layout and statistical analysis:

The experimental layout was a completely randomized design (CRD). It consisted of nine treatments with three

replicates, and each treatment contained three cut flowers. The means of the studied treatments were compared by DMR test at 5% level of probability according to Duncan (1955).

Data were recorded as the following:

The postharvest characters:

Vase life (days):

Selloum leaves were discarded when the yellowish of the leaf was observed on about 20% of the leaf surface. This stage was considered to be the end of the potential useful longevity of the cut leaf.

Increase of leaf fresh weight percentage (ILFW):

It was determined at the fading stage as the flowing formula:

ILFW (%) = (final fresh weight – initial fresh weight) / (initial fresh weight) × 100

Final water uptake (g):

It was calculated at the end of the experiment using the following formula (Khenizy *et al*., 2014):

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.

Leaf fresh weight/leaf dry weight ratio (LWR):

At the fading stage, the leaves were oven-dried at 75 °C for 48 hours for a constant weight to get the leaves' dry weight. The fresh weight was then divided by the dry weight as follows below (Mahmoud, 2013):

LWR = (fresh weight per leaf (g)) / (Dry weight per leaf (g)) × 100

The amount of water transpired from the leaf surface:

After 2, 6 and 11 days from the experiment started, the amount of water transpired from the leaf surface was calculated as follows **(**Besufkad and Woltering, 2015):

Transpiration (g) = [(weight of the leaf + tube + vase solution at (day n)) – (weight of leaf + tube + vase solution at day (n+1))] / (initial leaf weight)

Where n = 1, 5 and 10 days and n+1 is the next day

Relative fresh weight (RFW):

The fresh weight of the leaves was determined just before the immersion of the leaves into the solutions and collected on the 8th, 13th, 18th and 22nd day from the experiment start. The fresh weight of each leaf was expressed relative to the initial weight to represent the water status of the leaf (He *et al.,* 2006)**:**

Relative fresh weight (RFW) = $Wt/W0 \times 100$

Where *Wt* is the weight of leaf (g) on the 8th, 13th, 18th and 22nd day from the experiment start, *W0* is the initial fresh weight of the same leaf (g).

Vase solution uptake rate (VSU):

It was measured according to the formula below (Damunupola, 2009):

VSU rate = ((St-1) – St) / (IFW of stem) × 100

Where (St) is the weight of vase solution (g) after 8 days, 13 days, 18 days and 22 days from the experiment start (St-1) is the weight of the vase solution (g) on the previous day and (IFW) is the initial fresh weight (g).

Relative chlorophyll content (RCC):

Chlorophyll content was determined as SPAD unites of the fresh leaves of plants for the different treatments under the experiment using Minolta (chlorophyll meter) SPAD 502 according to Yadava (1986) just before the immersion of the leaves into the solutions and collected two times. The 1st time after five days from the experiment start and the 2nd time after ten days from the experiment start. The chlorophyll content of each leaf was expressed relative to the initial chlorophyll content to represent the greenish status of the leaf:

Relative chlorophyll content (RCC) = Ch*t* / Ch*0* × 100

Where Ch*t* is the chlorophyll content (SPAD) after 5 days and 10 days from the experiment start and Ch*0* is the initial chlorophyll content (SPAD) of the same leaf.

Reducing sugars (%):

It was determined according to Miller (1959) at the end of the vase life of the control.

Epidermal peels check:

At the end of the first experiment, the best anti-transpirant which led to the longest vase life was chosen to study its effect on stomata structure. Fresh selloum leaves were brought and sprayed with these treatments beside tap water. After 24 hours of the treatment. The leaves were brought to the laboratory to start leaf epidermal peel check. The leaf has bent to break the surface and the epidermis has torn. The epidermal layer was cut from the leaf and placed on microscopic slide. Two drops of water were added then the coverslip was put on the sample and examined under the compound light microscope at an appropriate magnification (400x).

The second experiment:

Study the effects of the best anti-transpirant treatments which let the longest vase life in the first experiment on the quality of selloum cut leaves during dry transportation with or without cooling.

On the 26th July 2021 and 2nd August 2021 in the first and second seasons, respectively, leaves of selloum were obtained from well–known commercial nursery. The leaves were transplanted to the laboratory under dry conditions and put in tap water for one hour.

The leaves were then sprayed with different treatments by hand sprayer until the leaves were run off point. The leaf stalks were re-cut to the length of 30 cm and stored in dry condition in a laboratory or cooling condition for 48 hours, after that the leaves were transferred to glass jars containing 500 ml of tap water to supplement their shelf-life period.

The following treatments were applied:

Eight treatments were applied in this experiment: tap water (control) under cooling or without cooling storage, *Aloe vera* extract at 10% under cooling or without cooling storage, sweet almond oil at 5% under cooling or without cooling storage and glycerol at 5% under cooling or without cooling storage.

Storage conditions**:** lab condition (29.5-31.5 °C), humidity (74-76%) and cooling condition at (18 °C) and humidity (88%).

Lab conditions: The leaves have remained at the average temperature of (29.5-32.5 °C), average humidity (74-76%) and 24 hours fluorescent light (about 450-500 lux).

The following data were recorded:

Survival percentage after storage**:** At the end of storage time, the greenish of selloum leaves was observed and when about 20% of leaf surface or more was yellow, the leaf was discarded and the percentage of survived leaves was calculated as follows:

Survival (%) = number of survived leaves / number of total leaves × 100

Vase life after storage (days). Loss of shoot fresh weight percentage (LSFW), leaf fresh weight/leaf dry weight ratio (LWR), chlorophylls content (SPAD) and reducing sugars (%) were determined at the end of the vase life of the control plant according to the method of the first experiment.

Experimental layout and statistical analysis:

The layout of the experiment was factorial in a complete randomized design with three replicates. Each replicate contained four leaves; the first factor was cooling conditions while the other was anti-transpirant treatments. The means of the studied treatments were compared by DMR test at 5% level of probability according to Duncan (1955).

RESULTS AND DISCUSSION

First experiment:

Effect of some natural and chemical anti-transpirants on the longevity and quality of *Thaumatophyllum bipinnatifidum* (selloum) cut leaves.

1. The postharvest characters:

Data in Table (1) showed that the highest increase in vase life was obtained after application of glycerol at 5% and *Aloe vera* extract at 10% while using Na_2CO_3 at 10% resulted in the lowest significant vase life in both seasons.

The displayed results in Table (1) showed that using glycerol at 5% and *Aloe vera* extract at 10% resulted in the highest increase in ILFW in the 1st and 2nd seasons. On the other hand, Na_2CO_3 application at 10% caused the lowest significant increase in ILFW in the 1st and 2nd seasons.

For the final water uptake, application of glycerol at 5 or 10% and *Aloe vera* extract at 5 or 10% caused the highest increase in both seasons. On contrary, the smallest amount of final water uptake was recorded after the application of Na_2CO_3 at 10% in both seasons.

Also, Table (1) cleared that, the highest significant LWR was recorded after application of glycerol at 5% and the lowest significant LWR was recorded after application of Na_2CO_3 at 10 %

Moreover, Table (1) cleared that the lowest significant content of reducing sugar was obtained after application of Na_2CO_3 at 10% and the highest significant one was obtained after application of glycerol at 5% and almond oil at 5% in both seasons.

Data in Table (2) showed that the lowest significant amount of transpired water along the first eleven days of vase life was recorded after the application of *Aloe vera* extract at 10%, while the application of Na_2CO_3 at 10% recorded the highest significant amount of transpired water in the first and second seasons with the same level of significant compared to the untreated leaves.

Fig. (1), showed that after 8 days from the experiment commencement date, application of Na_2CO_3 at 10% caused the highest significant decrease in RFW and by the end of the 12th day of the experiment start the vase life of this treatment was terminated while there was no significant different after application of any of other treatments. Moreover, after 13 days there was no significant difference in RFW of the other studied treatments in both seasons and by the end 15th day of the experiment start the vase life of the leaves treated with Na_2CO_3 at 5% in both season and control plant in the first season was terminated.

Also, Fig. (1) cleared that after 13 days of the experiment start application of *Aloe vera* at 5 and 10%, almond oil at 10% and glycerol at 5% in the first season and *Aloe vera* extract at 5% in the second season caused the highest significant increase in RFW.

After 22 days of the experiment start the vase life of the treated leaves of all treatments was terminated, except *Aloe vera* extract at 5% and glycerol at 5% with no significant difference in RFW between them.

For the vase solution uptake rate, Fig. (2) showed that after 8 days the lowest significant VSU rate was obtained after the application of almond oil at 5 and 10% and *Aloe vera* extract at 10% in both seasons. This decrement continued after 13 and 18 days of the experiment commencement date. After 22 days of the experiment start all treated leaves terminated their vase life except for *Aloe vera* extract at 10% and glycerol at 5% and the least VSU was recorded after application of *Aloe vera* extract at 10%.

Fig. (3) showed that the highest significant decrease in relative chlorophyll content was obtained after the application of Na_2CO_3 at concentrations of 5 and 10% followed by untreated plants. On the other hand, application of *Aloe vera* extract,

Table 1. Means of vase life (days), increase of leaf fresh weight (ILFW; %), final water uptake (g), leaf fresh weight/leaf dry weight ratio (LWR; %) and reducing sugars of selloum cut leaves as affected by Na_2CO_3, *Aloe vera* gel, almond oil and glycerol treatments during the two seasons.

Treatments	Vase life (days)		ILFW (%)		Final water uptake (g)		LWR (%)		Reducing sugars (%)	
	1st season	2nd season	1st season	2nd season	1st season	2nd season	1st season	2nd season	1st season	2nd season
Control	15.67de	19.56 ab	2.15 a-c	2.32 ab	13.69 ab	13.53 bc	5.74 ab	5.52 b-d	0.701 bc	0.626 cd
Na_2Co_3 at 5%	14.00 ef	15.33 c	1.81 bc	2.06 ab	14.52 ab	12.9 bc	5.74ab	5.44 b-d	0.672 c	0.597 cd
Na_2Co_3 at 10%	11.44 f	11.22 d	1.16 c	1.36 c	10.71 b	11.27 c	5.20 c	5.16 c	0.658 c	0.583 d
***Aloe vera* extract at 5%**	19.56 bc	17.56 bc	2.70 ab	2.87 a	18.17 a	17.48 a-c	5.55 b	5.88 ab	0.753 b	0.689 b
***Aloe vera* extract at 10%**	23.67 a	22.89 a	3.39 a	3.08 a	18.74 a	15.7 bc	5.60 b	5.64 a-c	0.736 b	0.657 bc
Almond oil at 5%	21.33 a-c	21.89 a	2.21 a-c	2.03 ab	15.87 ab	12.44 bc	5.75 ab	5.75 ab	0.810 a	0.694 ab
Almond oil at 10%	21.78 ab	21.89 a	2.76 ab	2.66 a	13.10 ab	14.78 bc	5.87 ab	5.76 ab	0.726 b	0.651 c
Glycerol at 5%	24.00 a	23.56 a	3.63 a	2.71 a	18.84 a	23.00 a	5.97 a	6.06 a	0.831 a	0.756 a
Glycerol at 10%	18.33 cd	21.11 ab	2.34 ab	2.61 a	18.60 a	18.85 ab	5.52 b	5.24 bc	0.750 b	0.689 b

Means in the same column having the same letters, are not significantly different at 5% level of probability (Duncan, 1955).

Table 2. Means of the amount of water transpired from the leaf surface (g) of selloum cut leaves as affected by Na_2CO_3, *Aloe vera* extract, almond oil and glycerol treatments in the two experiment seasons after 2, 6 and 11 days from the commencement date.

Treatments	Transpiration (g)					
	1st season			2nd season		
	2 days	6 days	11 days	2 days	6 days	11 days
Control	0.217 a	0.446 a	1.320 b	0.190 a	0.454 ab	1.045 b
Na_2CO_3 at 5%	0.195 a	0.418 a	0.835 bc	0.192 a	0.462 a	0.817 b
Na_2CO_3 at 10%	0.200 a	0.418 a	2.448 a	0.206 a	0.408 ab	2.502 a
***Aloe vera* extract at 5%**	0.202 a	0.427 a	0.707 bc	0.191 a	0.402 ab	0.807 b
***Aloe vera* extract at 10%**	0.143 c	0.318 b	0.569 c	0.152 b	0.366 a-c	0.557 b
Almond oil at 5%	0.194 a	0.367 ab	0.683 bc	0.178 ab	0.394 ab	0.753 b
Almond oil at 10%	0.154 bc	0.316 b	0.609 bc	0.151 b	0.290 c	0.555 b
Glycerol at 5%	0.181 ab	0.368 a	0.665 bc	0.173 ab	0.361 bc	0.668 b
Glycerol at 10%	0.213 a	0.426 ab	0.748 bc	0.198 a	0.376 a-c	0.718 b

Means in the same column having the same letters, are not significantly different at 5% level of probability (Duncan, 1955).

almond oil and glycerol treatments at both concentrations resulted in the highest significant increase in RCC with no significant difference in-between after five days from the experiment start in both seasons.

Also, Fig. (3) cleared that after ten days from the experiment commencement date, application of Na_2CO_3 at 5% caused the highest significant decrease in RCC while the highest significant increase was obtained after foliar spray of *Aloe vera* at 10% in both seasons.

2. Epidermal peels check:

Fig. (4) illustrated that the application of almond oil at 5% (B), *Aloe vera* extract at 10% (C) and glycerol at 5% (D) caused stomatal closure and the largest stomatal pore was observed after the application of tap water (A), while the smallest stomatal pore was obtained after the application of Almond oil at 5%.

Table (1), showed that using glycerol at 5%, caused a significant increase in vase life that may be attributed to the osmolyte action of glycerol which participates in maintaining water balance or its function as osmoprotectant and consequently allows the work of many cellular operations during osmotic stress causing a decrease of the water loss and increase in vase life (Yancey, 2005). Fig. (4) cleared the function of glycerol 5% in closing stomata and reducing the transpiration rate. Also, Fig. (1) showed that, the application of this treatment increased RFW during the experimental period which resulted in freshness and increased the leave's vase life. These results are in agreement with those obtained by Shanen and Shaleby (2011) who found that using glycerol at 4% caused a decrease in leaf weight reduction rate and water loss rate, which extended the vase life of *Monstera deliciosa* leaves and Punetha and Trivedi (2018) who found that the foliar application of 8% glycerol increased the vase life to about 3 times as compared to control of cut rose cv. Naranjo.

Moreover, Table (1) cleared that the application of *Aloe vera* extract at 10% and almond oil at 5% caused the highest significant increase in vase life, decrease in ILFW and increase in final water uptake, which may be due to their effects on stomatal closure (Fig., 4) which decreased the amount of the transpired water from leaves (Table, 2) and consequently increased RFW along the experiment period (Fig., 1). Increasing relative chlorophyll content (Fig.,

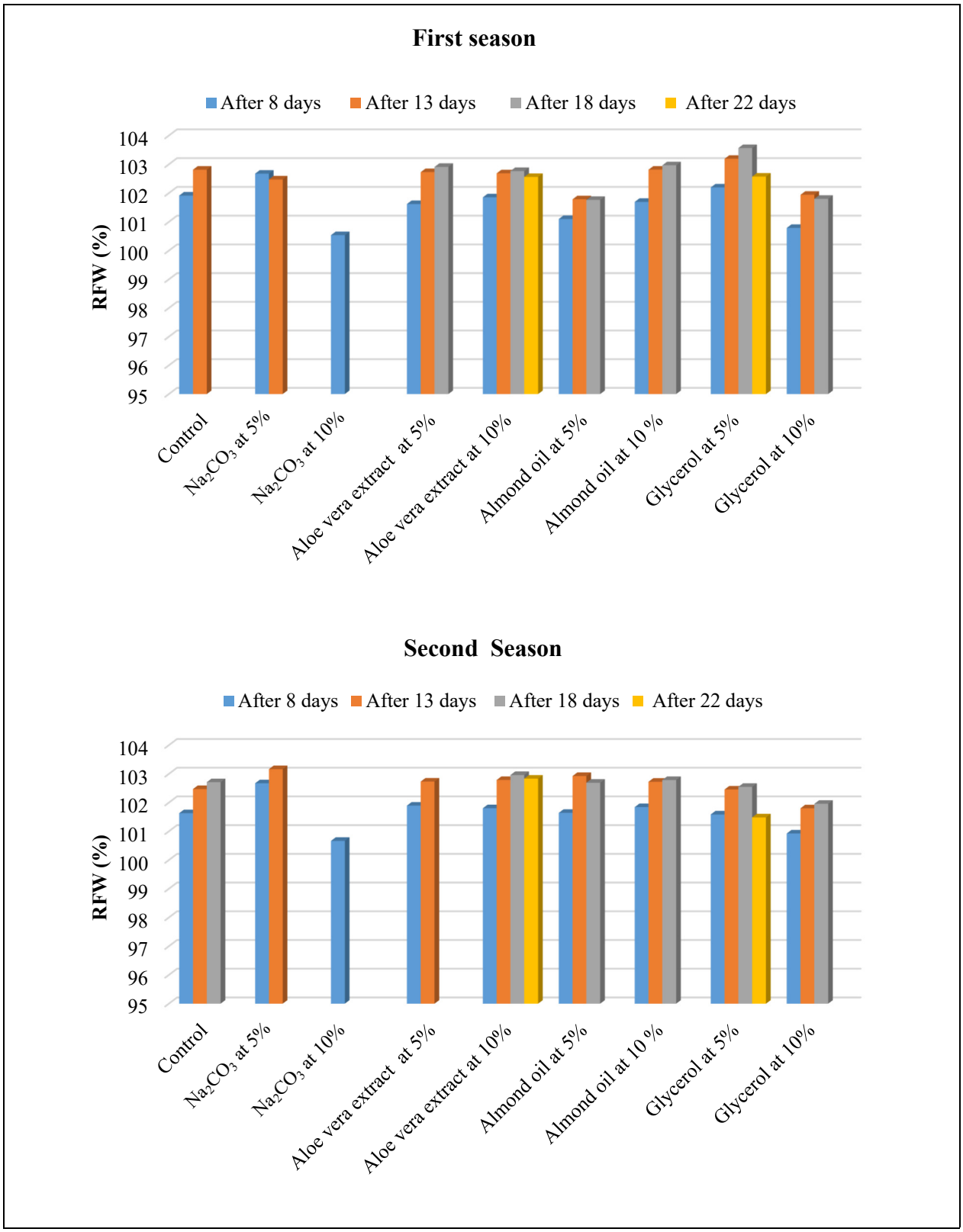

Fig. 1. Effect of Na_2CO_3, *Aloe vera* extract, almond oil and glycerol treatments on relative fresh weight RFW (%) in the two experimental seasons after 8, 13, 18 and 22 days from the experiment start.

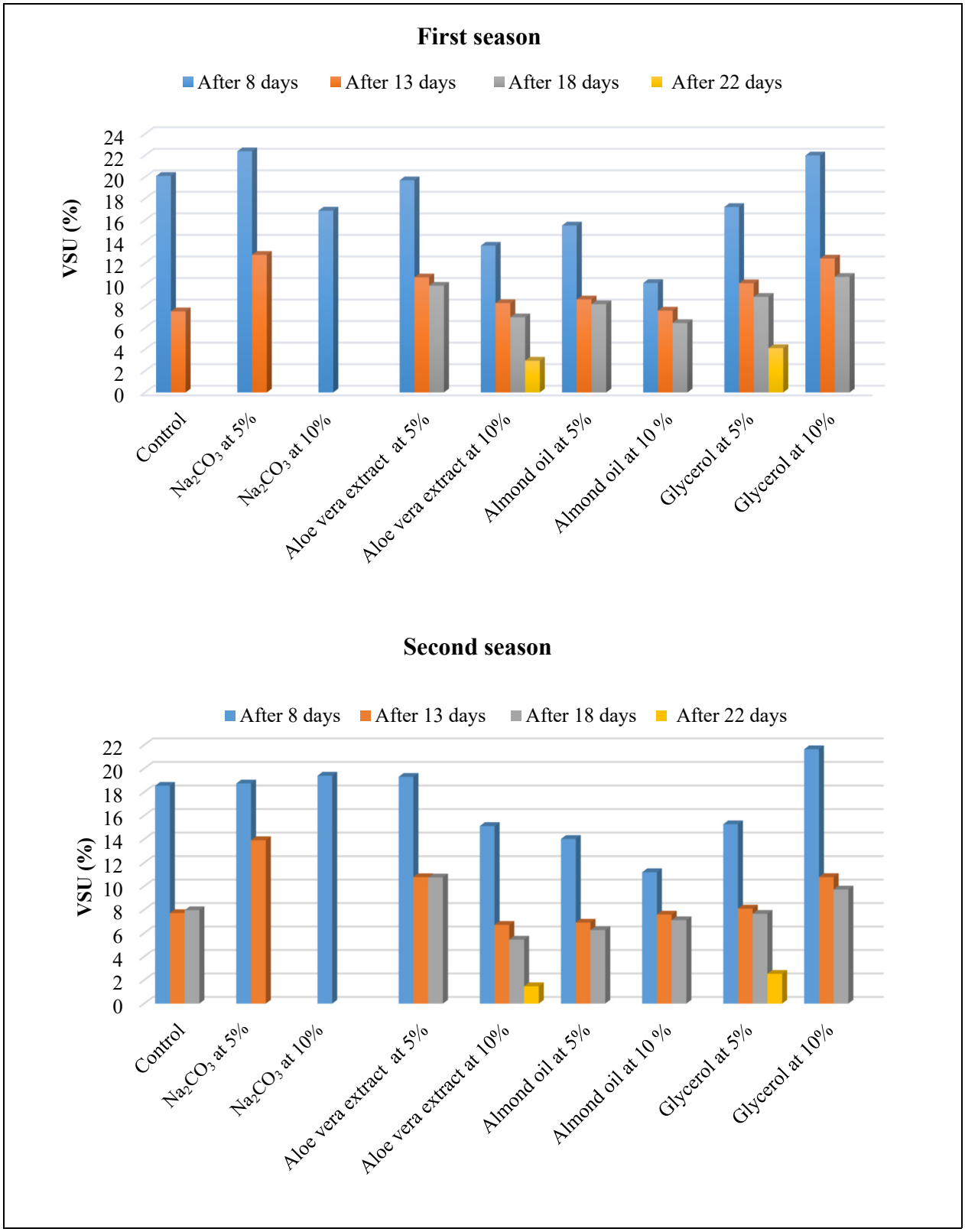

Fig. 2. Effect of Na_2CO_3, *Aloe vera* extract, almond oil and glycerol treatments on vase solution uptake rate VSU (%) in the two experimental seasons after 8, 13, 18 and 22 days from the experiment start.

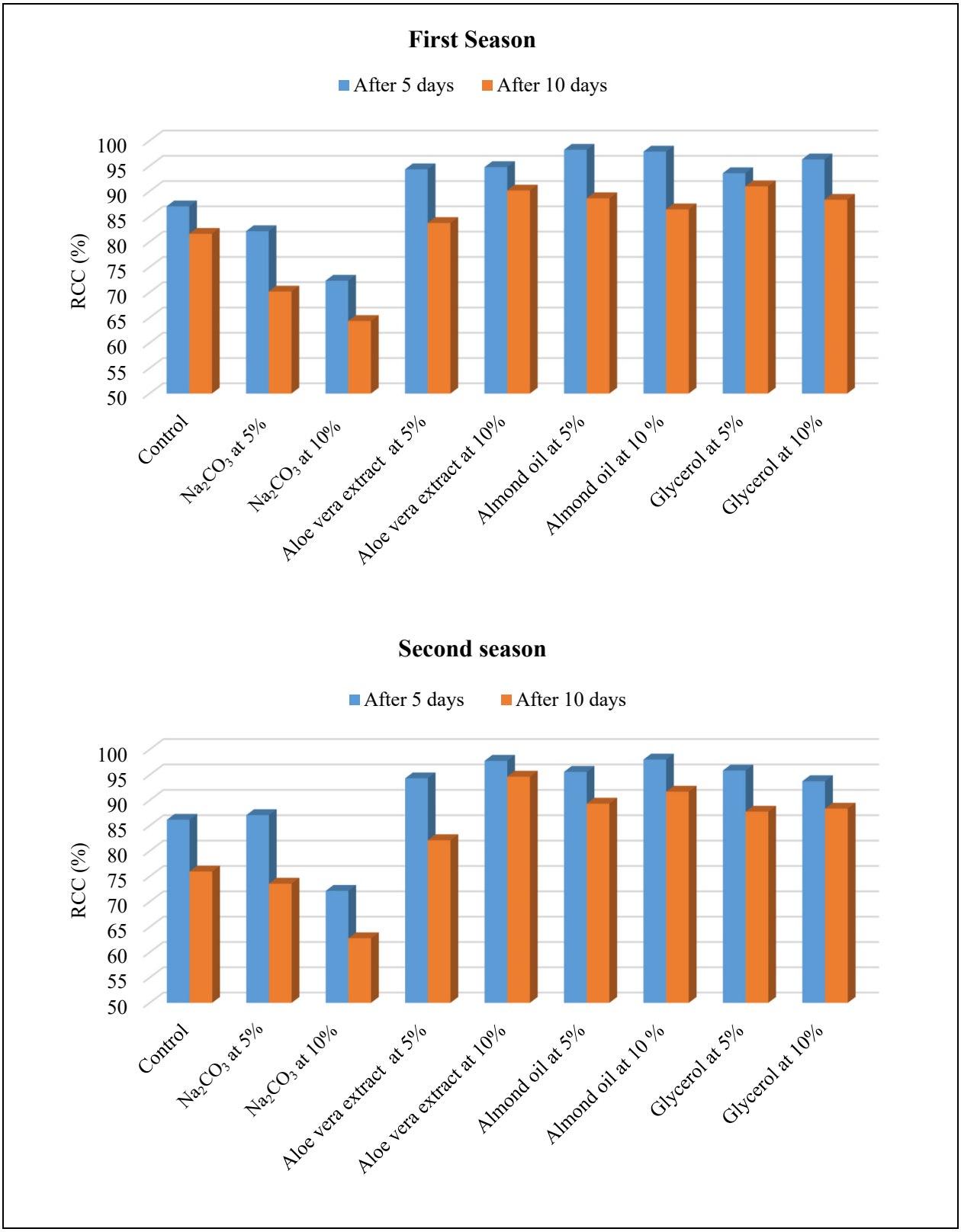

Fig. 3. Effect of Na_2CO_3, *Aloe vera* extract, almond oil and glycerol treatments on relative chlorophyll content (RCC) in the two experimental seasons after 5 and 10 days from the experiment start.

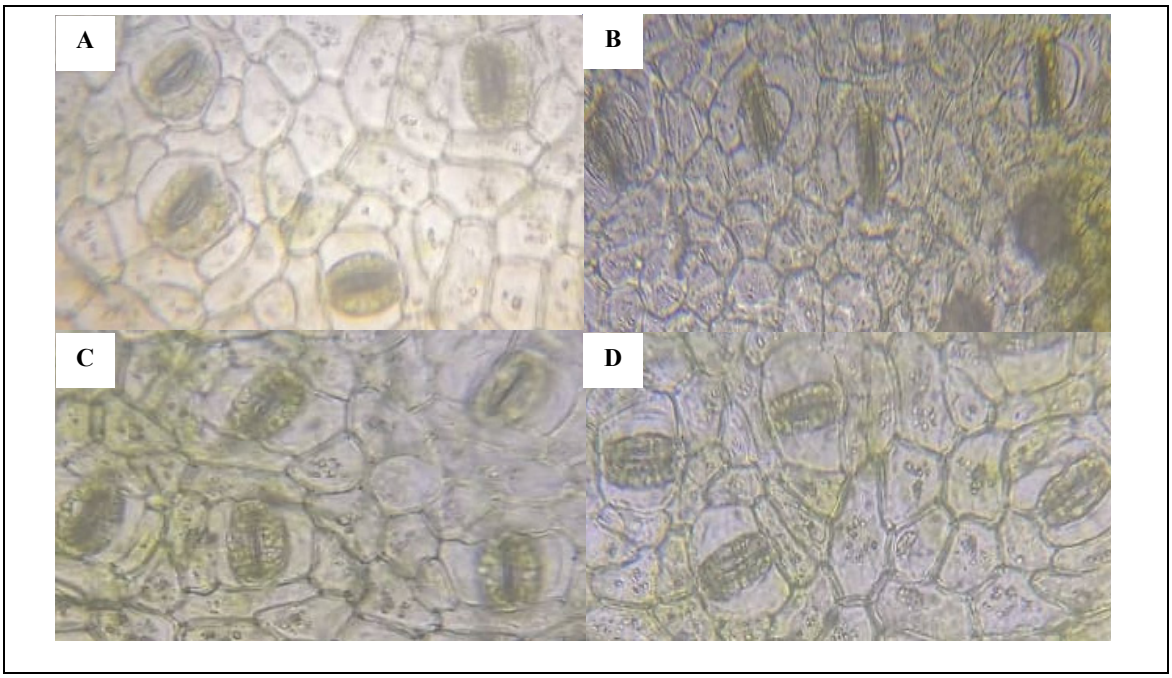

Fig. 4. Visualization of stomatal apertures (closed and open) in epidermis peels of selloum leaves as affected by foliar spray of tap water (A), almond oil at 5% (B), *Aloe vera* extract at 10% (C) and glycerol at 5% (D) with microscope magnification 400x.

3) maintained the water balance, leaf freshness and save leaf from early wilting resulting in enhanced vase life. These results are in harmony with those obtained by Suchismita *et al.* (2019) who mentioned that the *Aloe vera* extract retarded moisture loss and reduced respiration rate in pomegranate.

The lowest amount of reducing sugars % at the end of vase life resulted from the application of Na_2CO_3 at 5 or 10% and untreated leaves (Table, 1). This decrement may decrease the osmotic potential of the leaves, thus decreasing their ability to absorb nutrients, which may explain the decrease of the leaf longevity of these treatments (Prathamesh and John, 2013).

Although, Shanen and Shaleby (2011) mentioned that using Na_2CO_3 at 2,4,6 and 8% had a positive effect on enhancing the vase life of *Monstera deliciosa,* leaves, but our results showed that applying Na_2CO_3 at 5 or 10 % caused a significant decrease in the vase life of selloum leaves. This decrease may be due to the sensitivity of selloum leaves to sodium which caused burned leaves and decreased the leaves' vase life.

Second experiment:

Study the effects of the best anti-transpiration treatments which produced the longest vase life in the first experiment on the quality of selloum cut leaves during dry transportation with or without cooling.

1. Effect of anti-transpirant treatments on the quality of selloum cut leaves:

Data presented in Table (3) cleared that there were no significant differences among, the effect of *Aloe vera* extract at 10%, sweet almond oil at 5% and glycerol at 5% on survival rate and vase life of selloum cut leaves after dry storage for 48 hours, as these treatments showed superior effect over the control treatment in both seasons. Also, It showed that using *Aloe vera* extract at 10% and glycerol at 5% caused the highest significant increase in leaf fresh weight at the end of the vase life in the first season, while the highest significant increase in fresh weight at the end of the vase life in the second one was obtained from applying *Aloe vera* extract at 10%.

Table 3. Means of survival (%), vase life after storage (days) and increase of leaf fresh weight (ILFW; %) as influenced by anti-transpirants, storage condition and interaction between them during the two seasons.

Storage conditions	Anti-transpirants	Survival (%)		Vase life after storage (days)		ILFW (%)	
		1st season	2nd season	1st season	2nd season	1st season	2nd season
Cooling	Control	36.49 a	41.62 a	3.33 a	3.33 a	8.46 ab	8.99 a
	Aloe vera extract at 10%	66.49 a	66.49 a	4.33 a	4.66 a	9.83 a	8.11 b
	Sweet almond oil at 5%	66.49 a	78.25 a	5.00 a	4.66 a	5.22 cd	5.98 d
	Glycerol at 5%	78.24 a	60.00 a	5.55 a	5.55 a	7.17 bc	7.51 c
Mean		61.93 a	61.59 a	4.55 a	4.55 a	7.67 a	7.65 a
Without cooling	Control	18.25 a	11.75 a	3.00 a	2.00 a	3.50 d	2.15 f
	Aloe vera extract at 10%	48.11 a	59.93 a	4.33 a	4.33 a	7.19 bc	7.58 c
	Sweet almond oil at 5%	48.25 a	35.26 a	4.33 a	4.00 a	5.36 cd	5.02 e
	Glycerol at 5%	56.49 a	56.49 a	4.00 a	3.66 a	6.92 bc	6.08 d
Mean		42.77 b	40.86 b	3.92 b	3.50 b	5.74 b	5.21 b
Means of anti-transpiration	Control	27.37 b	26.69 b	3.17 b	2.67 b	5.98 b	5.57 c
	Aloe vera extract at 10%	57.30 a	63.21 a	4.33 a	4.50 a	8.51 a	7.85 a
	Sweet almond oil at 5%	57.37 a	56.76 a	4.67 a	4.33 a	5.29 b	5.50 c
	Glycerol at 5%	67.37 a	58.25 a	4.78 a	4.61 a	7.05 a	6.80 b

Means in the same column have the same letters, are not significantly different at 5% level of probability (Duncan, 1955).

Data in Table (3) showed that all treatments caused a significant increase in survival rate after dry storage. This can be explained by the ability of these treatments to work as a barrier to moisture and minimizing water loss during storage. Also, these treatments work as a gas barrier and slow down respiration, senescence and enzymatic oxidation (Mohebbi *et al.,* 2012 and Ghasemnezhad *et al.,* 2013).

Table (4) showed that the application of all treatments caused a significant increase in leaf fresh weight/leaf dry weight ratio (LWR) with no significant differences among them as compared to untreated leaves which recorded the lowest significant value in both seasons (5.35 and 5.24), respectively. Also, the data cleared that in the first season, using any treatment caused a significant increase in chlorophyll content with non-significant differences among them, while in the second season the highest significant chlorophyll content was obtained after using *Aloe vera* extract at 10% or sweet almond oil at 5% with no significant difference between them as compared to other treatments. Also, results showed that the lowest significant reducing sugars (%) was recorded in the control treatment in the first season and both control and glycerol at 5% treatments in the second one.

2. Effect of cooling conditions on the quality of selloum cut leaves:

Data in Table (3) and Table (4) cleared that cooling conditions caused significant increases in all studied parameters as compared to non-cooling conditions in both seasons.

The increase in all studied parameters after cooling conditions may be due to the effect of low temperature and high humidity on minimizing the water loss, respiration rate, decreasing ethylene production and suppressing pathogen development (Irtwange, 2006).

Table 4. Means of leaf fresh weight/leaf dry weight ratio (LWR), chlorophylls content and reducing sugars as influenced anti-transpirants, storage condition and interaction between them during the two seasons.

Storage conditions	Anti-transpirants	LWR		Chlorophylls content (SPAD-units)		Reducing sugars (%)	
		1st season	2nd season	1st season	2nd season	1st season	2nd season
Cooling	Control	6.08 b	6.06 c	40.48 c	37.14 b	0.62 f	0.86 d
	Aloe vera extract at 10%	6.30 a	6.10 c	46.12 a	43.23 a	1.11 a	0.88 c
	Sweet almond oil at 5%	6.22 a	6.65 a	47.91 a	44.17 a	0.91 b	0.91 a
	Glycerol at 5%	6.12 b	6.14 c	43.16 b	34.81 c	0.71 e	0.89 b
Mean		6.18 a	6.24 a	44.42 a	39.84 a	0.84 a	0.88 a
Without cooling	Control	4.61 e	4.42 e	34.20 e	31.74 c	0.58 h	0.62 f
	Aloe vera extract at 10%	5.83 c	6.21 b	40.47 c	39.77 b	0.89 c	0.88 c
	Sweet almond oil at 5%	6.06 b	6.04 d	37.86 d	35.71 c	0.82 d	0.75 e
	Glycerol at 5%	5.71 d	6.03 d	43.05 b	40.06 b	0.61 g	0.61 g
Mean		5.55 b	5.68 b	38.90 b	36.82 b	0.73 b	0.72 b
Means of anti-transpiration	Control	5.35 b	5.24 b	37.34 b	34.44 c	0.60 d	0.73 b
	Aloe vera extract at 10%	6.07 a	6.16 a	43.30 a	41.50 a	1.00 a	0.88 a
	Sweet almond oil at 5%	6.14 a	6.34 a	42.89 a	39.94 ab	0.87 b	0.83 a
	Glycerol at 5%	5.92 a	6.09 a	43.11 a	37.44 bc	0.66 c	0.76 b

Means in the same column have the same letters, are not significantly different at 5% level of probability (Duncan, 1955).

3. Effect of the interaction between anti-transpirant treatments and cooling conditions on the quality of selloum cut leaves:

Data in Table (3) cleared that the highest significant increase of leaf fresh weight was recorded after using tap water and *Aloe vera* extract at 10% under cooling conditions in the first season and tap water under cooling conditions in the second season.

Table (4) showed that using *Aloe vera* extract at 10% or sweet almond oil at 5% under cooling conditions in the first season and sweet almond oil at 5% under cooling conditions in the second one resulted in the highest significant increase in leaf fresh weight/leaf dry weight ratio. Also, the table indicated that using *Aloe vera* extract at 10% or sweet almond oil at 5% under cooling conditions caused the highest significant increase in chlorophyll content. The highest significant reducing sugars (%) was recorded after the application of *Aloe vera* extract at 10% under cooling conditions in the first season and sweet almond oil at 5% under cooling conditions in the second one.

The scatter plots displayed in (Fig., 5) showed a significant positive correlation between survival rate and vase live after storage, with a correlation coefficient of r = 0.89 and 0.96 in the first and second seasons, respectively. This correlation relationship indicates that the effect of the used treatments on the survival rate continued after leaf storage till the end of its vase life and the vase life of cut leaves was correlated significantly with the survival rate of selloum cut leaves.

The effects of these treatments on decreasing respiration, senescence and enzymatic oxidation are reflected in decreasing loss of leaf fresh weight (Table, 3), increasing LWR and increasing chlorophyll content. (Table, 4) which enhanced the vase life of the cut leaves. The scatter plots (Fig., 6) showed a strong positive correlation between chlorophyll content and vase life, with a correlation

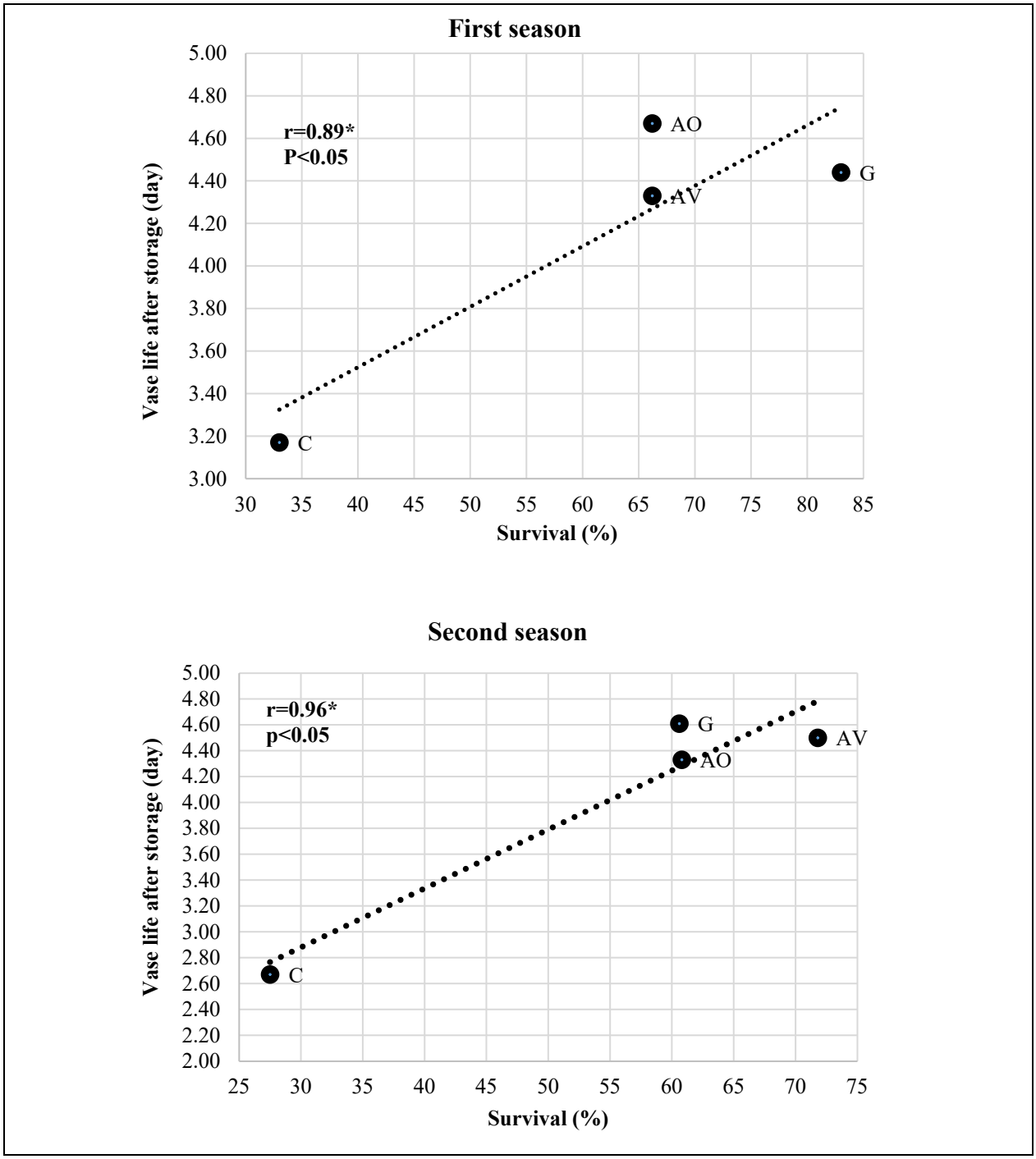

Fig. 5. Scatter plots of the survival (%) and vase life after storage (days) measured on control (C), *Aloe vera* extract at 10% (AV), sweet almond oil at 5% (AO), glycerol at 5% (G) treatments.

The scatter plot indicates a strong correlation between the two variables, with a correlation coefficient of r = 0.89 in the first season and 0.96 in the second season. p < 0.05 indicates the statistical significance level of the observed correlation.

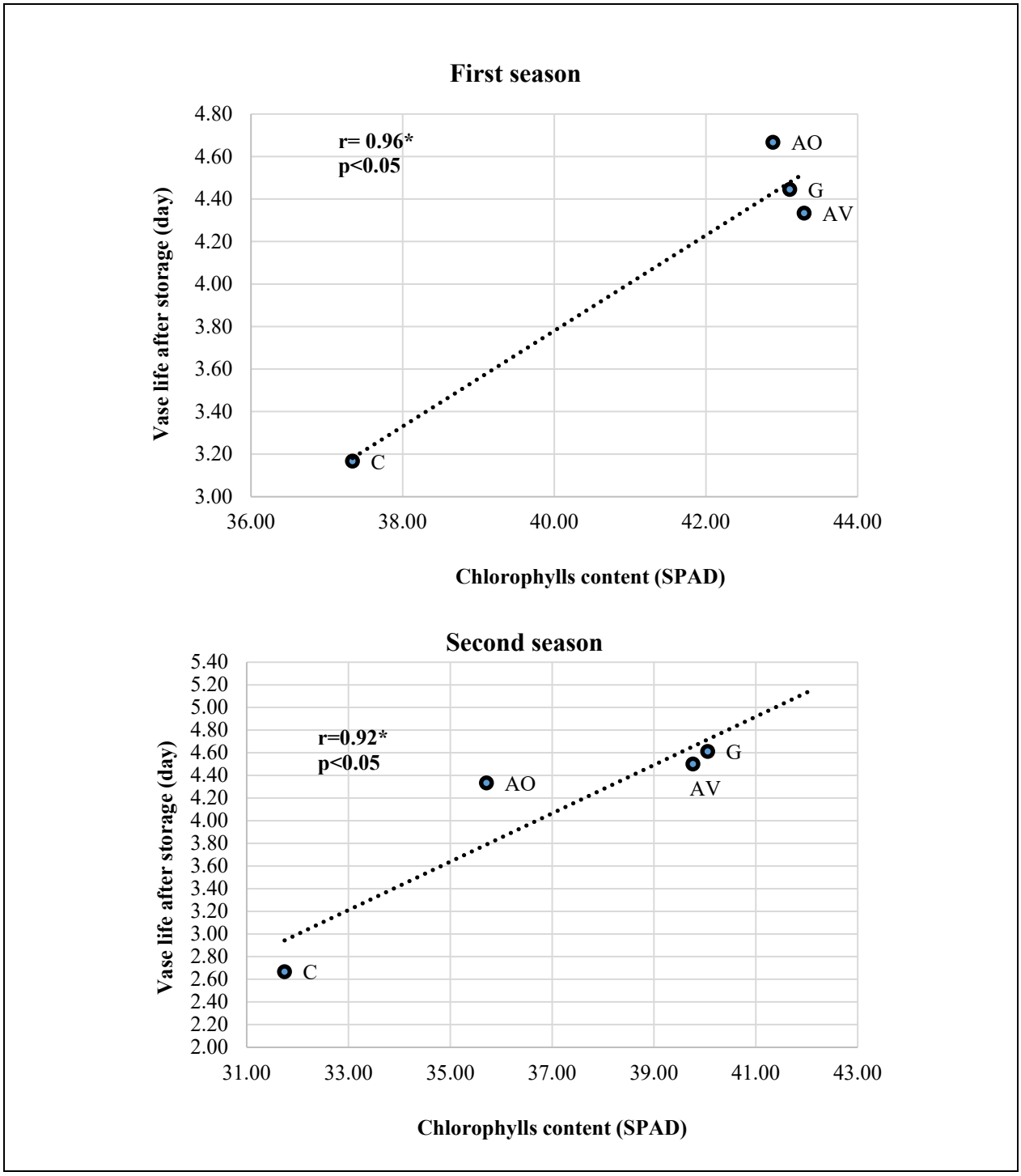

Fig. 6. Scatter plots of chlorophylls content (SPAD) and vase life after storage (days) measured on control (C), *Aloe vera* extract at 10% (AV), sweet almond oil at 5% (AO), glycerol at 5% (G) treatments.

The scatter plot indicates a positive strong correlation between the two variables, with a correlation coefficient of r = 0.96 in the first season and 0.92 in the second season. p< 0.05 indicates the statistical significance level of the observed correlation.

coefficient of r = 0.96 and 0.92 at p < 0.05 in the first and second seasons respectively. This correlation relationship indicates that the vase life was correlated significantly with the chlorophyll content of selloum cut leaves.

RECOMMENDATION

From the obtained results it could be recommended to use either glycerol at 5%, *Aloe vera* extract at 10% or sweet almond oil at 5% as a foliar spray on selloum leaves, as these resulted in the highest significant increase in vase life. Also, the dry transportation of selloum leaves can be done under cooling conditions (18 ºC and 88% of humidity) for 48 hours of this treatment. The vase life of selloum leaves under cooling conditions can be extended by spraying the leaves with either glycerol at 5%, *Aloe vera* extract at 10% or sweet almond oil at 5%.

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تأثير بعض مضادات النتح على القدرة الحفظية،الجودة و النقل الجاف المبرد لأوراق نبات فللودندرن سالومي المقطوفة

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من المشكلات الأساسية التى تواجه منتجي اوراق القطف تدهورها السريع بعد قطفها من النباتات الأم وتمتاز أوراق نبات السالومي بمساحتها الكبيرة مما يزيد من فرصة فقدانها للماء من خلال عملية النتح ومن الممكن تقليل هذا الفقد باستخدام مضدات النتح. أيضاً شحن الأوراق تحت درجات حرارة غير مناسبة يؤدي إلى تدهور في عمر الأوراق بعد القطف. تم إجراء تجربتين الأولى لدراسة تأثير رش أوراق السالومي المقطوفة بكربونات الصوديوم بنسبة ٥ و ١٠٪، مستخلص الصبار بنسبة ٥ و ١٠٪، زيت اللوز الحلو بنسبة ٥ و ١٠٪، الجلسرين بنسبة ٥٪ و ١٠٪ وماء الصنبور للتحكم في عمر الأوراق بعد القطف وجودتها. والتجربة الثانية دراسة تأثير مستخلص الصبار بنسبة ١٠٪ وزيت اللوز الحلو بنسبة ٥٪ والجلسرين بنسبة ٥٪ على جودة أوراق السالومي المقطوفة أثناء التخزين البارد الجاف. في التجربة الأولى أظهرت النتائج أن أعلى زيادة معنوية في عمر الأوراق تم الحصول عليها بمعاملة الأوراق بالجلسرين بنسبة ٥٪ ومستخلص الصبار بنسبة ١٠٪ . أظهرت نتائج التجربة الثانية أن جميع المعاملات أدت إلى زيادة معنوية في معدل البقاء

حية وعمر الأوراق بعد التخزين مقارنة بالغير معاملة دون اختلاف معنوي بينهم، كما أدى التبريد إلى زيادة معنوية في جميع االصفات المدروسة. أعلى زيادة معنوية في محتوى الكلوروفيل تم الحصول عليها باستخدام مستخلص الصبار بنسبة ١٠٪ أو زيت اللوز الحلو بنسبة ٥٪ تحت ظروف التبريد مقارنة بالمعاملات الأخرى.