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EFFECT OF MYCORRHIZA FUNGI AND SALINITY OF IRRIGATION WATER ON THE GROWTH AND FLOWERING OF LISIANTHUS PLANT [LISTEN TO GRANDIFLORUM (RAF.) SHINN.] ADVANTAGE CULTIVAR

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Abstract

This experiment was conducted to study the effect of the inoculation with Micorrhiza and salinity of irrigation water on plant growth and flowering of Lisianthus plant [Listen to Grandiflorum (Raf.) Shinn.] Advantage cultivar, F1 included two factors, first: Fungal bio-inoculation with Mycorrhiza, It is with two levels (M0: without inoculation, M1: 15 g / seedling) using Mycorrhiza fungi (*Glomus intraradices*, *Glomus mosseae*), second: saline irrigation water (drainage water), with four levels (S0: Tap water, S1: 3 ds.m^{-1}, S2: 6 ds.m^{-1}, S3: 9 ds.m^{-1}) was prepared by mixing the drainage water with the tap water, the treatment began with salt levels after a month of cultivating the seedlings in the land of the greenhouse. The results showed that the inoculated of Lisianthus plants with Mycorrhiza significantly reduced the harmful effects of saline water (drainage water), reduced the effectiveness of the antioxidants enzyme (POD, SOD), the leaves content of proline. It also led to a significant increase in the vegetative and flower growth traits (plant height, number of inflorescence per plant, vase life of cut flowers). The treatment of the bio-inoculation was significantly improved in the number of spores and the percentage of infection with Mycorrhiza, while the leaves content of proline and the effectiveness of the antioxidants enzyme (POD, SOD) with the salinity of irrigation water, the level (9 ds.m^{-1}) recorded the highest to it. The salinity of irrigation water reduced the plant height, the number of inflorescence per plant, the vase life of flowers, the number of spores and the percentage of root infection with Mycorrhizia. Where, the level 9 ds.m^{-1} gave the lowest averages.

Key words : Mycorrhiza fungus, salinity of irrigation water, Lisianthus plant.

Introduction

Salinity is a major and important problem facing the agricultural sector for areas exposed to the lack of Irrigation water suitable for agricultural irrigation. It is a major factor in transforming fertile and productive land into deserts and it leads to changing the biological diversity of natural plants, thus reducing the growth and yield plants in these soils.Through their effects in reducing the plant's ability to absorb water and nutrients from the soil solution, destruction of soil structure and increased toxicity due to high concentrations of certain ions, inhibition of cell expansion, impact on photosynthesis process, inhibition of metabolism and Production of effective oxygen species (ROS). In addition to inhibiting the effectiveness of enzymes and imbalance in the hormonal balance of the plant especially when the subjected to high concentrations of salts or for a long period of stress (Wang *et al*., 2013) and because of the aggravation it in irrigation and soil water and the occurrence of droughts, low rainfall amounts, high temperatures, high evaporation, reduction of vegetation and transpiration. The use of medium-saline water in irrigation operations has been recently focused on the commercial production of economically important species in many countries of the world.These species include Lisianthus plant [*Eustoma grandiflorum* (Raf.) Shinn]. It is a herbaceous plant, annual or Biennial or Perennial depending on species and environment, its original country is semi-dry regions of the southern United States, northern Mexico and the Caribbean in the West Indies, Nebraska to Louisiana and Mexico, indicating that it is adapted in more harsh environments than the other cultivating ornamental plants (Riva-Morales *et al*., 2013).

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Lisianthus has recently been introduced into the market as an ornamental plant. It occupies a global position and is quickly classified in the top ten species of cut flowers worldwide (Kiamohammadi, 2011). It has become a favorite flower because of its long vase life and its flowers that resemble Rose flowers and their multiple colors worldwide it is expected to become even more popular in the next century (Valdez-Aguilar, 2013). Its reproductive by cutting, seeds,tissue culture and the bulk of the seedlings are produced by seeds which characterized by small size, slow germination and long growth period with low percentage of germination (Esizad *et al*., 2012). The "Advantage" cultivar is one of the hybrid species. Its flowers are large in size, medium speed in maturity and Its height ranges (70-90 cm), its seeds are small that grow at 15-18°C during a period of 25-20 days, Its production is suitable for high temperature and long day conditions. Several strategies have been adopted to reduce the severity of the adverse effects of salinity, such as the use of microorganisms that promote growth and increase plant tolerance to salt stress. Among these organisms, symbiotic fungi in the plant roots were used to improve nutrient uptake and increase plant susceptibility to environmental stresses. Mycorrhiza fungus is the most common fungus, infecting about 95% of plants (Smith and Read, 2008). The fungi have many characteristics that have made it the focus of researchers' interest. These properties are able to form a symbiotic relationship with the plant. It takes from the host the source of energy (carbon) and provides the plant with the necessary nutrients, especially phosphorus, As well as providing the plant with nitrogen, zinc and manganese in addition to its role in the protection of plants against environmental stresses such as drought and salinity, reduce the plants need for water and enrich the environment of roots by many compounds. It also helps to collect soil granules with the secretion of the substance of the globin, which is the desired condition in building the soil, the growth rates of inoculated plants compared to non-inoculated plants in dry lands and water stress were also observed (Bolandnazar *et al*., 2007). In the studies conducted, Saleh (2015) found when studying the effect of the Mycorrhiza fungus in the growth and flowering of Gladiolus plant and their vase life increased significantly in all the vegetative and flowering traits and plant content of nutrient elements, Kumar (2014) found that when inoculation the mint plant with Mycorrhiza fungi (*Acaulospora laevis* and *Glomus mosseae* species), there was a significant increase in plant lengths, fresh and dry weight of roots, branches, length of roots and the percentage of infection with Mycorrhiza in comparison with the control treatment. It also found a decrease in the density of spores formed with the increased Mycorrhiza infection in the roots. Khalaf (2013) also found when studying the effect of the Mycorrhiza fungus on the growth and storage of *Dianthus caryophllus* flowers, significant increase in plant height and vase life of flowers. Hassan *et al*. (2012) found that the treatment with Mycorrhiza fungi improved the vegetative and flowering traits of catharanthus roseus, while Valdez-Aguilar *et al*. (2013) found that the water use at 17 $ds.m^{-1}$ concentration led to obtaining the lowest averages of Vegetative and syphilis growth of the lisianthus plant. Bayat *et al*. (2013) found that exposure of *Calendula officinalis* L. to levels of sodium chloride caused a significant decrease in plant height and number of flowers. Sadak and Dawood (2013) found that the treatment of Linum usitatissinun with different saline concentrations led to a significant decrease in all vegetative traits and high sodium content. For the purpose of expanding the cultivation of ornamental plants and trying to alleviate the problem of irrigation water salinity it became necessary to develop a deliberate strategy for the use of the Mycorrhiza fungi in the development of Lisianthus plant under the conditions of salt stress. The study aims to Studying the effect of irrigating with salty water in the growth and flowering of Lisianthus plant, "Advantage" cultivar, and the role of Mycorrhiza fungi in increasing the plant resistance to salt stress, thus improving its growth and prolonging vase life after cut flowers.

Materials and Methods

The research was conducted in the greenhouse belonging to one of the ornamental nurseries in Babylon Province, Musayyib district for the two seasons (first: from 30/11/2012 to 30/12/2013) and (second: from 8/12/2013 to 30/12/2014) to study the effect of Mycorrhiza fungi and irrigation with saline water (drainage water) on the growth and flowering of the Lisianthus (*Eustoma grandiflorum*) F1 type "Advantage" cultivar with pale purple color as shown in fig. 1.

The soil of the greenhouse was substituted to a depth of 30 cm by placing an agriculture media consisting of Animal manure (sheep), full decomposition, peat moss, and loamy sand, with a volume ratio of 1: 3: 6. The soil was smoothed and divided into basins; wooden dividers were placed between each two basins and another, with 40 cm height. Lisianthus seeds plant (*Eustomagradiflorum*) were imported F1 Advantage cultivar with pale purple color from Japan by a delegate from the Japanese company TAKII in Baghdad. The

Fig. 1 : Flowers of Lisianthus plant (*Eustoma grandiflorum*) "Advantage" cultivar.

seeds of the first season were cultivated in the GlassHouse beloning to Imam Husayn Shrine Nurseries in Karbala Province, while the seeds of the second season were cultivated in the glasshouse of the Department of Horticulture and Landscaper Gardening, College of Agriculture, University of Baghdad. Abu Ghraib, seeds were cultivated for two seasons in plastic dishes of 128 seeds, peat moss used as an agriculture media. Seeds started to germinate after 27 days of cultivating and the percentage of germination was low which reached 46%. The seedlings were separated after 90 days of cultivating the seeds in plastic sac with size of (10 × 10) cm containing the Peat moss treated with fungicide (Beltanol) by 2 ml /10 L of water. Seedlings were sprayed after separation with a solution of 18: 18: 18 NP.K balanced fertilizer by 2 g / L water. Then after a month, seedlings were cultivated in the land of the greenhouse. The experiment included the following factors:

First : the fungal vaccine

The control treatment (without inoculation), which is symbolized by M_0; the fungal inoculation treatment which is symbolized by M_1. A mixture of 15 g of fungal vaccine consisting of Glomus intraradices fungus (producing at Biovita Laboratories in Al Ain, UAE) and *Glomus mosseae* fungi, (obtaining from the Agricultural Research Department of the Ministry of Science and Technology) was placed in the pits prepared for cultivating the seedlings. It has been taken into account that the Mycorrhiza vaccine be in contact with the seedlings roots (Matysiak and Falkowski, 2010).

Second:Salt levels

Four levels of salinity of irrigation water were prepared. High salinity drainage water was used with (Ec = 20.9) and then was diluted by the tap water to the three saline levels used in the experiment, which included

1. The control treatment (tap water): S0 1.13 $ds.m^{-1}$.
2. The first salt level: S1 3 $ds.m^{-1}$.
3. The second salt level: S2 6 $ds.m^{-1}$.
4. The third salt level: S3 9 $ds.m^{-1}$.

Drip irrigation system was used in the irrigation process through the Drip system was installed on four water tanks each tank dedicated to one of the levels of salt used in the experiment. The plants cultivated under a greenhouse covered with a green agricultural net in the basins (1 × 2 m) on the lines, the distance between line and other is 30 cm and between the plant and other is 30 cm. All service operations were done from irrigation and weeding as needed. Apical Tips was pinched after a week of cultivating and for all the plants in order to encourage the growth of lateral branches. Plant irrigation was conducted using tap water for one month and then the process of exposing the plants to salt stress was started using pre-prepared salt levels in irrigation process rather than tape water. Irrigation operations continued whenever the plant needed water to use saline modified water according to the above levels until the end of the experiment. The plants were supported by reeds and tied with plastic laces to prevent the plants from lying on the ground, especially after the flowers appeared on them. The experiment was conducted as a complete randomize design (CRD), withthree replicates. The SAS program was used to conduct statistical analyzes. The averages for all study indicators were compared to the least significant difference (LSD) at the probability level of 5% (Al-Sahuki, 1990) (fig. 2). The following traits were studied:

Plant height (cm)

Plant height was measured from the soil surface to the highest point in the plant by the ruler metric (Abdali, 2011).

Number of inflorescence per plant

The number of inflorescence forming on each plant was calculated until the end of flowering and for all plants.

Vase life

Vase life was calculated as marketable until signs of wilt or blackness appeared on the petals (Rahman *et al*., 2012).

Estimation of leaves content of amino acid (proline)

Proline was estimated according to (Bates *et al*., 1973).

Estimation of the percentage of roots infected with Mycorrhiza

The method described by (Floss *et al*., 2008) was used.

Fig. 2 : Recycling process for the seedlings of Lisianthus plant.

Calculation of the number of Mycorrhiza spores (spore. 10 g^{-1} dry soil)

Calculated using (Gaur and Adholya, 1994).

Estimation the Effectiveness of Superoxide dismutase (SOD)

The enzymatic efficacy (UI.g^{-1} gram weight) of this enzyme was estimated using Lisianthus leaf extract using the method of (Beyer and Fridowich, 1987).

Estimation the Peroxidase enzyme efficacy (POD)

Enzyme efficacy was estimated in the method described by Nezih (1985).

Results and Discussion

Plant height (cm)

Table 1 shows the superiority of the treatment of the bio-vaccine in plant height trait which gave the highest value in both seasons was 72.67 and 65.79 cm, respectively, compared to the non-inoculation treatment (M_0) for the first and second seasons (58.55, 57.10 cm), respectively. The salinity of irrigation water had a significant effect on reducing the plant height, the third treatment (S_3) recorded the lowest plant height in both seasons (55.66, 51.04 cm), respectively, while the highest ratio was recorded in both seasons (71.72, 67.23 cm), respectively. In the interaction between the levels of Mycorrhiza and salinity levels, S_0M_1 and S_1M_1 treatments were excelled by giving them (76.00, 75.33 and 70.15, 70.44 cm) respectively, while S_3M_0 treatment showed the lowest plant height in both seasons (45.22, 43.61 cm), respectively.

Number of inflorescences per plant

Table 2 shows the significant effect of the Mycorrhiza fungi in the increasing the number of inflorescences per plants.In both seasons, the inoculating plants recorded (4.53, 4.81 inflorescences/plant), respectively, compared to the non-inoculated plants, which recorded (2.72, 3.16 inflorescences / plant), respectively, and the treatment of salinity level (S_3: 9 ds.m^{-1}) recorded the lowest average number of inflorescences for both seasons of the experiment were (2.61, 3.22 inflorescences / plant), respectively, compared to the control treatment (S_0) (tap water) which recorded for both seasons (4.22, 4.56 inflorescences / plant), respectively.In the bi-interaction between the inoculation with Mycorrhiza and the salinity treatment, the M1 treatment with salinity levels (S_0, S_1, S_2) was recorded in the first season with a highest value of this trait (5.00, 4.89, 4.67 inflorescences / plant). The results of the second season indicated the superiority of the treatment (S_0M_1) by recording the highest value of this trait (5.33 inflorescences/plant), which surpassed the treatment (S_3M_0), which recorded the lowest value (2.44 inflorescences / plant).

Vase life of Lisianthus flowers

The vase life of flowers after cut flowers depends on the nutritional status for the plants from which flowers are cut. More than 30% of the ability of flowers to survive long after the cut flowers to the circumstances in which the plants grow up and the flowers that are taken from them. Table 3 shows that the treatment of M_1 was excelled by giving it a value (17.83, 16.64 days) for the first and

Table 1 : Effect of Mycorrhiza fungus and salinity of irrigation water on the height of Lisianthns plant (cm) "Advantage" cultivar.

Inoculation with Mycorrhiza		First seasons					Second seasons				
Mycorrhiza M		Salinity of irrigation water (ds.m^{-1})				Mycorrhiza M	Salinity of irrigation water (ds.m^{-1})				Mycorrhiza M
		S_0	S_1	S_2	S_3		S_0	S_1	S_2	S_3	
		Tap water	3	6	9		Tap water	3	6	9	
M ×S	M_0	67.43	63.88	57.66	45.22	58.55	64.27	63.65	56.86	43.61	57.10
	M_1	76.00	75.33	73.22	66.11	72.67	70.19	70.44	64.06	58.48	65.79
L.S.D (0.05)		**1.94**				**0.86**					**0.77**
Salinity of irrigation water (S)		71.72	69.61	65.44	55.66		67.23	67.05	60.46	51.04	
L.S.D (0.05)		**1.21**				**1.09**					

Table 2 : Effect of Mycorrhiza fungus and salinity of irrigation water on the number of inflorescences per plant of Lisianthns plant "Advantage" cultivar.

Inoculation with Mycorrhiza		First seasons					Second seasons				
Mycorrhiza M		Salinity of irrigation water (ds.m^{-1})				Mycorrhiza M	Salinity of irrigation water (ds.m^{-1})				Mycorrhiza M
		S_0	S_1	S_2	S_3		S_0	S_1	S_2	S_3	
		Tap water	3	6	9		Tap water	3	6	9	
M ×S	M_0	3.45	3.34	2.44	1.66	2.72	3.78	3.44	3.00	2.44	3.16
	M_1	5.00	4.89	4.67	3.56	4.53	5.33	5.11	4.78	4.00	4.81
L.S.D (0.05)		**0.49**				**0.23**					0.22
Salinity of irrigation water (S)		4.22	4.11	3.56	2.61	4.56	4.28	3.89	3.22		
L.S.D (0.05)		**0.33**				**0.31**					

second seasons, respectively. Decreased vase life of flowers with increased salinity of irrigation water. The treatment (S_0) showed a significant increase in this trait for the first and second seasons by giving it (16.50, 15.39 days) respectively, while the treatment (S_3) recorded the lowest average of vase life after cut flowers for the first and second season was (14.00,13.00 days), respectively. The S_0M_1, S_1M_1 and S_2M_1 treatments were significantly excelled in thebi-interaction between the fungal and salinity levels in both seasons (18.78, 18.33, 18.00 days and 17.44, 17.33, 16.78 days), respectively, compared to the S_3M_0 treatment which recorded the lowest average of vase life for flowers of the first and second seasons was (1.77, 11.00 days), respectively.

Leaves content of proline acid (mg.g^{-1} dry weight)

Proline is one of the amino acids produced by the plant more than other amino acids when exposed it to Abiotic stresses (environmental), especially salt and water stress. It acts as an Osmotic regulator and as a non-enzymatic antioxidant and is quantified in plant tissues with the amount of stress and the duration of exposure. Table 4 shows that the fungal vaccine reduced the average concentration of proline in the two seasons (0.266 and 0.318 mg.g^{-1} dry weight) before using the vaccine to reach (0.186, 0.01 mg.g^{-1} dry weight), respectively after using the vaccine. Proline levels increased with increased salinity of irrigation water. The lowest average of proline content in leaves at saline level irrigation (S_0) (tap water), which gave for both seasons of (0.171, 0.191 mg.g^{-1} dry

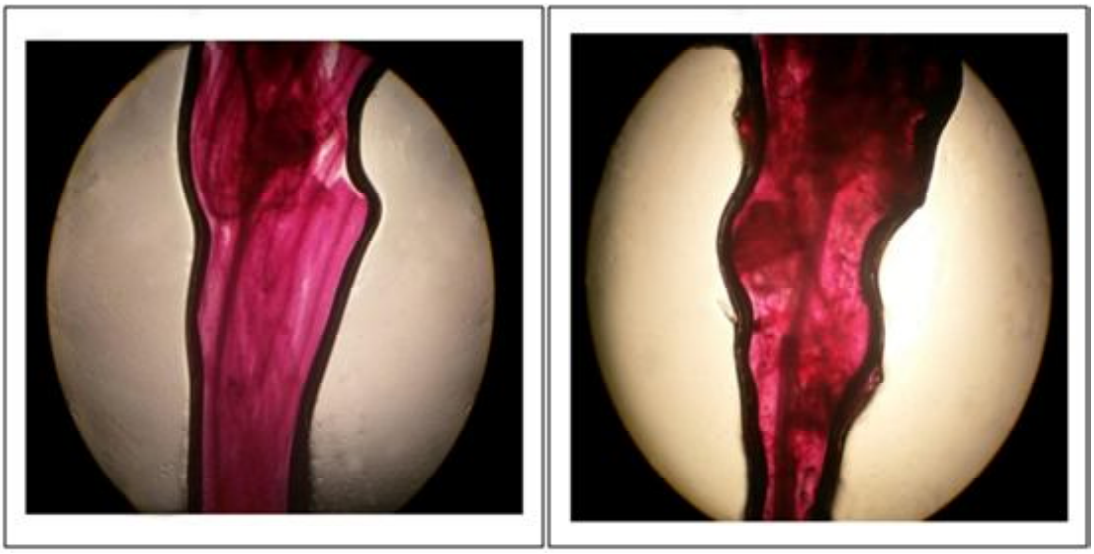

Fig. 3 : Shows the severity of the infection of Lisianthus (Advantage cultivar) roots with Mycorrhiza.

Table 3: Effect of Mycorrhiza fungus and salinity of irrigation water on the vase life of Lisianthns plant "Advantage" cultivar.

Inoculation with Mycorrhiza		First seasons					Second seasons				
Mycorrhiza M		Salinity of irrigation water (ds.m^{-1})				Mycorrhiza M	Salinity of irrigation water (ds.m^{-1})				Mycorrhiza M
		S_0	S_1	S_2	S_3		S_0	S_1	S_2	S_3	
		Tap water	3	6	9		Tap water	3	6	9	
M ×S	M_0	14.22	14.11	13.67	11.77	13.44	13.33	13.00	12.00	11.00	12.33
	M_1	18.78	18.33	18.00	16.22	17.83	17.44	17.33	16.78	15.00	16.64
L.S.D (0.05)		**0.79**				**0.26**	**0.74**				**0.33**
Salinity of irrigation water (S)		16.50	16.22	15.83	14.00		15.39	15.17	14.39	13.00	
L.S.D (0.05)		**0.36**	**0.47**								

weight), respectively, while the highest average at the treatment of S_3 (9 ds.m^{-1}) for both seasons was (0.325, 0.370 mg.g^{-1} dry weight), respectively. The S_0M_1 and S_1M_1treatments achieved the lowest concentration of proline in the total vegetative for the both study seasons (0.139, 0.140, 0.141, 0.156 mg.g^{-1}dry weight), respectively. While the concentration of proline increased to its highest value in irrigation treatment using Salt level (S_3) with or without bio-vaccine (0.374, 0.275 and 0.453, 0.286 mg.g^{-1} dry weight), respectively for both seasons.

Percentage of roots infected with Mycorrhiza%

Table 5 shows the affected of the percentage of roots infected with Mycorrhiza for Lisianthus plants by saline stress due to irrigation water salinity was excelled by giving values of 61.00 and 64.89% in the treatment of salt level S1 and decreased to 39.11 and 38.11% in the treatment of salt level S_4 by recording it a significant decrease of 35.88 and 41.26% for the seasons, respectively.

The number of spores of the Mycorrhiza fungus in the soil (spore.10 g^{-1}. Dry soil)

Table 6 shows that the inoculation treatment with Mycorrhiza fungi (*G. inatradices* and *G. mosseae*) were significantly excelled by giving it the highest averages number of spores (81.81, 89.33 spore. 10 g^{-1} dry soil) compared to the non-inoculation treatment, which recorded (1.00, 1.16 spore.10 g^{-1}. Dry soil) for two seasons.Saline stress due to the salinity of irrigation water significantly reduced the number of Mycorrhiza spores in the soil as it decreased from (62.00 to 66.50 spore. 10 g^{-1}.Dry soil) respectively in the S_1 treatment to (24.94, 28.22 spore .10 g^{-1}. Dry soil) for two consecutive seasons

Table 4 : Effect of Mycorrhiza fungus and salinity of irrigation water on the leaves content of proline acid (mg.g^{-1} dry weight) of Lisianthns plant "Advantage" cultivar.

Inoculation with Mycorrhiza		First seasons					Second seasons				
Mycorrhiza M		Salinity of irrigation water (ds.m^{-1})				Mycorrhiza M	Salinity of irrigation water (ds.m^{-1})				Mycorrhiza M
		S_0	S_1	S_2	S_3		S_0	S_1	S_2	S_3	
		Tap water	3	6	9		Tap water	3	6	9	
M ×S	M_0	0.808	0.201	0.280	0.374	0.266	0.243	0.245	0.330	0.453	0.318
	M_1	0.139	0.140	0.188	0.275	0.180	0.141	0.156	0.222	0.286	0.201
L.S.D (0.05)		**0.027**				**0.019**	**0.033**				**0.23**
Salinity of irrigation water (S)		0.171	0.174	0.234	0.325		0.191	0.200	0.276	0.370	
L.S.D (0.05)		**0.026**				**0.033**					

Table 5 : Effect of Mycorrhiza fungus and salinity of irrigation water on the percentage of roots infected with Mycorrhiza% of Lisianthns plant "Advantage" cultivar.

Salinity of irrigation water S	First seasons				Second seasons			
	Salinity of irrigation water (ds.m^{-1})				Salinity of irrigation water (ds.m^{-1})			
	S_0	S_1	S_2	S_3	S_0	S_1	S_2	S_3
	Tap water	3	6	9	Tap water	3	6	9
	61.00	58.22	51.56	39.11	64.89	60.00	54.78	38.11
L.S.D 0.05	**1.45**				**2.84**			

Table 6 : Effect of Mycorrhiza fungus and salinity of irrigation water on the number of spores of the Mycorrhiza fungus in the soil (spore.10 g^{-1}. Dry soil) of Lisianthns plant "Advantage" cultivar.

Inoculation with Mycorrhiza		First seasons					Second seasons				
Mycorrhiza M		Salinity of irrigation water (ds.m^{-1})				Mycorrhiza M	Salinity of irrigation water (ds.m^{-1})				Mycorrhiza M
		S_0	S_1	S_2	S_3		S_0	S_1	S_2	S_3	
		Tap water	3	6	9		Tap water	3	6	9	
M ×S	M_0	1.66	1.11	0.66	0.56	1.00	1.78	1.22	1.00	0.67	1.16
	M_1	122.33	96.33	59.22	49.33	81.81	131.22	102.11	68.21	55.78	89.33
L.S.D (0.05)		**5.81**				**2.59**	**6.59**				3.08
Salinity of irrigation water (S)		62.00	48.72	29.94	24.94		66.50	51.67	34.61	28.22	
L.S.D (0.05)		**3.66**				**4.35**					

at the S_4 level treatment. The bi-interaction between salinity and Mycorrhiza showed a significant effect on the number of spores in the soil, S_1M_1 treatment was excelled by giving it an values of (122.33 and 131.22 spore. 10 g^{-1} dry soil), respectively, for the two seasons compared to the S_4M_0 treatment, which recorded the lowest number of spores for both seasons.

Effectiveness of Superoxide dismutase (SOD)

Table 7 shows that the Bio-vaccine by Mycorrhiza fungi significantly reduced the Effectiveness of SOD from

Fig. 4 : Growth stages of Lisianthus plant.

(40.85, 44.35 UI.g^{-1} fresh weight) in the absence of the bio-vaccine to (33.10, 35.98 UI.g^{-1} fresh weight) in the presence of bio-vaccine with a significant reduction of (18.97, 18.87%) for the two seasons, respectively. The results showed that the effectiveness of SOD was significantly affected by saline stress, which it is increased from (26.04, 26.77 UI.g^{-1} fresh weight) in the treatment of S_1 to (47.27, 53.36 UI.g^{-1} fresh weight) in S4 treatment with an increase of (81.52, 99.32%) for the two seasons.In the bi-interaction of the Mycorrhiza and the salinity of the irrigation water, the results show that salt stress caused the increase in the effectiveness of SOD in the non-vaccinated plants more than the plants vaccinated with Mycorrhiza. S_4M_0 interaction treatment gave the highest averages of (50.51, 57.95 UI.g^{-1} fresh weight). The S_1M_1 treatment had the lowest values of (22.08, 22.90 UI.g^{-1} fresh weight) for both seasons, respectively.

Effectiveness of the peroxidase enzyme (POD)

Table 8 indicates the significant effect of the Bio-vaccine by Mycorrhizafungi treatment on the Effectiveness of POD enzyme. The effectiveness of POD enzyme was significantly reduced from (157.72, 153.83 UI.g^{-1} fresh weight) in non-inoculation treatment

Table 7 : Effect of Mycorrhiza fungus and salinity of irrigation water on the Effectiveness of superoxide dismutase (SOD) of Lisianthns plant "Advantage" cultivar.

Inoculation with Mycorrhiza		First seasons					Second seasons				
Mycorrhiza M		Salinity of irrigation water (ds.m^{-1})				Mycorrhiza M	Salinity of irrigation water (ds.m^{-1})				Mycorrhiza M
		S_0	S_1	S_2	S_3		S_0	S_1	S_2	S_3	
		Tap water	3	6	9		Tap water	3	6	9	
M ×S	M_0	29.99	38.55	44.33	50.51	40.85	30.65	40.81	47.97	57.95	44.35
	M_1	22.08	29.28	37.03	44.02	33.10	22.90	31.52	40.74	48.76	35.98
L.S.D (0.05)		2.33				**0.46**	2.54				0.75
Salinity of irrigation water (S)		26.04	33.91	40.68	47.27		26.77	36.16	44.36	53.36	26.04
L.S.D (0.05)		**0.65**					**1.07**				

Table 8 : Effect of Mycorrhiza fungus and salinity of irrigation water on the effectiveness of the peroxidase enzyme (POD) of Lisianthns plant "Advantage" cultivar.

Inoculation with Mycorrhiza		First seasons					Second seasons				
Mycorrhiza M		Salinity of irrigation water (ds.m^{-1})				Mycorrhiza M	Salinity of irrigation water (ds.m^{-1})				Mycorrhiza M
		S_0	S_1	S_2	S_3		S_0	S_1	S_2	S_3	
		Tap water	3	6	9		Tap water	3	6	9	
M ×S	M_0	129.57	134.82	155.76	210.71	157.72	126.45	132.14	152.03	204.71	153.83
	M_1	121.87	141.13	163.44	167.41	148.46	100.36	127.96	140.53	159.15	132.00
L.S.D (0.05)		4.81				**1.69**	3.84				0.55
Salinity of irrigation water (S)		125.72	137.97	159.60	189.06		113.40	130.04	146.28	181.94	
L.S.D (0.05)		**2.39**					**0.78**				

(M0) to (148.46, 132.00UI.g^{-1} fresh weight) in the inoculation treatment (M_1) with a significant reduction of (5.87, 11.19%) for the two seasons, respectively. The results of the table indicated that saline stress due to increased salinity of irrigation water caused a significant increase in the effectiveness of the enzyme from (125.72, 113.40 UI.g^{-1} fresh weight) in treatment of salinity level S1 to (189.06, 181.94 UI.g^{-1} fresh weight), respectively in the S_4 salinity treatment. The results of the interaction between Mycorrhiza and salinity showed that the inoculation with Mycorrhiza fungus had a significant effect on raising the plant's ability to withstand salt stress, which led to reducing the enzyme's effectiveness to (121.87, 100.36 UI.g^{-1} fresh weight) in the treatment of interference S_1M_1, while increasing its effectiveness to reach the highest values were (210.71, 204.71 UI.g^{-1} fresh weight) for the two seasons respectively in the S_4M_0 treatment. The table also indicates that the triple interaction has a significant effect in these traits. The $T_2S_1M_1$ treatment recorded the lowest values of (116.22, 97.72 UI.g^{-1} fresh weight), while the $T_0S_4M_0$ treatment gave the highest averages of (218.51, 211.07 UI.g^{-1} fresh weight), respectively.

Discussion

The results of the tables 1-8 indicate that there is an increase in the indicators of vegetative and flowering growth due to the treatment of Mycorrhiza, while the decrease in enzymatic Effectiveness (SOD and POD) may be due to the role of Mycorrhiza fungi in the secretion of many secondary compounds (antibiotics and plant hormones), which improves the physiological processes

such as the ability of the plant to absorb water and increase the absorption of micro and macro-elements, which improves the growth of plant vegetation, flowering and root, in addition to the role of growth regulator in the division of plant cells and increase it size and elongation of its plant tissues, which increases the plant height (Bashan and De-B Ashan, 2010). In addition to the role of Mycorrhiza fungi in reducing the production of effective oxygen species ROS, including the superoxide O_2^{-1} and thus reduce the effectiveness of enzymes for antioxidant (SOD and POD) (Moslemi *et al*., 2011) and agreed with (Allawi, 2013) found When inoculation pepper plant with Mycorrhiza fungi, which led to increased enzymatic Effectiveness (SOD and POD) and with the results of (Salih, 2015) when inoculation of Gladiolusplant with Mycorrhiza fungi, which led to a significant increase in the traits of vegetative and flowering, the percentage of infection with Mycorrhiza, the number of spores in the soil and increase the concentrations of both sodium and chloride in the soil solution because of salinity irrigation water, which increases the Osmotic potential of the soil solution, the difficulty of water absorption and mineral ions by the roots, the cell membrane disruption, the activation of the cell division, the expansion of the cells, the weak vegetative and flowering growth and thus the reduction of photosynthetic process (Daei *et al*., 2009). In addition to increasing the effectiveness of antioxidant enzymes due to the increase in the production of effective oxygen and then increase the oxidative stress in the plant to increase the production of the anti-enzymes, including (SOD and POD) (Harinasut *et al*., 2000). These results agreed with Isa (2015) that exposure of Troyer Strang citrus origin in tissue cultures to salt stress caused increased efficiency of peroxidase with increased sodium and chloride content and with results (Al-Obeidi, 2013), who found salt stress caused a significant increase in the effectiveness of enzymatic antioxidants (SOD and POD) in corn that grown up under saline stress conditions.

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