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# INFLUENCE OF ANTITRANSPIRANTS AND MAGNETIC TECHNOLOGY ON ASIATIC *LILIUM LONGIFLORUM* L. CV. "YELLOW COCOTTE"

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## Abstract

Lilium has the highest economic importance in the floriculture industry, it is one of the most popular cut flowers, decoration and adornment and is also traded both as cut flowers and potted plants in world markets. Longevity differs among many species and cultivars. It is one of the most important characteristics for determining flower quality, enhancing its commercial value and satisfying consumer preferences. The most important factor for prolonging vase life period is maintenance of optimal water status. This research was performed in Lab. of Sand and Carculuse Soils Dept., Water and Environment Res. Inst., ARC, Giza, Egypt. during 2019 and 2020 seasons in order to study the effects of some antitranspairants (chitosan at 0.00, 2.00 and 4.00 % w/v and sodium alginate at 0.00, 2.00 and 4.00% w/v) and water treatments (tap water and magnetize tap water) in the first experiment, while the second experiment comprises flowers magnet exposure time at (0,15,30,45 minutes) and water treatments (as mentioned before) on several aspects of postharvest quality such as longevity, flower head diameters, water loss, water uptake and water analysis of cut Asiatic *Lilium longiflorum* L. flowers cv. "Yellow Cocotte". Results indicated that all studied traits were significantly influenced by the different types of antitranspairants and magnetized tap water, in the first experiment, the best treatment was chitosan at 4% as antitranspairants with magnetize tap water while in the second experiment, the best treatment was flowers magnetic exposure time at 30 minutes with magnetize tap water for all postharvest characteristics.

***Key words:*** Lilium, Magnetized Water Treatment (MWT), Electromagnetic field (EMF), Chitosan (CHT), Sodium alginate (SA), Chitosan, Water loss, Longevity.

## Introduction

Longevity termination for many cut flowers is characterized by wilting, vase life of cut flowers is affected by water uptake, transpiration and balance between these two processes, blockage of the xylem vessels in cut flowers could be caused by aspired air, bacteria, particulate matter, macromolecules and pectic enzymes and disruption of water columns in the stem vessels by air embolism is one of the main factors causing water deficit (He *et al*., 2006).

Magnetized water treatment (MWT) techniques has opened new research avenues in agriculture in the advantages of safety, compatibility and simplicity, environmentally friendliness (Bharath *et al*., 2016 and Abobatta, 2019).

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During the last decade lilies are one of the most necessary bulbous plants it has gained popularity worldwide among cut flowers and potted flowering plants, producing wonderful flowers with a wide range of colours, shapes, making excellent cut flowers, very attractive potted flowering plants and a great ornamental value for landscapes and for parks, gardens. Asiatic hybrid lilies blooms are larger than traditional, their vase life is the longest of any liliaceous plant and they boost the widest range of colors (Roh, 2011; Grassotti and Gimelli, 2011; Younis *et al*., 2014 and Eissa *et al*., 2019).

Chitosan is a biopolymer, a chitin derivative, a compound which is completely safe for the environment, produced by deacetylation of chitin, chitosan and its compounds enhanced longevity of numerous horticultural crops related to its fungicidal effects and evaluation of defence mechanism in plant tissues, reduce transpiration has been suggested by (Dzung *et al*., 2011; Dias *et al*., 2013; Lodhi *et al*., 2014 and Hong-juan and Huan-qing, 2015)

Sodium alginate is derived from the cell walls brown algae species, it is a natural polysaccharide used in the bio industry. Alginate-based edible coatings and films attract interest for increasing maintaining quality and prolonging the shelf-life of vegetable, fruit by decreasing dehydration (as sacrificial moisture agent), controlling respiration, improving product appearance, enhancing mechanical properties, etc. Its formula is $NaC_6H_7O_6$. (El-Mohdy, 2017 and Parreidt *et al*., 2018).

The major idea of this research was to evaluate the best antitranspirants and suitable flowers magnet exposure time with two different water treatments to extend the vase life of Asiatic (*Lilium longiflorum* L.) cv. "Yellow Cocotte".

## Material and Methods

To achieve the goal of this investigation, the present study was carried out during two successive seasons of 2019 and 2020 at the Laboratory of the Sand and Carculuse Soils Research Institute, Giza, Egypt in the two seasons to study the effect of some antitranspirants, flowers magnet exposure time and water treatments on Asiatic lily (*Lilium longiflorum* L.) flowers cv. "Yellow Cocotte".

**Plant material:**

Cut flower stems of lilium obtained from a local commercial farm (Floramix) in each season. Flowers were picked at the beginning of the flower bud coloring (standard for export) in the early morning and wrapped directly in groups and transported quickly to the laboratory for 1 hour. Once in the laboratory, the stems were pre-cooled by putting them in cold water for 30 minutes at (5°C) to remove the effect of high field heat. Stem bases were recut under water to prevent air embolism. Cut flower stems were adjusted to the same length (85cm) and shape. Injury free stems were selected for the experiment.

**Experimental design and treatments:**

This research divided into two experiments:

**• The first experiment:**

Ten treatments were arranged in a factorial experiment in complete randomized design with two factors: (1) two water treatments i.e. tap and magnetized water (2) Antitranspirants i.e. chitosan at 0.0, 2.0 and 4.0 % w/v and sodium alginate at 0.0, 2.0 and 4.0% w/v. Cut flower stems were placed in a clean glass bottles (1000 ml) containing 800 ml of two water treatments. Each treatment was composed for six replicates.

The effect of chitosan and sodium alginate (SA) of cut lilium flowers: Each treatment was composed for six replicates. The treatments assessed were alginate solution (0.0, 2.0 and 4.0% w/v) was prepared by dissolving the powder in distilled water with agitation using magnetic stirrer at room temperature (Young *et al*., 2006). The cut flower stems were covered with the solution using a natural bristle brush, then the cut flower stems of each treatment were individually placed into a vase containing 800 mL tap water and magnetized tap water, at room temperature (27°C ± 4 and 42 ± 6% RH).

The chitosan treatments assessed were 0.0, 2.0 and 4% (w/v). To prepare 1 L of 2.0 and 4% chitosan solution, 20 or 40 g of chitosan (low molecular weight, Sigma-Aldrich) were added in 900 mL of tap water plus 100 mL of glacial acetic acid to dissolve the chitosan. The pH of the solution was adjusted to 5. The cut flower stems were covered with the solution using a natural bristle brush, then the cut flower stems of each treatment were placed individually into a vase containing 800 mL tap water and magnetized tap water, at room temperature as mentioned before.

**• The second experiment:**

Eight treatments were arranged in a factorial experiment in complete randomized design with two factors: (1) two water treatments i.e. tap and magnetized water (2) flower exposure period to magnetic field for 0, 15, 30 and 45 minutes. Cut flower stems were placed in clean glass bottles (1000 ml) containing 800 ml of tap water and magnetized tap water at room temperature as mentioned before. Each treatment was composed for six replicates.

The tap water used was regular drinking water of the laboratory tap and its chemical analysis is shown in table (A), magnetized tap water was prepared out of water exposed to magnetic field through magnetic device according to Bharath *et al*., (2016) as they reported that magnetic or magnetized water "water treated by the magnetic field or pass through a magnetic field device" is now considered to have effect on plant growth and development, exposure of water to magnetic field was

**Table A:** Chemical analysis of tap water (meq/l).

| | | | |
|---|---|---|---|
| **pH** | 7.4 | **Ca++** | 1.23 |
| **EC (dS/m)** | 0.39 | **Mg++** | 0.93 |
| **$HCO^{-3}$** | 1.14 | **Na+** | 2.4 |
| **$Cl^-$** | 2.12 | **K+** | 0.13 |
| **$SO^{-4}$** | 1.01 | | |

**Table B:** Chemical analysis of magnetized water (meq/l).

| | | | |
|---|---|---|---|
| **pH** | 7.37 | **Ca++** | 1.2 |
| **EC (dS/m)** | 0.36 | **Mg++** | 0.9 |
| **$HCO^3$** | 1.12 | **Na+** | 2.38 |
| **$Cl^-$** | 2.1 | **K+** | 0.1 |
| **$SO^{-4}$** | 1 | | |

**Table C:** Properties of tap water and magnetized tap water according to Bharath *et al.*, 2016.

| Test Parameter | Test Results | |
|---|---|---|
| | Tap water | Magnetized water |
| **Surface Tension (N/m)** | 0.07275 | 0.0675 |
| **Viscosity ($m^2$/s)** | $7.65 \times 10^{-6}$ | $7.13 \times 10^{-6}$ |
| **Electrical Conductivity (μs/cm)** | 343.2 | 353.3 |
| **pH** | 8.1 | 8.15 |

reported to reduce pH of the water and reduce its surface tension which is measured using the apparatus called Tensiometer. Magnetized tap water and its chemical analysis is shown in table (B) and properties of tap water and magnetized tap water are shown in table (C).

### Experimental measurements:

• Longevity (days): number of days from beginning of the treatment till the end of longevity of the flowers (when the petals showed symptoms of wilting).

• Flower bud open (days).

• Flower head diameter (cm).

• Relative fresh weight: The fresh weight of cut flower stem was recorded daily in 1, 3, 6…etc. during the experiment.

• Relative fresh weight of cut flower stem during the vase life period was calculated according to the formulae:

$$FW\ (\%) = \frac{\text{Fresh weight of cut flower stem in mentioned day}}{\text{Fresh weight of cut flower stem in zero day}} \times 100$$

according to He *et al.,* (2006).


**Fig. 1:** Flower stem of Asiatic (*Lilium longiflorum* L.) flowers cv. "Yellow Cocotte". A = Flower bud stage (control); B =chitosan treatment at 4%; C= chitosan treatment of 4% at flowering stage.

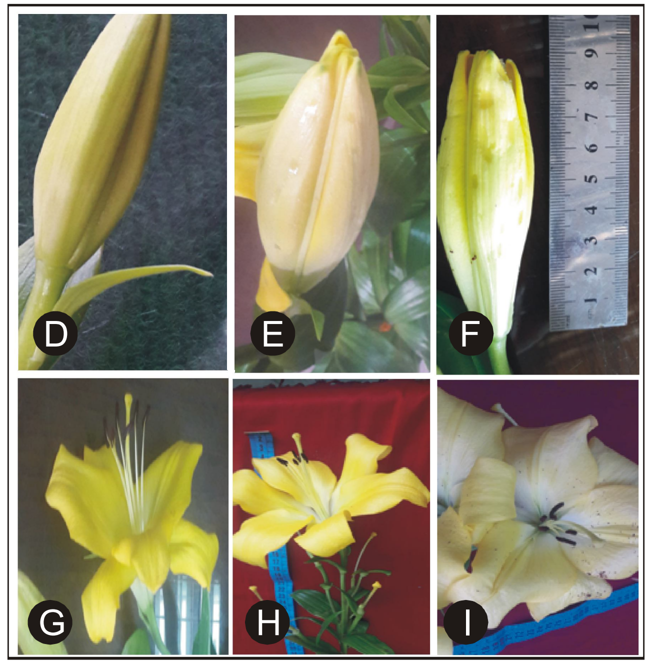


**Fig. 2:** Flowering stages (D-I = chitosan treatment at 4% during vase period).

• Dry matter: At the end of flower longevity, fresh weight of cut flower stem of each treatment was determined then it was dried to a constant weight in an oven for 48 hour at 70°C. Dry matter percentage of cut flowers was calculated by the following equation:

$$DM\ (\%) = \frac{\text{Dry weight}}{\text{Fresh weight}} \times 100$$

according to Hashemabadi *et al*., (2015).

• Water loss (g/flower stem)**:** Cumulative water loss was measured for the entire period of vase life of the flower stalk.

• Water uptake (g/flower stem): Cumulative water uptake was measured for the entire period of vase life of the flower stalk.

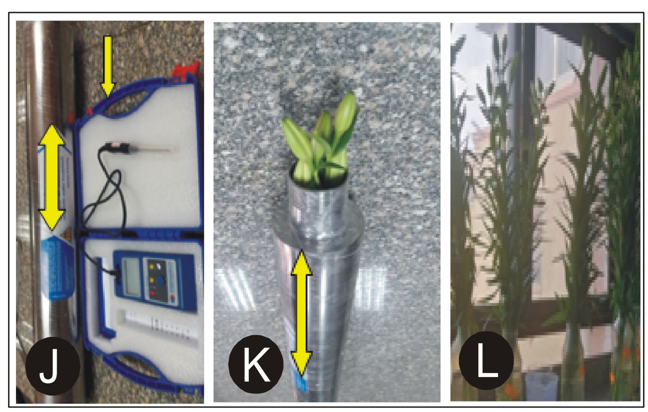


**Fig. 3:** J = Magnetic device= 1.5 Tesla and transmitter device K= flower exposure to magnet device L= vase life period.

• Water analysis: Colony forming unit of bacteria (cfu/ml.) water sample according to (Allen, 1959), fungi (cfu/ml.) water sample according to (Martin, 1950) and actinomycetes (cfu/ml.) water sample according to (Williams and Davis, 1965) were determined after two weeks and at the end of experiments.

• Chemical analysis**:** chlorophyll a, chlorophyll b and carotenoids (mg/ g f.w.) were determined in in fresh leaves after two weeks and at the end of longevity according to Moran, (1982). Total flavonoids were measured according to Rahmani *et al*., (2015).

**Experimental conditions:**

Cut flower stem were placed in ambient conditions at 27±4°C, light level was about 15 μmol $m^{2-}S^{1-}$ partially from natural light and partially from fluorescent cool light for 12h/day.

**Statistical analysis:**

Data were tabulated and subjected to analysis of variance as a factorial experiment using MSTAT statistical software, (1985) and the means of treatments were compared by Duncan's Multiple Range Test at 5% level as indicated by Waller and Duncan, (1969).

## Results and Discussion

**First experiment**

**• Longevity:**

The recorded data in table 1 show that all antitranspirats treatments significantly increased longevity of cut Asiatic lily (*Lilium longiflorum* L.) cv. "Yellow Cocotte over the control in the two seasons. The highest value was achieved by chitosan 4% treatment (25.94 and 26.13 days in the two seasons, respectively). The remainder treatments gave less values in the two seasons. The lowest values resulted from the control treatment (tap water) during both seasons as gave 23.28 and 23.50 days, respectively. The interaction between antitranspairants and water type treatments showed that the longest vase life was achieved using magnetic water and chitosan at 4% treatment (26.91 and 27.46 days in the two seasons, respectively). The use of chitosan has been found to increase the longevity of the cut flower stems as compared to control and the probable reason for this might be due to the decrease in stomatal conductance and decrease in water loss during transpiration due to chitosan which might have maintained the integrity of cell membranes and thus prolong the vase life of cut flowers.

These results are in agreement to those of (Song *et al*., 2011 and Hong-juan and Huan-qing, 2015; Bañuelos-Hernández *et al*., 2017 and Punetha and Trivedi, 2018) who reported that "beneficial properties of chitosan are related to its polycationic nature, chain length, inhibitory synthesis of certain fungal enzymes, production of phenolic compounds and formation of structural barriers, chitosan seemed to confer stability to the cell membrane and avoided flowering stems electrolyte leakage, extend vase life, decrease symptoms of senescence like necrosis of cut flowers".

**• Flower bud open*:***

It is obvious from table 2 that all antitranspirats treatments significantly decreased flower bud open of Asiatic lily (*Lilium longiflorum* L.) cv. "Yellow Cocotte compared to the control in both seasons. The faster flower bud open value was obtained from magnetic water treatment (control) as recorded 5.96 and 6.51 days in the two seasons, respectively followed by tap water as gave 6.75 and 6.56 days in the two seasons, respectively. In this study the importance of antitranspirants to decrease flower bud open might be due to the anti-transpirants provide a physical barrier to water loss and stomatal closure leading to slow flower open. The faster flower bud open value was obtained from magnetic water treatment this may be due to the properties of tap water were changed following the magnetic water treatment, shown as decreased of pH values and the decrease of

**Table 1:** Effect of water type, antitranspairants and their interaction on longevity (days) of Asiatic lily (*Lilium longiflorum* L.) cv. "Yellow Cocotte during during the vase life period of 2019 and 2020 seasons.

| Treatments | Longevity (days) | | | | | |
|---|---|---|---|---|---|---|
| Water type / Antitranspirats | First season (2019) | | | Second season (2020) | | |
| | Tap water | Magnetized tap water | Mean B | Tap water | Magnetized tap water | Mean B |
| Control (0 %) | 21.01e | 23.81c | 22.41C | 21.40f | 23.85de | 22.63C |
| Chitosan 2% | 24.00c | 25.56b | 24.78AB | 24.26cd | 26.15b | 25.21AB |
| Chitosan 4% | 24.96bc | 26.91a | 25.94A | 24.80cd | 27.46a | 26.13A |
| SA 2% | 22.54d | 24.64bc | 23.59BC | 23.10e | 26.02b | 24.56B |
| SA 4% | 23.91b | 25.00bc | 24.46B | 23.94de | 25.14bc | 24.54B |
| Mean A | 23.28B | 25.14A | | 23.50B | 25.72A | |

Means followed by the same letters in a column or raw do not differ significantly according to Duncan's New Multiple Range test at P = 0.05.

**Table 2:** Effect of water treatments, antitranspairants and their interaction on flower bud open (days) of Asiatic lily (*Lilium longiflorum* L.) cv. "Yellow Cocotte during the vase life period of 2019 and 2020 seasons.

| Treatments | Flower bud open (days) | | | | | |
|---|---|---|---|---|---|---|
| Water type / Antitranspirats | First season (2019) | | | Second season (2020) | | |
| | Tap water | Magnetized tap water | Mean B | Tap water | Magnetized tap water | Mean B |
| Control (0 %) | 6.17b | 4.10c | 5.14D | 6.4ab | 5.56b | 5.98D |
| Chitosan 2% | 7.15ab | 6.52ab | 6.84AB | 6.61ab | 7.01a | 6.81AB |
| Chitosan 4% | 7.54a | 6.64ab | 7.09A | 6.78a | 7.20a | 6.99A |
| SA 2% | 6.65ab | 6.40b | 6.53BC | 6.54ab | 6.50ab | 6.52BC |
| SA 4% | 6.22b | 6.14b | 6.18C | 6.45ab | 6.30ab | 6.38C |
| Mean A | 6.75A | 5.96 B | | 6.56A | 6.51B | |

Means followed by the same letters in a column or raw do not differ significantly according to Duncan's New Multiple Range test at P = 0.05.

EC water after magnetization, this may be due to increase water uptake under magnetic treatment which leads to biochemical changes or altered enzyme activities, which might have resulted in better development of photosynthesis stimulation. These results are in good agreement with those of Abobatta, 2015 who reported that "the electromagnetic fields increase the plant growth regulator and induced phenylalanine ammonia-lyrase during cell differentiation in the suspended cultured plant cell".

Bañuelos-Hernández *et al*., 2017 declared that "chitosan treatments delayed the process of flower open of *Heliconia bihai* (L.) L. cv. Halloween in comparison with untreated flowers stems".

**• Flower head diameter:**

According the data in table 3 showed that most treatments did not show significant differences in flower diameter because the flowers were picked at the same stage (at the beginning of the flower bud coloring). These results are in good agreement with those of Eissa, (2008) on *Chrysanthemum leucanthemum* L. and *Rudbeckia tricolor* L. as revealed that the flowers were picked at the same stage did not show significant differences in flower diameter.

**• Relative fresh weight:**

Cut flower stems of Asiatic lily (*Lilium longiflorum* L.) cv. "Yellow Cocotte were affected by all used antitranspairnts at various concentrations. Table 4 declared that treating cut flowers with chitosan (4%) recorded the maximum results as gave 94.65 and 97.45% with highly significant differences compared to the control in two seasons. A similar trend was also obtained regarding the effect of the interaction between chitosan (4%) and magnetized water as gave 95.79 and 99.79% in the two seasons, respectively. Stems coated with chitosan increased relative fresh weight as may be a result of a semipermeable cover formed by the biopolymer, diminishing transpiration and delaying the production of $CO_2$ and ethylene and preventing excessive water loss. It reduces transpiration in three different ways.

1. Reduce the absorption of radiant energy and thereby reduces leaf temperatures and transpiration rates.
2. Antitranspirant can form thin transparent films which hinder the escape of water vapor from the leaves.
3. They prevent stomata from fully open (by affecting the guard cells around the stomatal pore), thus decreasing the loss of water vapor from the leaf.

These results are conformity with those of previous workers who noticed the enhancing effect on relative fresh weight, improved quality and vase life of cut flowers by chitosan treatments (Hong-juan and Huan-qing, 2015

**Table 3:** Effect of water type, antitranspairants and their interaction on flower head diameter (cm) of Asiatic lily (*Lilium longiflorum* L.) flowers cv. "Yellow Cocotte during the vase life period of 2019 and 2020 seasons.

| Treatments | Flower head diameter (cm) | | | | | |
|---|---|---|---|---|---|---|
| Water type / Antitranspirats | First season (2019) | | | Second season (2020) | | |
| | Tap water | Magnetized tap water | Mean B | Tap water | Magnetized tap water | Mean B |
| Control (0 %) | 18.50 c | 19.64 a | 19.07A | 17.52 d | 18.03bc | 17.78 B |
| Chitosan 2% | 18.73 c | 19.35 ab | 19.04A | 17.82cd | 18.05bc | 17.94AB |
| Chitosan 4% | 18.65 c | 19.41ab | 19.03A | 18.01bc | 18.45 a | 18.23 A |
| SA 2% | 18.58 c | 19.15 b | 18.87A | 17.52d | 18.30 ab | 17.91AB |
| SA 4% | 18.61 c | 19.42 ab | 19.02A | 18.00bc | 18.32ab | 18.16 A |
| Mean A | 18.61A | 19.39A | 19.07A | | 18.23A | |

Means followed by the same letters in a column or raw do not differ significantly according to Duncan's New Multiple Range test at P = 0.05.

**Table 4:** Effect of water type, antitranspairants and their interaction on relative fresh weight (%) of Asiatic lily (*Lilium longiflorum* L.) cv. "Yellow Cocotte during the vase life period of 2019 and 2020 seasons.

| Treatments | Relative fresh weight (%) | | | | | |
|---|---|---|---|---|---|---|
| Water type / Antitranspirats | First season (2019) | | | Second season (2020) | | |
| | Tap water | Magnetized tap water | Mean B | Tap water | Magnetized tap water | Mean B |
| Control (0 %) | 60.43h | 65.93g | 63.18E | 63.03j | 68.13i | 65.58E |
| Chitosan 2% | 89.15e | 93.45b | 91.30B | 92.93e | 97.45b | 95.19B |
| Chitosan 4% | 93.50b | 95.79a | 94.65A | 95.10c | 99.79a | 97.45A |
| SA 2% | 87.11f | 90.01d | 88.56D | 88.19h | 90.01g | 89.10D |
| SA 4% | 89.12e | 92.64c | 90.88C | 91.93f | 94.12d | 93.03C |
| Mean A | 83.86B | 87.56A | | 86.24A | 89.90B | |
| Means followed by the same letters in a column or raw do not differ significantly according to Duncan's New Multiple Range test at P = 0.05. | | | | | | |

**Table 5:** Effect of water type, antitranspairants and their interaction on dry matter (%) of Asiatic lily (*Lilium longiflorum* L.) cv. "Yellow Cocotte during the vase life period of 2019 and 2020 seasons.

| Treatments | Dry Matter (%) | | | | | |
|---|---|---|---|---|---|---|
| Water type / Antitranspirats | First season (2019) | | | Second season (2020) | | |
| | Tap water | Magnetized tap water | Mean B | Tap water | Magnetized tap water | Mean B |
| Control (0 %) | 22.70 f | 23.88 e | 23.29D | 23.27j | 24.34i | 23.81 E |
| Chitosan 2% | 28.77 c | 29.67 b | 29.22 B | 29.56e | 30.52b | 30.04 B |
| Chitosan 4% | 29.68 b | 30.16 a | 29.92A | 30.02c | 31.01a | 30.52 A |
| SA 2% | 28.33 d | 28.94 c | 28.64C | 28.57h | 28.94g | 28.76 D |
| SA 4% | 28.76 c | 29.50 b | 29.13B | 29.35f | 29.81d | 29.58 C |
| Mean A | 27.65 B | 28.43 A | | 28.15 B | 28.92 A | |
| Means followed by the same letters in a column or raw do not differ significantly according to Duncan's New Multiple Range test at P = 0.05. | | | | | | |

**Table 6:** Effect of water type, antitranspairants and their interaction on water loss (g/flower) of Asiatic lily (*Lilium longiflorum* L.) cv. "Yellow Cocotte during the vase life period of 2019 and 2020 seasons.

| Treatments | Water Loss (g/flower) | | | | | |
|---|---|---|---|---|---|---|
| Water type / Antitranspirats | First season (2019) | | | Second season (2020) | | |
| | Tap water | Magnetized tap water | Mean B | Tap water | Magnetized tap water | Mean B |
| Control (0 %) | 127.89 a | 123.68 d | 125.79A | 128.10 a | 125.99c | 127.05A |
| Chitosan 2% | 122.20 e | 118.45 h | 120.33 D | 124.16 f | 120.52h | 122.34D |
| Chitosan 4% | 120.64 f | 116.71i | 118.68 E | 122.36g | 119.43i | 120.90E |
| SA 2% | 123.91 c | 120.15g | 122.03 C | 127.14b | 124.82e | 125.98B |
| SA 4% | 124.56 b | 122.09e | 125.79A | 126.13c | 125.00d | 125.57C |
| Mean A | 123.84 A | 120.22 B | | 125.58 A | 123.15 B | |
| Means followed by the same letters in a column or raw do not differ significantly according to Duncan's New Multiple Range test at P = 0.05. | | | | | | |

and Bañuelos-Hernández *et al*., 2017).

**• Dry matter:**

From the presentation in table 5 data indicated that all treatments had a pronounced effect on dry matter percentage which maintain positive values. The highest dry weight gain of Asiatic lily was achieved by chitosan at 4% as gave 29.92 and 30.52% in the two seasons, respectively. A similar trend was also obtained regarding the effect of the interaction between chitosan (4%) and magnetized water as gave 30.16 and 31.01% in the two seasons, respectively. The lowest dry weight was achieved by tap water as gave 27.65 and 28.15% in the two seasons, respectively. In this study, it seems that chitosan prevented oxidative stress through increasing water absorption and dry matter percentage through reducing protein degradation and respiration rates.

These results were consistent with the observation of (Malerba and Cerana, 2016) they reported that "other biochemical and molecular changes observed in plants treated with CHT include: callose apposition, increases in cytosolic Ca2+, activation of MAP-kinases, plasma membrane H+-ATPase inhibition, chromatin alterations, synthesis of alkaloids, phytoregulators (jasmonic acid, JA and abscisic acid, ABA) and increased dry matter percentage through reducing protein degradation".

**• Water loss:**

Data in table 6 revealed that there was a gradual

**Table 7:** Effect of water type, antitranspirants and their interaction on water uptake (g/flower) of Asiatic lilly (*Lilium longiflorum* L.) cv. "Yellow Cocotte during the vase life period of 2019 and 2020 seasons.

| Treatments | Water uptake (g/flower) | | | | | |
|---|---|---|---|---|---|---|
| Water type | First season (2019) | | | Second season (2020) | | |
| Antitranspirats | Tap water | Magnetized tap water | Mean B | Tap water | Magnetized tap water | Mean B |
| Control (0 %) | 117.20 i | 125.68 g | 121.44 E | 120.75i | 129.14 h | 124.95 E |
| Chitosan 2% | 140.21 f | 143.64 c | 141.93 B | 142.96 e | 145.96 c | 144.46 B |
| Chitosan 4% | 143.87 b | 146.85 a | 145.36A | 148.25b | 150.65 a | 149.45A |
| SA 2% | 137.17 b | 141.15 e | 139.16D | 138.96g | 143.12 e | 141.04 D |
| SA 4% | 139.17 h | 142.00 d | 140.59 C | 141.15f | 143.65 d | 142.40 C |
| Mean A | 135.52 B | 139.86 A | | 138.41 B | 142.50 A | |

Means followed by the same letters in a column or raw do not differ significantly according to Duncan's New Multiple Range test at P = 0.05.

increase in water loss of cut Asiatic lily stems by prolonging vase period, rates of water loss decreased by the various concentrations of antitranspirats, during vase period with different averages. The best results which gave the lowest levels of water loss were observed for cut flowers held in magnetic water and (chitosan 4%) as gave 116.71-119.43 ml/flower consecutively in both seasons. Close to this ratio were 118.68-120.90 ml/flower, achieved by chitosan (4%) as antitranspiration.Chitosan suppressed water loss more than the control treatments (tap water) which recorded 123.84 and 125.58 ml/flower in the two seasons. This effect of chitosan may be due to decreases transpiration rate, thereby enhancing water balance of cut flowers. Antitranspirants is any natural applied to transpire plant surfaces for reducing water loss from the plant.

In this concern, (Song *et al.,* 2011 and Punetha and Trivedi, 2018) reported that the spray of antitranspirants might decrease stomatal conductance and decrease in water loss during transpiration, which might have maintained the integrity of cell membranes cut roses.

**• Water uptake:**

Data illustrated in table 7 indicated that some treatments gradually increased water uptake over control. The amount of water uptake by flowering stems throughout vase period was raised with significant differences compared to the amount up taken by flowering stems held in magnetized tap water in both seasons. At the beginning of the vase life, water uptake of flowering stems placed in magnetized tap water was the highest as gave 139.86 and 142.50 ml/ flower respectively in both seasons, while that of flowering stems placed in tap water was the lowest as gave 135.52 and 138.41ml/ flower, respectively in both seasons. This result may be affected with used antitranspirants proves the role of these substances in prolonging vase life by increasing the water uptake, maintaining both better water balance and higher fresh weight throughout the vase period which have reduced the transpiration rate as compared to control due to the reduction in water absorption.

In regard to the interaction effect, the previous data show that chitosan at 4% and magnetized tap water enhanced absorption and gave the maximum values (146.85 and 150.65 ml/ flower, in both seasons) compared to other treatments including the control. This effect may be due to chitosan as an antimicrobial in inhibiting vascular blockage, thereafter increases the water uptake due to its acidifying and stress alleviating properties, also magnetic water enhanced absorption of water into the cell. These results are parallel with those obtained by (Goreta *et al*., 2007) who suggested that almost 99% of

**Table 8:** Effect of water type, antitranspairants and their interaction on water analysis of Asiatic lilly (*Lilium longiflorum* L.) cv. "Yellow Cocotte during the vase life period of 2020 season.

| Treatments | Water analysis after two weeks | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| Water type | Tap water | | | | | Magnetized tap water | | | | |
| Antitranspirats | pH | EC (dS /m$^{-1}$) | TC (Cfu/ml.) | AC (Cfu/ml.) | Fungi (Cfu/ml.) | pH | EC (dS /m$^{-1}$) | TC (Cfu/ml.) | AC (Cfu/ml.) | Fungi (Cfu/ml.) |
| **Control (0 %)** | 7.74 | 0.82 | 55 | 11 | 35 | 7.63 | 0.71 | 5 | 1 | 3 |
| **Chitosan 2%** | 7.61 | 0.59 | 42 | 8 | 15 | 7.59 | 0.56 | 40 | 5 | 12 |
| **Chitosan 4%** | 7.54 | 0.72 | 40 | 5 | 11 | 7.43 | 0.60 | 35 | 4 | 7 |
| **SA 2%** | 7.40 | 0.87 | 55 | 12 | 25 | 7.39 | 0.75 | 45 | 9 | 14 |
| **SA 4%** | 7.33 | 0.82 | 52 | 14 | 23 | 7.30 | 0.71 | 48 | 10 | 20 |

Means followed by the same letters in a column or raw do not differ significantly according to Duncan's New Multiple Range test at P = 0.05.

**Table 9:** Effect of water type, antitranspairants and their interaction on water analysis at the end of experiment of Asiatic lily (*Lilium longiflorum* L.) cv. "Yellow Cocotte during the vase life period of 2020 season.

| Treatments | Water analysis at the end of experiment | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| Water type | Tap water | | | | | Magnetized tap water | | | | |
| Antitranspirats | pH | EC (dS /m$^{-1}$) | TC (Cfu/ml.) | AC (Cfu/ml.) | Fungi (Cfu/ml.) | pH | EC (dS /m$^{-1}$) | TC (Cfu/ml.) | AC (Cfu/ml.) | Fungi (Cfu/ml.) |
| Control (0 %) | 7.97 | 0.94 | 98 | 14 | 61 | 7.88 | 0.84 | 12 | 12 | 6 |
| Chitosan 2% | 7.74 | 0.71 | 45 | 15 | 32 | 6.72 | 0.55 | 51 | 11 | 20 |
| Chitosan 4% | 7.65 | 0.90 | 56 | 9 | 20 | 5.63 | 0.61 | 45 | 6 | 17 |
| SA 2% | 7.70 | 0.83 | 53 | 13 | 52 | 7.33 | 0.81 | 50 | 11 | 40 |
| SA 4% | 7.37 | 0.86 | 57 | 14 | 44 | 7.34 | 0.80 | 52 | 13 | 41 |

Means followed by the same letters in a column or raw do not differ significantly according to Duncan's New Multiple Range test at P = 0.05.

the water absorbed by the plant is lost in transpiration, causing a reduction in life of plants. So there is a need to antitranspirants which can decrease the transpiration rate and mitigate plant water stress by increasing leaf resistance to diffusion of water vapor. Magnetic water treatment reduces the bond angle of the hydrogen-oxygen within the water molecule, so, these form smaller clusters of water molecule than in ordinary water and then it is leads to enhance absorption of water into the cell (El-Sabrout and Hanafy, 2017).

**• Water analysis:**

It is evident from the obtained data in tables (8 and 9) that most treatments gradually increased water uptake over control in both seasons. In this research, the effect of magnetic water on the partial physical properties of water are reported, tap water with or without magnetic water was measured in the same condition. It was found that the properties of tap water were changed following the magnetic water treatment, shown as decreased of pH values and the decrease of EC water after magnetization, the changes depend on the longtime of magnetization effect. Magnetic water has been shown to affect the properties of water and its constituents. In this study, assessments of changes in electrical conductivity, Tao and Jonathan, (2020) indicated that magnetic water has been to affect the properties of water and its constituent's assessments of changes in electrical conductivity. In many different applications passing water through a magnetic field has been claimed to improve chemical, physical and bacteriological quality of water. These results are in agreement with those of (Mahon, 2009 and El-Sabrout and Hanafy, 2017) as they reported that physicall, exposure of the water to a magnetic field changes the water's properties including raising dissolved oxygen and minerals, moreover increasing the total hardness.

On the other hand the magnetic water used led to lower pH, microbial growth was limited and water uptake by flowers was improved. Antitranspirants and magnetic water may decreased bacteria and fungi. In the light of the past results Bañuelos-Hernández *et al*., (2017) on *Heliconia bihai* (L.) L. cv. Halloween found that "the type of response of chitosan treatments is in function of the molecular weight (directly related to its antimicrobial activity)". Mahdi *et al*., (2017) found that that after exposure to magnetic water the percentage of killing *P.aeruginosa* bacteria was increased.

**• Chemical analysis:**

Using antitranspirats had a positive effect on cut flower stems as presented in table 10 which cleared that treating cut flowers with chitosan as an antitranspirats at 4% enhanced chlorophyll "a","b","carotenoids" and

**Table 10:** Effect of water type, antitranspirants and their interaction on chlorophyll a, b and carotenoids (mg/g f.w) and flavonoids (%) after two weeks during the vase life period of 2020 season.

| Treatments | Chemical analyses after two weeks | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Water type | Tap water | | | | | | Magnetized tap water | | | | | |
| | Leaves | | | | Flower | | Leaves | | | | Flower | |
| Antitranspirats | Chl.a | Chl.b | Car. | Flavo. | Car. | Flavo. | Chl.a | Chl.b | Car. | Flavo. | Car. | Flavo. |
| Control (0 %) | 1.10 | 0.70 | 0.42 | 0.74 | 0.73 | 0.70 | 1.20 | 0.74 | 0.59 | 0.84 | 0.83 | 0.81 |
| Chitosan 2% | 1.39 | 0.78 | 0.60 | 0.84 | 0.83 | 0.81 | 1.53 | 0.85 | 0.60 | 0.92 | 0.98 | 0.90 |
| Chitosan 4% | 1.46 | 0.83 | 0.63 | 0.89 | 0.83 | 0.83 | 1.62 | 0.87 | 0.63 | 0.95 | 0.99 | 0.92 |
| SA 2% | 1.38 | 0.75 | 0.43 | 0.82 | 0.77 | 0.80 | 1.42 | 0.69 | 0.65 | 0.86 | 0.86 | 0.84 |
| SA 4% | 1.35 | 0.68 | 0.48 | 0.83 | 0.70 | 0.82 | 1.36 | 0.56 | 0.42 | 0.87 | 0.86 | 0.86 |

Means followed by the same letters in a column or raw do not differ significantly according to Duncan's New Multiple Range test at P = 0.05.

**Table 11:** Effect of water type, antitranspirants and their interaction on chlorophyll a, b and carotenoids (mg/ g f.w), and flavonoids (%) at the end of experiment during the vase life period of 2020 season.

| Treatments | Chemical analyses after two weeks | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Water type | Tap water | | | | | | Magnetized tap water | | | | | |
| | Leaves | | | | Flower | | Leaves | | | | Flower | |
| Antitranspirats | Chl.a | Chl.b | Car. | Flavo. | Car. | Flavo. | Chl.a | Chl.b | Car. | Flavo. | Car. | Flavo. |
| Control (0 %) | 1.06 | 0.65 | 0.43 | 1.14 | 0.73 | 0.85 | 1.15 | 0.72 | 0.53 | 1.05 | 0.83 | 0.96 |
| Chitosan 2% | 1.27 | 0.69 | 0.59 | 1.26 | 0.83 | 1.21 | 1.43 | 0.78 | 0.58 | 1.35 | 0.98 | 1.31 |
| Chitosan 4% | 1.32 | 0.70 | 0.61 | 1.35 | 0.83 | 1.30 | 1.46 | 0.83 | 0.62 | 1.38 | 0.99 | 1.36 |
| SA 2% | 1.25 | 0.64 | 0.53 | 1.11 | 0.77 | 1.03 | 1.39 | 0.65 | 0.64 | 1.18 | 0.86 | 1.10 |
| SA 4% | 1.24 | 0.60 | 0.48 | 1.18 | 0.77 | 1.04 | 1.26 | 0.54 | 0.42 | 1.21 | 0.85 | 1.12 |
| Means followed by the same letters in a column or raw do not differ significantly according to Duncan's New Multiple Range test at P = 0.05. | | | | | | | | | | | | |

"flavonoids" content compared to the control in both seasons. The results show that use of chitosan can help in retaining freshness and color of flowers and leaves for a longer time, stimulates the synthesis of phenolic compounds, including flavonoids and carotenoids and this might be due to the reason that the thin transparent layer of chitosan hinders the escape of water vapor from the leaves and helps in improving the appearance. These results are in agreement with these of Jiang *et al*., 2005; Tanaka *et al*., 2008 and Bañuelos-Hernández *et al*., 2017) supporting the idea that "chitosan can improve the coloration, maintain the quality and increase shelf life, stem flowers coated with chitosan had the highest increase of flavonoid concentration from day 1 to 5 (46%)".

## Second experiment

### • Longevity:

Data presented in table 12 show that magnetizing tap water significantly improved longevity of the spikes compared with tap water which recorded 25.17 and 24.79 days in the two seasons, respectively. The lowest vase life of lilium flowers was achieved by tap water which recorded 23.16 and 23.15 days in the two seasons, respectively.

For the sake of convenience, the interaction effect between water and flower magnetic exposure time increased longevity in most treatments. The longest vase life was achieved by the interaction between flower magnetic exposure time treatment (30 minutes) and magnetizing tap water which recorded 26.96 and 26.14 days in the two seasons, respectively. The exposure of water to magnetic field reduced pH of the water, increased its ability to dissolve gases and reduce its surface tension and these factors could lead to overcoming air bubbles formed after cutting the flower stem.

These results are in a good agreement with Abdel-Kader *et al*., (2015) show that the use of magnetized water improved water uptake and subsequently fresh weight and vase life of cut gladiolus spikes, reduced pH of the water, increased its ability to dissolve gases. The vase life of cut flowers is extremely affected by vase water composition, which is one of the main challenges for florists today (Ahmad *et al*., 2013).

### • Flower bud open:

Data in table 13 found that all magnetized treatments significantly increased flower bud opening of Asiatic lily (*Lilium longiflorum* L.) cv. "Yellow Cocotte over the control in both seasons. The fastest flower bud open value was obtained from magnetic water treatment (control) and flower magnetic exposure time (30 minutes) as recorded 4.10 and 5.56 days in the two seasons, respectively followed by flower magnetic exposure time

**Table 12:** Effect of water type, flower magnetic exposure time and their interaction on longevity (days) of Asiatic lily (*Lilium longiflorum* L.) cv. "Yellow Cocotte during the vase life period in 2019 and 2020 seasons.

| Treatments | Longevity (days) | | | | | |
|---|---|---|---|---|---|---|
| Water type | First season (2019) | | | Second season (2020) | | |
| Exposure time | Tap water | Magnetized tap water | Mean B | Tap water | Magnetized tap water | Mean B |
| 0 Mintues | 21.54h | 23.64f | 22.59D | 22.11f | 23.00bc | 22.56C |
| 15 Mintues | 22.52g | 24.54d | 23.53C | 22.94e | 24.85c | 23.90B |
| 30 Mintues | 24.74c | 26.96a | 25.85A | 24.52d | 26.14a | 25.33A |
| 45 Mintues | 23.84e | 25.54b | 24.69B | 23.03e | 25.17b | 24.10B |
| Mean A | 23.16B | 25.17A | | 23.15B | 24.79A | |
| Means followed by the same letters in a column or raw do not differ significantly according to Duncan's New Multiple Range test at P = 0.05. | | | | | | |

**Table 13:** Effect of water treatments, flower magnetic exposure time and their interaction on flower bud open (days) of Asiatic lily (*Lilium longiflorum* L.) cv. "Yellow Cocotte during the vase life period of 2019 and 2020 seasons.

| Treatments | Flower bud open (days) | | | | | |
|---|---|---|---|---|---|---|
| Water type / Exposure time | First season (2019) | | | Second season (2020) | | |
| | Tap water | Magnetized tap water | Mean B | Tap water | Magnetized tap water | Mean B |
| 0 Mintues | 7.54a | 6.64ab | 7.09A | 7.20a | 6.78a | 6.99A |
| 15 Mintues | 7.15ab | 6.52ab | 6.84AB | 7.01a | 6.61ab | 6.81AB |
| 30 Mintues | 6.17b | 4.10 c | 5.14D | 5.56b | 6.4ab | 5.98D |
| 45 Mintues | 6.65ab | 6.40b | 6.53BC | 6.50ab | 6.54ab | 6.52BC |
| Mean A | 6.75A | 5.96 B | | 6.51B | 6.56A | |

Means followed by the same letters in a column or raw do not differ significantly according to Duncan's New Multiple Range test at P = 0.05.

**Table 14:** Effect of water type, flower magnetic exposure time and their interaction on flower head diameter (cm) of Asiatic lily (*Lilium longiflorum* L.) cv. "Yellow Cocotte during the vase life period of 2019 and 2020 seasons.

| Treatments | Flower head diameter (cm) | | | | | |
|---|---|---|---|---|---|---|
| Water type / Exposure time | First season (2019) | | | Second season (2020) | | |
| | Tap water | Magnetized tap water | Mean B | Tap water | Magnetized tap water | Mean B |
| 0 Mintues | 18.20bc | 18.04c | 18.10B | 17.72d | 18.44a | 18.08A |
| 15 Mintues | 18.45a | 18.41a | 18.43A | 18.45a | 18.15bc | 18.30A |
| 30 Mintues | 18.25ab | 18.31ab | 18.28AB | 18.01c | 18.44a | 18.23A |
| 45 Mintues | 18.40ab | 18.25ab | 18.33AB | 18.42a | 18.23b | 18.33A |
| Mean A | 18.33A | 18.24A | | 18.15A | 18.32A | |

Means followed by the same letters in a column or raw do not differ significantly according to Duncan's New Multiple Range test at P = 0.05.

**Table 15:** Effect of water type, flower magnetic exposure time and their interaction on relative fresh weight (%) of Asiatic lily (*Lilium longiflorum* L.) cv. "Yellow Cocotte during the vase life period of 2019 and 2020 seasons.

| Treatments | Relative fresh weight (%) | | | | | |
|---|---|---|---|---|---|---|
| Water type / Exposure time | First season (2019) | | | Second season (2020) | | |
| | Tap water | Magnetized tap water | Mean B | Tap water | Magnetized tap water | Mean B |
| 0 Mintues | 67.18h | 77.65g | 72.42D | 65.16g | 80.65f | 72.91D |
| 15 Mintues | 89.65f | 90.65d | 90.15C | 87.63e | 92.10h | 89.87C |
| 30 Mintues | 93.16b | 95.18a | 94.17A | 94.10c | 97.52a | 95.81A |
| 45 Mintues | 90.15e | 92.14c | 91.15B | 93.15d | 95.00b | 94.08B |
| Mean A | 85.04B | 88.91A | | 85.01B | 91.32A | |

Means followed by the same letters in a column or raw do not differ significantly according to Duncan's New Multiple Range test at P = 0.05.

(30 minutes) as gave 5.14 and 5.98 days in the two seasons, respectively. The use of magnetized water and exposure time accelerated flower bud open may be due to improved water uptake, increase its ability to dissolve gases, reduce its surface tension and magnetic field characteristics such as intensity and exposure time, also. Electromagnetic field can interact with all living cells so that can modulate their functions.

These results are conformity with those of Nyakane *et al.*, 2019 who reported that the effects of magnetic field on plants may be dependent magnetic field characteristics and species.

- **Flower head diameter:**

It is evident from the obtained data in table 14 that all treatments did not show significant differences in flower diameter because the flowers were picked at the same stage and the same time (at the beginning of the flower bud coloring). These results are in a good agreement with those of Eissa, (2008) on *Chrysanthemum leucanthemum* L. and *Rudbeckia tricolor* L. revealed that the flowers were picked at the same stage did not show significant differences in flower diameter.

- **Relative fresh weight:**

As presented in table 15 data realized that cut flowers of Asiatic lily (*Lilium longiflorum* L.) cv. "Yellow Cocotte were influenced by all used water treatments and flower magnetic exposure time treatments. Treating cut flowers recorded the maximum results with highly significant differences compared to the control in both seasons. A similar findings was also obtained regarding the effect of the interaction between water treatments and flower magnetic exposure time treatments gave 94.65 and

**Table 16:** Effect of water type, flower magnetic exposure time and their interaction on relative dry matter (%) of Asiatic lily (*Lilium longiflorum* L.) cv. "Yellow Cocotte during the vase life period of 2019 and 2020 seasons.

| Treatments | Dry matter (%) | | | | | |
|---|---|---|---|---|---|---|
| Water type / Exposure time | First season (2019) | | | Second season (2020) | | |
| | Tap water | Magnetized tap water | Mean B | Tap water | Magnetized tap water | Mean B |
| 0 Mintues | 17.04g | 18.34f | 17.69D | 16.72g | 20.98f | 18.85D |
| 15 Mintues | 27.87e | 29.05d | 28.46C | 28.45e | 31.39d | 29.92C |
| 30 Mintues | 31.61b | 35.04a | 33.33A | 33.81b | 37.53a | 35.67A |
| 45 Mintues | 28.97d | 31.40c | 30.19BD | 31.31d | 32.00c | 31.66B |
| Mean A | 26.37B | 28.46A | | 27.57B | 30.48A | |

Means followed by the same letters in a column or raw do not differ significantly according to Duncan's New Multiple Range test at P = 0.05.

97.45% in the two seasons, respectively. In this research the stimulatory effect of magnetized treated water on relative fresh weight is probably due to induction of mitosis and cell metabolism, all catalytic processes involving oxidation and cause an increase and accelerate the activity of growth and development of the plant, which is related to increase GA3, RNA, DNA and enzyme activities. Similar trends were reported by (Nasher, 2008; Yadollahpour *et al.*, 2014 and Nyakane *et al.*, 2019) found that certain combinations of magnetic field and duration are very effective in improving growth characteristics, as applied magnetic field changes memory effect which not disappears directly after removing magnetic field and is the main feature of its application; the memory time of MTW depends on the magnetic field strength and time of exposure.

**• Dry matter:**

Data presented in table 16 cleared that dry matter % increased by all treatments which maintain positive values. The maximum dry matter was achieved by magnetized tap water and flower magnetic exposure time at 30 minutes as gave 35.04 and 37.67%, respectively in both seasons. The minimum dry matter was achieved by tap water as gave 17.69 and 16.85% in both seasons. These results are in agreement with those of (Tanaka *et al.*, 2010) as they revealed that the magnetic field significantly increased fresh and dry weight of treated Phalaenopsis clusters.

**• Water loss:**

It is clear from data presented in table 17 that rates of water loss in cut Asiatic lily (*Lilium longiflorum* L.) cv. "Yellow Cocotte stems decreased by magnetizing tap water during vase period as gave 117.75 and 121.94 ml/ flower in both seasons, respectively, most treatments gradually decreased water loss compared to control in both seasons, the best treatment was magnetizing tap water and flower magnetic exposure time at 30 minutes as gave 113.78 and 119.43 ml/ flower in both seasons, respectively, the highest values were obtained from tap water (control) as gave 122.12 and 125.44 in both seasons, respectively. Magnetized water increased the relative fresh weight as may be reflected in biomass increase. In our research this increment may be due to increase water uptake under magnetic treatment which leads to biochemical changes or altered enzyme activities, which might have resulted in better development of photosynthesis stimulation. These results of the present experiment were in line with those of Abobatta, 2015 who reported that "the electromagnetic fields increase the plant growth regulator and induced phenylalanine ammonia-lyrase during cell differentiation in the suspended cultured plant cell".

**• Water uptake:**

It is clear from data presented in table 18 that rates of water uptake in cut flower stems significantly were

**Table 17:** Effect of water type, flower magnetic exposure time and their interaction on water loss (g/flower) of Asiatic lily (*Lilium longiflorum* L.) cv. "Yellow Cocotte during the vase life period of 2019 and 2020 seasons.

| Treatments | Water loss (g/flower) | | | | | |
|---|---|---|---|---|---|---|
| Water type / Exposure time | First season (2019) | | | Second season (2020) | | |
| | Tap water | Magnetized tap water | Mean B | Tap water | Magnetized tap water | Mean B |
| 0 Mintues | 125.19 a | 120.68 d | 122.94A | 128.10 a | 122.99 f | 125.55A |
| 15 Mintues | 119.20 e | 118.42 f | 118.81C | 124.16 e | 120.52 g | 122.34C |
| 30 Mintues | 122.64 b | 113.78h | 118.21D | 124.36 d | 119.43 h | 121.90D |
| 45 Mintues | 121.45 c | 118.10g | 119.78B | 125.14 b | 124.82c | 124.98B |
| Mean A | 122.12B | 117.75A | | 125.44B | 121.94A | |

Means followed by the same letters in a column or raw do not differ significantly according to Duncan's New Multiple Range test at P = 0.05.

**Table 18:** Effect of water type, flower magnetic exposure time and their interaction on water uptake (ml./flower) of Asiatic lily (*Lilium longiflorum* L.) cv. "Yellow Cocotte during the vase life period of 2019 and 2020 seasons.

| Treatments | Water uptake (ml./flower) | | | | | |
|---|---|---|---|---|---|---|
| Water type / Exposure time | First season (2019) | | | Second season (2020) | | |
| | Tap water | Magnetized tap water | Mean B | Tap water | Magnetized tap water | Mean B |
| 0 Mintues | 113.26h | 126.67g | 119.97D | 118.77h | 130.17g | 124.47D |
| 15 Mintues | 135.51e | 138.99b | 137.25B | 137.90e | 140.26b | 139.08B |
| 30 Mintues | 137.87d | 139.84a | 138.86A | 138.26d | 142.87a | 140.57A |
| 45 Mintues | 134.67f | 138.15c | 136.41C | 133.36f | 140.00c | 136.68C |
| Mean A | 130.33B | 135.91A | | 132.07B | 138.33A | |

Means followed by the same letters in a column or raw do not differ significantly according to Duncan's New Multiple Range test at P = 0.05.

**Table 19:** Effect of water type, flower magnetic exposure time and their interaction on water analysis after two weeks of experiment of Asiatic lily (*Lilium longiflorum* L.) cv. "Yellow Cocotte during the vase life period of 2020 season.

| Treatments | Water analysis after two weeks | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| Water type / Exposure time | Tap water | | | | | Magnetized tap water | | | | |
| | pH | EC (dS /m$^{-1}$) | TC (Cfu/ml.) | AC (Cfu/ml.) | Fungi (Cfu/ml.) | pH | EC (dS /m$^{-1}$) | TC (Cfu/ml.) | AC (Cfu/ml.) | Fungi (Cfu/ml.) |
| **0 Mintues** | 7.63 | 0.82 | 15 | 12 | 25 | 7.50 | 0.72 | 5 | 1 | 3 |
| **15 Mintues** | 7.61 | 0.73 | 40 | 5 | 30 | 7.45 | 0.70 | 40 | 2 | 18 |
| **30 Minutes** | 7.57 | 0.71 | 45 | 10 | 32 | 7.39 | 0.55 | 50 | 4 | 20 |
| **45 Mintues** | 7.55 | 0.60 | 55 | 11 | 35 | 7.26 | 0.47 | 55 | 5 | 25 |

Means followed by the same letters in a column or raw do not differ significantly according to Duncan's New Multiple Range test at P = 0.05.

**Table 20:** Effect of water type, flower magnetic exposure time and their interaction on water analysis at the end of experiment of Asiatic lily (*Lilium longiflorum* L.) cv. "Yellow Cocotte during the vase life period of 2020 season.

| Treatments | Water analysis at the end of experiment | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| Water type / Exposure time | Tap water | | | | | Magnetized tap water | | | | |
| | pH | EC (dS /m$^{-1}$) | TC (Cfu/ml.) | AC (Cfu/ml.) | Fungi (Cfu/ml.) | pH | EC (dS /m$^{-1}$) | TC (Cfu/ml.) | AC (Cfu/ml.) | Fungi (Cfu/ml.) |
| **0 Mintues** | 7.55 | 0.84 | 38 | 12 | 22 | 7.53 | 0.82 | 12 | 3 | 6 |
| **15 Mintues** | 7.65 | 0.71 | 95 | 9 | 61 | 7.50 | 0.78 | 66 | 5 | 52 |
| **30 Minutes** | 7.67 | 0.90 | 98 | 14 | 75 | 7.45 | 0.64 | 75 | 9 | 56 |
| **45 Mintues** | 7.66 | 0.83 | 125 | 15 | 81 | 7.42 | 0.51 | 95 | 12 | 63 |

Means followed by the same letters in a column or raw do not differ significantly according to Duncan's New Multiple Range test at P = 0.05.

improved by using magnetizing tap water during vase period as gave 135.91 and 138.33 ml/ flower in both seasons, respectively, most treatments gradually increased water uptake over control in both seasons and the best treatment was magnetizing tap water and flower magnetic exposure time at 30 minutes as gave 139.84 and 142.87 ml/ flower in both seasons, respectively. The effect of magnetized water on water uptake might be related to its improving ability to dissolve gasses, at the start of vase life.

In this respects, Abdel-Kader *et al*., 2015 reported that gladiolus spikes placed in magnetized tap water had highest water uptake at the beginning of the vase life followed by tap water. However, water uptake tended to decrease throughout the vase life and water uptake by spikes placed in magnetized tap water sharply decreased by the last few days of vase life

The effect of magnetized water on the trend of water uptake might be related to that air will be trapped between the pit membranes of the vessels inside the xylem and the water column and it would be dissolved into surrounding water in order to be removed from these cut open vessels (Abdel-Kader *et al*., 2015).

Because, in most cases, consumers will not use deionized water for their cut flowers (Macnish *et al*., 2005), there is a debate about the use of deionized water in postharvest of cut flowers, since research was made about using tap water or other types of water to replace the use of distilled water for keeping the cut flowers (Abdel-Kader, 2004; Saleem *et al*., 2014). Abdel-Kader *et al*., 2015, gives a potential of using magnetized tap water in cut gladiolus flower preservatives.

- **Water analysis:**

Data in tables (19 and 20) cleared that most

**Table 21:** Effect of water type, flower magnetic exposure time and their interaction on chlorophyll a, b and carotenoid (mg/ g f.w) and flavonoids% after two weeks of Asiatic lily (*Lilium longiflorum* L.) cv. "Yellow Cocotte during the vase life period of 2020 season.

| Treatments | Chemical analyses after two weeks | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Water type | Tap water | | | | | | Magnetized tap water | | | | | |
| | Leaves | | | | Flower | | Leaves | | | | Flower | |
| Exposure time | Chl.a | Chl.b | Car. | Flavo. | Car. | Flavo. | Chl.a | Chl.b | Car. | Flavo. | Car. | Flavo. |
| 0 Minutes | 1.03 | 0.42 | 0.52 | 0.74 | 0.70 | 0.70 | 1.31 | 0.51 | 0.56 | 0.84 | 0.73 | 0.81 |
| 15 Minutes | 1.29 | 0.45 | 0.57 | 0.84 | 0.72 | 0.81 | 1.37 | 0.59 | 0.60 | 0.92 | 0.75 | 0.90 |
| 30 Minutes | 1.34 | 0.59 | 0.63 | 0.89 | 0.74 | 0.83 | 1.40 | 0.73 | 0.63 | 0.95 | 0.79 | 0.92 |
| 45 Minutes | 1.27 | 0.45 | 0.56 | 0.82 | 0.73 | 0.80 | 1.32 | 0.64 | 0.59 | 0.86 | 0.74 | 0.84 |

Means followed by the same letters in a column or raw do not differ significantly according to Duncan's New Multiple Range test at P = 0.05.

**Table 22:** Effect of water type, flower magnetic exposure time and their interaction on chlorophyll a, b and carotenoid (mg/g f.w) and flavonoids% at the end of Asiatic lily (*Lilium longiflorum* L.) cv. "Yellow Cocotte during the vase life period of 2020 season.

| Treatments | Chemical analyses at the end of experiment | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Water type | Tap water | | | | | | Magnetized tap water | | | | | |
| | Leaves | | | | Flower | | Leaves | | | | Flower | |
| Exposure time | Chl.a | Chl.b | Car. | Flavo. | Car. | Flavo. | Chl.a | Chl.b | Car. | Flavo. | Car. | Flavo. |
| 0 Minutes | 0.97 | 0.44 | 0.28 | 0.73 | 0.73 | 1.14 | 1.21 | 0.47 | 0.57 | 0.73 | 0.73 | 0.96 |
| 15 Minutes | 1.24 | 0.50 | 0.32 | 0.83 | 0.74 | 1.26 | 1.28 | 0.49 | 0.60 | 0.83 | 0.75 | 1.31 |
| 30 Minutes | 1.26 | 0.56 | 0.45 | 0.83 | 0.76 | 1.35 | 1.31 | 0.59 | 0.63 | 0.83 | 0.79 | 1.36 |
| 45 Minutes | 1.19 | 0.54 | 0.43 | 0.77 | 0.74 | 1.11 | 1.25 | 0.57 | 0.65 | 0.77 | 0.74 | 1.10 |

Means followed by the same letters in a column or raw do not differ significantly according to Duncan's New Multiple Range test at P = 0.05.

treatments gradually increased water uptake over control in two seasons. In this investigation, the effect of magnetic water on the partial physical properties of water are reported, tap water with or without magnetic water were measured in the same condition. It was found that the properties of tap water were changed following the magnetic water treatment, shown as the decreased of pH values and the decrease of EC water after magnetization, the changes depend on the longtime of magnetization effect. In addition, magnetic field strength has a marked influence on the magnetization effect, the optimal magnetizing condition was determined as the MF after 30 minutes. Magnetic water has been shown to affect the properties of water and its constituents. Tao and Jonathan, (2020) indicated that magnetic water has been to affect the properties of water and its constituent's assessments of changes in electrical conductivity. In various different treatments passing water through a magnetic field has been claimed to improve physical, chemical and bacteriological quality of water. These results are in agreement with those of (Mahon, 2009 and El-Sabrout and Hanafy, 2017) they reported that physically, exposure of the water to a magnetic field changes the water's properties including raising dissolved oxygen and minerals, moreover increasing the total hardness.

**• Chemical analyses:**

Data presented in tables (21 and 22) showed the effect of water treatments, flower magnetic exposure time and their interaction on chlorophyll a, b and carotenoid (mg/ g f.w) and flavonoids (%).

In this respect Radhakrishnan and Kumari, (2012) reported that magnetic treatment are assumed to improve plant vigour by influencing the biochemical process that involve free radicals and by stimulating the activity of enzymes and proteins.

Finally in the same manner (Maheshwari and Grewal, 2009) associated the mechanism of magnetic field with the activation of phyto-hormone such as trans zeatin, indole-3-acetic acid and gibberellic acid-equivalents as well as activation of the bio-enzyme systems.

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## Conclusion

Based on the results of this study, it could be concluded that many aspects of postharvest quality such as longevity, water loss, water uptake, relative fresh weight were significantly influenced by different types of antitranspirants and magnetized tap water, in the first experiment, the best treatment was chitosan at 4% as antitranspairants with magnetized tap water while in the second experiment, the best treatment was flower magnetic exposure time at 30 minutes with magnetize tap water for all studied traits.

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