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EFFECT OF ARBUSCULAR MYCORRHIZA FUNGI (GLOMUS. MOSSEA) ON TOMATO GROWN IN SALINE SOIL

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ABSTRACT

The experiment was conducted in one of the greenhouses in the city of Nasiriyah during the season (2015 - 2016) to study the effect of adding the fungal inoculant which is consisting of arbuscularmycorrhiza fungi (Glomus. mossea) on the growth and yield of tomatoes grown in saline soil, the experiment was designed by using a randomized complete block design (RCBD) with three replicates. The results showed that the addition of the fungal inoculant leads to a significant increase in most of the parameters of the hybrid variety of tomato plant is (Elissa) than non-inoculated treatments. The addition of fungal inoculant leads to an increase in the examined parameters rates, namely (plant height, number of leaves, dry weight of shoot, number of fruits, plant yield and total yield) under saline stress in the treatment of (T4) compared with the treatment of non-inoculated (T3) under the same saline stress conditions through the use of salty draining water for irrigation, the increase in percentage of the properties studied reached(9.73, 60.54, 22, 45.20, 41 and 35.12) % respectively.

KEYWORDS: Greenhouse, Fungal Inoculant arbuscularmycorrhiza Fungi (Glomus. Mossea), Salt Stress, Saline Soil

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Original Article

INTRODUCTION

The problem of salinity is the main problems that limited the growth of plants and agricultural productivity, high concentrations of Na^+ and Cl^- salts that cause hyperosmotic stress and ion imbalance often lead to oxidative stress conditions forplant (Khan et, al 2009)**.** Salt is an inhibitor of the growth of many various crops, so the soils affected by salinity which is considered a problem in several parts of the world, especially the areas where the crops are grown under surface irrigation (Cuartero and Fernandez – Munoz 1999).Salt stress affects the cell membrane permeability, also affects the solubility of several concentrations, ions and nutrient deficiency, which in turn leads to the inhibition of plant growth and reduced the surface area of leaf (Cekicet; al 2012)**.**

Inoculants microbial and bio fertilizers such as bacteria, fungi and algae, whether alone or combination working to increase the productivity of agricultural crops by improves biological activity in the rhizosphere of soil **(**Tilak and Reddy, 2006). In recent years, the several of researchers produced and used of bio-fertilizers to improve crop yield through the use of rhizobial bacteria and mycorhizal fungi or other microorganisms have the ability to increase the provision of mineral nutrients (Nehra 2014).Some Inoculants microbial especially beneficial bacteria and fungi can enhance the growth of plants under saline conditions and thus improve the productivity of agricultural crops (Evelin at; al 2009).

Many researchers proved that the arbuscularmycorrhiza fungi application improves the growth of various plants the presence of salt stress by improving the absorption of nutrients, increase the ion balance, facilitate the

absorption of water by plants, protecting enzyme activities, producing of plant growth hormones, and improved rhizospheric conditions of soil also to protecting the roots of plants from pathogens in the soil (Ruiz – Lozano et al; 2008; Cantrell and Linderman, 2001; Giri et al; 2007; Colla et al; 2008; Evelin at; al 2009; Al-Karaki and Al-Raddad, 1997).

In addition to mycorrhiza fungi improves the physiological properties of the host plant, such as increasing the plant's ability to absorb water by increasing root hydraulic conductivity and modify ion balance and composition of carbohydrates, all these characteristics of the arbuscularmycorrhiza fungi have made it to be the best in the improvement of soil salinity and therefore plant growth and increase productivity (Evelin et; al 2009). Al–karaka and Hammad (2001) reported that the tomato plant has a high symbiotic life with arbuscularmycorrhiza fungi, and the importance of tomato which is one of the most important major vegetable crops that are grown in all the provinces of Iraq, because affected most soils in central and southern of Iraq with salinity, the experiment conducted to study:

- The effect of the fungal inoculant on the growth and yield of tomatoes under saline stress through the use of salty draining water for irrigation.
- Compare the effect of fungal inoculant with plants that have been irrigated non saltwater.

MATERIALS AND METHODS

The experiment was carried out in one of the greenhouses with dimensions (10 × 19 m) of a farm in the city of Nasiriyah, to study the effect Add arbuscularmycorrhiza fungi (*Glomus*. *mosseae*) on the growth and yield of tomato cultivated under saline soil with clay loam texture, the soil preparation was conducted of plowing, smoothing and leveling, soil samples were taken from greenhouse before sowing randomly, the chemical and physical properties of soil samples were determined as explained in table (1) and by the following ways:

Soil pH and electrical conductivity (EC) estimated in the saturated paste extract using (pH-meter) and (Conductivity Bridge) respectively, according to (Page et; al 1982). The organic matter as given by Jackson (1958). The total nitrogen was determined by Kjeldahl) method according to (Page et; al 1982). Phosphorus estimated by spectrophotometer according to (Page et; al 1982). Potassium using flame photometer as given by (Jackson, 1958). Soil texture estimated by hydrometer as suggested by (Gee and Bauder, 1986).

Table 1: Physico-Chemical Properties of Soil Samples before Sowing

Parameters		Unit	Amount
pH			7.98
E.C.		$ds.m^{-1}$	5.9
O.M.		$g.kg^{-1}$	1.43
N		$ml.kg^{-1}$	0.071
P		$ml.kg^{-1}$	33.15
K		$ml.kg^{-1}$	211.20
Soil Texture (clay loam)	Sand	$g.kg^{-1}$	208
	Silt	$g.kg^{-1}$	498
	Clay	$g.kg^{-1}$	294

The design was used a randomized complete block design (RCBD) with three replicates which included four treatments are T1: was non inoculated with arbuscularmycorrhiza fungi (*Glomus*. *mossea*), T2: inoculated with arbuscularmycorrhiza fungi (*Glomus*. *mossea*) (T1 and T2 non-saltwater used for irrigation EC 1.9 $ds.m^{-1}$), T3: was non inoculated with arbuscularmycorrhiza fungi (*Glomus*. *mossea*), T4: inoculated with arbuscularmycorrhiza fungi

(*Glomus*. *mossea*) (T3 and T4 draining water used for irrigation EC 7 ds.m^{-1}), value of EC at 7 ds.m^{-1} were prepared by mixing drainage water with non-saltwater.

Six lines opened inside the greenhouse, the distance between them were 1m with leaving two lines in the center of the greenhouse without sowing to prevent the mixing of irrigation water, left a distance of 1m at the beginning and end of the house and a distance of 90cm on both sides of the greenhouse, were dividing each line into three experimental units in length 5m and width 70cm were leaving a space between each experimental unit and the other about 1m. Then added the inoculant of arbuscularmycorrhiza fungi (*Glomus*. *mossea*)for soil, which consists of (sand + spores + infected roots) which obtained from a laboratory bio-fertilizers in the Agricultural Research Center of the Ministry of Science and Technology, it was put 10 grams of the fungal inoculant at a depth of 5 cm down each plant.

NPK fertilizers were added in the form (urea, triple super phosphate and potassium sulphate) at two levels 50% and 100% of the fertilizer recommendations. Tomato seedlings were planted 30 days old and at 10 seedlings each experimental unit and the distance between them 50cm. The plants treated with fungal and pesticides to protect them from insects and diseases that affect tomatoes. After the maturity of the plants recorded of parameters such as plant height, leaf number, dry weight of shoots, number of fruits, plant yield and total yield.

Statistical Analysis

Experiment carried out by using randomized complete block design (RCBD) with three replications and data were analyzed statistically by the way analysis of variance using the program Genstat discovery edition 3, The significant differences among the means were tested using least significance difference (LSD) at 5% significance level**.**

RESULTS AND DUSCISSIONS

Vegetative Growth Parameters

The results showed in table (2) that the inoculant with arbuscularmycorrhiza fungi (*Glomus*. *mossea*) revealed significant increase in vegetative growth parameters. The treatment (T2) recorded the maximum plant height reached (149.08 cm), maximum number of leaves (20.66) and maximum dry weight of plant (206.75 g/plant) as compared with non-inoculated treatment (T1) were irrigated with non-saltwater which reached (125.54 cm), (14.33) and (105.31 g/plant) respectively, this is due to the positive role played by arbuscularmycorhiza fungi in increasing soil fertility and plant growth promoting by increasing soil content of nutrients, especially phosphorus and nitrogen. Drew et; al (2004) Indicated that the arbuscularmycorhiza fungi increases the provision of nutrients such as phosphorus and nitrogen due to the ability of extra radical mycelium of arbuscularmycorhiza fungi to access small soil pores when immobile mineral nutrients or in the status of low nutrients in the soil rhizosphere area, and Giri et; al (2007) who reported that inoculant with arbuscularmycorhiza fungi gave the highest dry weight than non-inoculated plants.

The data revealed that the application of fungal inoculant with saltwater treatment (T4) recorded the maximum plant height reached (132.54 cm), number of leaves (17.45) and dry weight (114.45 g /plant) compared with non-inoculated plants were irrigated with saltwater (T3) reached (120.78 cm), (11) and (93.76 g/plant) respectively. The values of inoculant plants with arbuscularmycorrhiza fungi (*Glomus*. *mossea*) under salt stress conditions (draining water) in treatment (T4) was higher than control treatment (T1) of irrigated with non-saltwater. In the present study the inoculant with arbuscularmycorrhiza fungi (*Glomus*. *mossea*)revealed significant increase under salt stress compared with non-inoculanted plants. Significant difference in the growth parameters was recorded due to that application

arbuscularmycorrhiza fungi (*Glomus. mossea*) may help in facilitate the transfer of water in the plants in the presence of salt by transferring them from the root to the other plant parts. Tomato plants in the salt stress and inoculated with arbuscularmycorhiza fungi the content of aquaporins in roots reduced while the leaves content of these proteins higher, suggesting a significant impact of arbuscularmycorhiza fungi on the distribution of water throughout the plant (Quziad, 2006). Srameket; al (2000) recorded that mycorhizal fungi application in horticultural crops production has shown significantly increase in the growth and yield characters.

Table 2: Effect of Different Treatments on Plant Growth Parameters of Tomato

Treatment	Plant Height (cm)	No. of Leaves / Plant	Dray Weight g/Plant
T1:	125.54	14.33	105.31
T2:	149.08	20.66	206.75
T3:	120.78	11.00	93.76
T4:	132.54	17.66	114.45
LSD	0.174	0.787	0.178

Yield Parameters

The results in the table 3 revealed that the application of arbuscularmycorrhiza fungi (*Glomus. mossea*) treatment (T2) without salt stress was found significantly superior over rest of all the treatments in the number of fruits reached (40.33), plant yield (1.28 kg/plant) and total yield (694.33kg/house), this is due to the positive impact to arbuscularmycorhiza fungi which supply of nutrients to the plant and leading to the improve the growth and yield of plant. The treatment (T4) inoculated with arbuscularmycorrhiza fungi (*Glomus. mossea*)under salt stress caused a significant increase in all examined plant parameters as the number of fruits reached (30), plant yield (1.03 kg/plant) and total yield (959 kg/house) than un-inoculated treatment (T3) this is due to that the inoculant with arbuscularmycorhiza fungi can reduce the salt stress, leading to better plant growth compared with non-inoculated plants under the same salt stress conditions. Karaki (2000) observed that the dry weight, plant yield, fruit weight and number of fruits to tomato plants inoculated with arbuscularmycorhiza fungi was higher than non-inoculated plants. The horticultural crops grown in greenhouses showed high responsiveness to arbuscularmycorhiza fungi which reflected positively on the growth and yield of crops (Khan et; al 2009).

The cause in increased growth and yield of plants in the presence of salt may be due to the positive impact to arbuscularmycorhiza fungi in increase the absorption of plant nutrients. Ruiz-Lozano and Azcon, (2000) obsorved that the inoculant with arbuscularmycorhiza fungi can increase the concentration of phosphorus element in the plant by enhancing its absorption from the soil by the fungal hyphae which can access to the small soil pores as well as the ability to convert the insoluble phosphate to soluble phosphate. Giri and Mukerji (2004) indicated that the inoculant with arbuscularmycorhiza fungi can help in uptake increase of nitrogen in the plant compared with non-inoculated plants. The inoculated plants with mycirrhizal fungi can increase of potassium uptake in plant tissues under salt stress conditions (Evelin et; al 2009), and Yano-Melo (2003) reported that the banana plants showed a good response and has given high concentrations of calcium at inoculant with mycorhizal fungi compared with non-mycorrhizal banana plants.

Table 3: Effect of Different Treatments on Yield Parameters of Tomato

Treatment	No. of Fruit /Plant	Plant Yield kg/Plant	Total Yield kg/House
T1:	25.33	0.87	475.33
T2:	40.33	1.28	694.33
T3:	20.66	0.73	410.33
T4:	30.00	1.03	559.00
LSD	0.330	0.099	0.064

CONCLUSIONS

From the present study, it is concluded that the application of arbuscularmycorhiza fungi (*Glomus*. *mossea*) can promoting the vegetative growth and yield of tomato plants in the presence of salt stress. Result found that the inoculated plants with arbuscularmycorhiza fungi enhance the growth and yield in tomato plants compared with non-mycorrhizal tomato plants by improvement of mineral nutrients uptake and enhance plant tolerance to salinity**.**

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المستخلص

نفذت التجربة في احد البيوت البلاستيكية في مدينة الناصرية خلال الموسم (2015 – 2016) لدراسة تأثير اضافة اللقاح الفطري المتكون من فطر arbuscularmycorhiza صنف () على نمو وانتاج الطماطة المزروعة في تربة مالحة, اذ صممت التجربة بأستعمال تصميم القطاعات الكاملة المعشاة (RCBD) وبواقع ثلاث مكررات. أظهرت النتائج ان اضافة اللقاح الفطري حقق زيادة معنوية في أغلب الصفات المدروسة لصنف هجين من نبات الطاطة هو () مقارنة مع المعاملات غير الملقحة, اذ ادت اضافة اللقاح الفطري الى زيادة في معدلات الصفات المدروسة وهي (طول النبات, عدد الأوراق, الوزن الجاف للمجموع الخضري, عدد الثمار, حاصل النبات والحاصل الكلي) تحت الجهد الملحي في معاملة T4 مقارنة مع المعاملة غير الملقحة T3 تحت نفس ظروف الاجهاد الملحي عن طريق استخدام مياه بزل مالحة للري, اذ بلغت نسبة الزيادة المئوية للصفات المدروسة (9.73, 60.54, 22, 45.20, 41 و 35.12) %على التوالي.