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Foliar Feeding with Micronutrients to Overcome Adverse Salinity Effects on Growth and Nutrients Uptake of Bean (*Phaseolus vulgaris*)

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A POT experiment was carried out at the green house of Fertilization Technology Department to investigate the effect of salinity through irrigation water (0.0 and 4000ppm NaCl) and foliar feeding with chelated 12% Fe, Zn and Mn in the form of EDTA each at rate of 1g /L as individual nutrient in addition, to mixture of them on growth and macro and micronutrients uptake of bean bean *(Phaseolus vulgaris*). Results revealed that salinity resulted in significant reduction in dry weight. However, foliar feeding showed significant increments in the bean dry weight. Moreover, normal soil condition in combination with foliar feeding with the mixture of micronutrients achieved the highest dry weight increments Results also showed that salinity had significant negative effects on micronutrients uptake, while it had no marked effects on macronutrients uptake except K where salinity markedly reduced its uptake. Foliar feeding with micronutrients treatments either as individual nutrient or mixture of them showed significant increases in macro and micronutrients uptake. Spraying bean plants with the mixture on micronutrients showed the highest marked increments as compared with control (water foliar spray) and the other micronutrient treatments. Moreover, the interaction between salinity and micronutrient treatments on macro and micronutrients uptake was significant, where; most of calculated macro and micronutrients uptake showed the highest values by spraying bean plants with the mixture treatment and under the normal soil condition. The only exception was N uptake which calculated in bean, stem where, the highest value resulted from the spraying plants with Fe in combination with normal soil condition.

Keywords: Bean (*Phaseolus vulgaris*), Dry weight, Foliar feeding, Micronutrient treatment, Nutrients uptake.

Introduction:

Bean *(Phaseolus vulgaris*) is one of the most important legume crops. It is consumed either as fresh centuries or as dry seeds. It is classified as sensitive to soil salinity (high concentrations of dissolved salts in the root propagation zone). Most of these salts are chloride, sulphate, bicarbonate of sodium or magnesium.

Soil salinity can hinder the absorption of nutrients necessary for crop growth and productivity (Tester & Devenport, 2003). These high concentrations affect plant growth by inhibiting the absorption of water and dissolved nutrients by roots. Plants normally take up nutrients from the soil through their root system. In some special cases like soils with high pH, high salinity; micronutrients became unavailable to the growing crops (Shao et al., 2007). In such cases foliar application of these nutrients should be supplied to the growing plants through foliar feeding (Bernal et al., 2007; Baloch et al., 2008).

Jouyban (2012) reported that under salinity conditions the growth of developing plants is inhibited by affecting their ability to absorb and transfer as well as distribute nutrients. In general, salinity has different effects on growth including: Nutrient deficiencies or imbalances due to competition of both sodium and chloride with nutrients such as potassium, calcium and nitrates.

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Specific ion toxicities due to increase the absorption (sodium and chloride).

Malakouti (200, 2007) found that the lack of micronutrients has caused stress on developing plants, resulting in decreasing yield and quality. It also makes the plant more susceptible to disease and insects. The lack micronutrients in the soil leads to a lack of plant absorption for such elements. Also mentioned that the micronutrients increased wheat yield by 50% as well as increased the efficiency of fertilizer use of the macronutrients.

El-Fouly & Abou El-Nour (1998) and El-Fouly et al. (1999) reported that crops cultivated under Egyptian conditions usually suffer from four micronutrient deficiencies, i.e., Fe, Zn, Mn and sometimes Cu. So multi-micronutrient compound containing these nutrients should be applied to supply crops with their needs. To overcome the negative effect of micronutrient deficiencies foliar feeding is recommended, through influencing root growth and absorption capacity (El-Foule & Abou El-Nour, 1998). Recently, Abou El-Nour et al. (2017) found that foliar feeding of micronutrients Fe and Zn in chelated form can recover the drastic depression in plant growth. Also, foliar feeding with either Fe or Zn could partially counteract the negative effect of salinity. Using foliar application technique may be improving root growth and correcting the nutritional disorders which reflect in increasing nutrients uptake by plant roots.

One of the methods used to reduce the harmful effect of salinity is to spray the necessary nutrients on leaves which make the plants that grow under salinity stress more tolerant to the negative effect (El-Fouly et al., 2002). The salinity of soil or irrigation water is one of the factors that negatively affect the growth and productivity of crops, especially those developing in arid and semi-dry areas (Khan & Duke, 2001). El-Fouly et al. (2011) observed that the growth parameter of wheat plants and uptake of essential nutrients decreased by increasing concentrations of NaCl. Also, found that spraying plants with the micronutrients (iron, zinc and manganese) had a stimulating effect on the growth and absorption of all necessary nutrients for plants growing under saline conditions.

The aim of this investigation was to investigate the influence of spraying iron, zinc and manganese as individual nutrient and mixture of them on growth and nutrients uptake of bean plants grown under salinity stress condition induced by irrigating the plants with saline water (4000ppm NaCl).

Materials and Methods

A pot experiment was carried out in the Vegetation Hall of the Project "Micronutrients and Other Plant Nutrition Problems in Egypt" – Fertilization Technology Department, National Research Centre, Cairo, Egypt. Plastic pots of 10kg soil were used. Each pot was fertilized with 3g ammonium nitrate (33.5%N) which is equivalent to nearly 300kg ammonium nitrate/ fed. (4200m^2), 2g calcium super phosphate (15.5% P_2O_5) which equivalent to 200kg calcium super phosphate/ fed. and 1g potassium sulphate (48%K_2O) which equivalent to 100kg potassium sulphate as recommended by MoA.

Soil sample was taken before addition of any fertilizer and analyzed for physic-chemical characteristics (Table 1).

TABLE 1. Soil physico–chemical characteristics

Character	Result
Sand %	96.2
Silt %	2.4
Clay %	1.4
Texture	loamy sand
pH	8.33
E.C dS/m	1.11
$CaCO_3$ %	1.65
Organic matter %	1.31
Available macronutrient (mg/100g soil)	
p	0.21
K	15.6
Mg	27.3
Ca	145
Na	35.2
Available micronutrient (mg/kg soil)	
Fe	2.83
Mn	0.97
Zn	2.10
Cu	0.73

Texture:	Bouyoucos (1954)
PH & E.C. (1 soil :2.5 water)	Jackson (1973)
Organic matter	Walkley & Black (1954)
$CaCO_3$	Black (1965)
P	Olsen et al (1954)
K ,Ca, Mg and Na	Jackson (1973)
Fe, Mn, Zn and Cu	Lindsay & Norvellk (1978)

Five seeds of bean var. Nebrasca were sown in each pot. After germination the seedlings were thinned to three/pot.

Treatments were arranged in spilt plot design with three replicates. Salinity treatment was placed as main plots and micronutrient treatments as subplots.

The following treatments were applied

Salinity treatments

1. Irrigation with tap water (Normal)
2. Irrigation with 4000 ppm NaCl (after thinning the seedlings, 15 days from sowing.

Micronutrient treatments

1. Control (Water foliar spray)
2. Iron foliar spray (1g/L EDTA 12% Fe)
3. Zinc foliar spray (1g/L EDTA 12% Zn)
4. Manganese foliar spray (1g/L EDTA 12% Mn)
5. Mix of 2, 3 and 4 (each 1g/L EDTA 12%)

Interactions between A and B

Salinity was induced after germination of the seeds (seedling of 15 days) by saline irrigation water.

Samples were collected after 45 days from planting, then, the the stems and leaves were separated, dried and weighted. They were prepared for macro- and micronutrients analysis according to Chapman & Pratt (1978). The nutrient uptakes were calculated by multiplying the dry weight by nutrient concentration.

The data were statistically analyzed as split plot design according to Snedecor & Cochran (1987). Comparisons among means were tested for significance against LSD values at 5% level of probabilities.

Results

Dry weight

Data presented in Table 2 revealed that salinity resulted in significant negative effects in both stem and leaves dry weight. The reduction recorded in both stem and leaves per plant were 22 and 23%, respectively.

However, spraying micronutrients either as single element (Fe, Mn, or Zn) or mixture of them resulted in significant increments in both dry weights. The increments in stem and leaves were 16 and 14% ; 15 and 13% ; 7 and 17% and 16 and 19% for spraying the plants by Fe, Zn , Mn and Mixture of them, respectively as compared with control (water spray).

Concerning the interaction between salinity and foliar spray with micronutrients, data presented in Table 2 showed that significant effect was recorded only for leaves dry weight. The highest leaves dry weight as a result of spraying either Mn or micronutrient mixture and under normal condition treatment (1.31 or 1.29g/plant). However, the lowest value (0.84g/plant) was recorded as a result of combined treatments of salinity and control treatment (water foliar spray).

TABLE 2. Effect of salinity, Micronutrients foliar spray and their interaction on dry weight of bean

Treatment	Stem dry weight		Mean	Leaves dry weight		Mean
	Normal	Salinity		Normal	Salinity	
Control (water pray)	0.73	0.60	**0.67**	1.06	0.84	**0.95**
Fe	0.85	0.70	**0.78**	1.16	1.01	**1.09**
Zn	0.85	0.68	**0.77**	1.20	0.94	**1.07**
Mn	0.82	0.61	**0.72**	1.31	0.91	**1.11**
Mix (Fe + Zn + Mn)	0.89	0.66	**0.78**	1.29	0.96	**1.13**
Mean	**0.83**	**0.65**		**1.20**	**0.93**	
LSD 5%						
Salinity (S)			**0.05**			**0.05**
Micronutrients (MN)			**0.06**			**0.03**
S X MN			**N.S.**			**0.07**

Micronutrients concentration in stem

Data presented in Table 3 show that salinity treatments had significant effects on stem micronutrients concentration. Salinity treatments showed significant decrements in zinc, manganese and copper concentrations, while it increases iron. The decrement recorded in Zn, Mn and Cu were amounted by 12, 42 and 16%, respectively. While the increment in stem Fe concentration was amounted by 15%.

On the other hand, foliar feeding treatments showed also significant increments in stem micronutrients concentration. The highest increments were achieved by Fe foliar feeding followed by spraying the mixture treatment (Fe +Zn +Mn) as compared to control and the other individual element treatments.

Table 3 shows that salinity treatment combined with Fe foliar spray treatment showed the highest significant increase in stem Fe concentration, while, the lowest value was recorded as a result of normal condition treatment combined with control treatment (water foliar spray). However, stem Zn and Mn concentrations showed the highest values when the plants grow under normal condition combined with foliar feeding with Zn and Mn, respectively. While the lowest Zn and Mn concentrations were recorded as a result of salinity treatment combined with control treatment (water foliar spray).

Micronutrients uptake in stem

Table 4 shows the effect of salinity, foliar spray of micronutrients and their interaction on stem micronutrients uptake. Under salinity conditions, the uptake of micronutrients showed great reduction in stem Fe, Zn, Mn and Cu uptake. The reductions were amounted to 11, 32, 46 and 34% respectively, as compared with those plants grown under normal condition.

It is also clear that micronutrient foliar feeding treatments markedly increased stem micronutrients uptake. However, spraying plants with mixture of micronutrients gave the highest Zn (96.0µg/plant), Mn (87.7µg/plant), and Cu (8.3µg/plant). Foliar feeding with Fe showed the highest absolute value (414.7µg/plant). The differences between foliar feeding with either Fe or micronutrients mixture were not significant, which mean that it could be considered that micronutrients mixture was the best treatment to achieve the highest stem micronutrients uptake.

TABLE 3. Effect of salinity, micronutrients foliar spray and their interaction on stem micronutrient concentrations of bean

Treatment	**Iron**		**Mean**	**Zinc**		**Mean**	**Manganese**		**Mean**	**Copper**		**Mean**
	Normal	**Salinity**		**Normal**	**Salinity**		**Normal**	**Salinity**		**Normal**	**Salinity**	
Control	413.7	488.7	**451.2**	66.7	76.7	**71.7**	54.0	49.0	**51.5**	10.3	8.0	**9.2**
Fe	483.0	603.7	**543.3**	113.7	74.0	**93.8**	69.3	55.3	**62.3**	10.3	9.7	**10.0**
Zn	445.7	559.3	**502.5**	130.7	111.7	**121.2**	82.0	56.0	**69.0**	10.0	9.3	**9.7**
Mn	421.0	472.3	**446.7**	70.3	67.7	**69.0**	85.3	63.7	**74.5**	10.3	9.0	**9.7**
Mix	504.0	535.0	**519.5**	125.0	121.7	**123.3**	138.7	78.0	**108.4**	12.0	9.3	**10.7**
Mean	**453.5**	**531.8**		**101.3**	**90.4**		**85.9**	**60.4**		**10.6**	**9.1**	
LSD 5%												
Salinity (S)			**5.8**			**8.6**			**5.8**			**1.3**
Micronutrient (MN)			**18.9**			**4.4**			**4.4**			**0.9**
S X MN			**26.8**			**6.2**			**6.2**			**N.S.**

TABLE 4. Effect of salinity, micronutrients foliar spray and their interaction on stem micronutrients uptake of bean

Treatment	Iron			Zinc			Manganese			Copper		
	Normal	Salinity	Mean	Normal	Salinity	Mean	Normal	Salinity	Mean	Normal	Salinity	Mean
Control	308.3	293.0	**300.7**	48.7	46.0	**47.4**	39.3	29.7	**34.5**	7.5	4.8	**6.2**
Fe	409.0	420.3	**414.7**	96.3	51.3	**73.8**	59.0	38.7	**48.8**	8.7	6.7	**7.7**
Zn	380.3	378.3	**379.3**	111.0	75.7	**93.3**	69.7	38.0	**53.8**	8.5	6.3	**7.4**
Mn	375.0	289.7	**332.3**	62.7	41.3	**52.0**	76.0	39.0	**57.5**	9.2	5.5	**7.4**
Mix	450.0	353.3	**401.8**	111.7	80.3	**96.0**	123.7	51.7	**87.7**	10.4	6.1	**8.3**
Mean	384.6	346.9		86.1	58.9		73.5	39.4		8.9	5.9	
LSD 5%												
Salinity (S)			**15.2**			**11.2**			**5.8**			**1.2**
Micronutrient (MN)			**16.5**			**8.8**			**4.4**			**0.8**
S X MN			**23.3**			**12.5**			**6.2**			**1.1**

Regarding the interaction effect between the two studied factors, it is clear that combination between plants grown under normal condition and spraying micronutrients mixture treatment showed the highest micronutrients uptake. However, growing plants under salinity condition and spraying the plants with water (control) showed the lowest uptake.

Micronutrient concentrations in leaves

It is quite clear from the data presented in Table 5 that salinity increased iron concentration measured in leaves of bean plants. The recorded increment was statistically significant. However, salinity showed significant reduction in Mn concentration. Furthermore, both Zn and Cu concentrations showed insignificant reduction under salinity condition. Spraying mixed micronutrients resulted in significant increment in Fe and Zn concentrations (590.6 and 155ppm, respectively), and spraying plants with Zn alone gave significant increment in leaves –Zn concentration. Cu concentration measured in leaves, showed no significant effect due to foliar feeding with micronutrients treatments.

The interaction effect between salinity and micronutrient foliar spray showed marked effects on micronutrient concentrations measured in the leaves. Spraying the plants with Fe under salinity condition showed the highest Fe concentration, and spraying the plants with Zn under salinity condition gave the highest Zn concentration. Moreover, spraying the plants with mixture of micronutrients under normal condition showed the highest Mn and Cu concentrations. On the other hand, plants grown under normal conditions combined with spraying the plants with water (control) showed the lowest Fe and Zn concentrations and plants grown under salinity condition combined with control treatment showed the lowest Mn and Cu concentrations

Micronutrients uptake in leaves

Data presented in Table 6 showed that salinity treatment significantly decreased micronutrients uptake in leaves except Fe which showed insignificant reduction. The decrements recorded were amounted by 25, 47 and 30% for Zn, Mn and Cu, respectively. Data also shows that micronutrient treatments resulted in marked increments in micronutrients uptake. Mixture or micronutrients treatment showed the highest increments in all micronutrients uptake as compared with control treatment and other micronutrient treatments. The increments reached 37, 71, 153 and 22% over control treatment for Fe, Zn, Mn and Cu, respectively. Concerning the interaction effect between salinity and micronutrients foliar feeding, were statistically significant.

Plants grown under normal conditions combined with mixture of micronutrients treatment showed the highest micronutrients uptake. While combination of salinity treatment and (control) water foliar spray treatments gave the lowest micronutrients uptake.

Macronutrients concentration in stem

Data presented in Table 7 reveals that salinity treatment had insignificant effect on studied macronutrients measured in stem with an exception for potassium where, salinity significantly decreased it . While micronutrient treatments showed significant increments in N, P, K and Mg concentrations. The highest N, P, K and Mg were found by spraying the plants with mixture of micronutrients.

The interaction between salinity and foliar feeding with micronutrients showed significant effects on stem macronutrient concentrations. The highest N concentration recorded due to the interaction between normal soil conditions and foliar spray with either individual micronutrients or mixture of them. There were no significant differences between combined treatment of normal soil condition and micronutrient treatments. While the lowest N concentration recorded as a result of normal soil condition combined with water foliar spray (control). The combined treatment between normal soil condition and foliar spry with either Fe or mixture of micronutrients gave the highest P concentration. The lowest P concentration resulted from combination of salinity treatment combined with micronutrient treatments. Moreover, combined treatment between normal soil condition and foliar spray with mixture of micronutrients showed the highest K and Mg concentrations. However, the lowest K and Mg concentrations recorded as a result of the combination between salinity treatment and foliar spry with Mn and between salinity treatment and water foliar spray, respectively.

TABLE 5. Effect of salinity, micronutrients foliar spray and their interaction on leaves micronutrient concentrations (ppm) of bean

Treatment	Iron			Zinc			Manganese			Copper		
	Normal	Salinity	Mean	Normal	Salinity	Mean	Normal	Salinity	Mean	Normal	Salinity	Mean
Control	443.0	591.7	**517.3**	88.0	79.3	**83.7**	76.7	73.0	**74.8**	11.0	9.3	**10.2**
Fe	522.0	640.7	**581.3**	92.3	106.7	**99.5**	73.7	79.7	**76.7**	9.7	10.3	**10.0**
Zn	466.7	592.3	**529.5**	123.3	138.7	**131.0**	131.0	90.7	**110.8**	9.0	9.7	**9.3**
Mn	433.0	494.7	**463.8**	87.0	71.0	**78.0**	160.7	98.7	**129.7**	11.3	8.7	**10.0**
Mix	562.7	633.7	**598.2**	131.0	109.7	**120.3**	200.3	111.0	**155.7**	11.3	9.3	**10.3**
Mean	**485.5**	**590.6**		**104.3**	**101.1**		**128.5**	**90.6**		**10.5**	**9.5**	
LSD 5%												
Salinity (S)			**28.0**			**N.S.**			**18.7**			**N.S.**
Micronutrient (MN)			**11.9**			**6.2**			**8.3**			**N.S.**
S X MN			**16.8**			**8.7**			**12.5**			**1.5**

TABLE 6. Effect of salinity, micronutrients foliar spray and their interaction on leaves micronutrients uptake of bean

Treatment	Iron		Mean	Zinc		Mean	Manganese		Mean	Copper		Mean
	Normal	Salinity		Normal	Salinity		Normal	Salinity		Normal	Salinity	
Control	469.7	499.3	**484.5**	93.3	66.7	**80.0**	81.7	62.0	**71.8**	11.7	7.9	**9.8**
Fe	603.7	645.0	**624.3**	107.0	107.3	**107.2**	85.7	80.7	**83.2**	11.2	10.4	**10.8**
Zn	559.0	558.7	**558.8**	147.7	131.0	**139.3**	157.0	85.3	**121.2**	10.8	9.1	**9.9**
Mn	568.7	448.3	**508.5**	114.3	63.7	**89.0**	211.3	89.3	**150.3**	14.9	8.2	**11.6**
Mix	723.7	606.0	**664.8**	168.7	105.0	**136.8**	258.0	106.3	**182.2**	15.0	8.9	**12.0**
Mean	**584.9**	**551.5**		**126.2**	**94.7**		**158.7**	**84.7**		**12.7**	**8.9**	
LSD 5%												
Salinity (S)			**N.S.**			**4.2**			**24.1**			**1.3**
Micronutrient (MN)			**28.6**			**9.0**			**13.0**			**1.3**
S X MN			**40.4**			**12.7**			**18.4**			**1.5**

TABLE 7. Effect of salinity, micronutrients foliar spray and their interaction on stem macronutrients concentration of bean

Treatment	Nitrogen		Mean	Phosphorus		Mean	Potassium		Mean	Magnesium		Mean
	Normal	Salinity		Normal	Salinity		Normal	Salinity		Normal	Salinity	
Control	4.49	5.43	**4.96**	0.28	0.28	**0.28**	2.53	2.30	**2.42**	1.07	0.94	**1.01**
Fe	5.73	5.27	**5.50**	0.32	0.27	**0.30**	2.49	2.40	**2.45**	1.17	1.10	**1.14**
Zn	5.76	5.17	**5.47**	0.27	0.29	**0.28**	2.50	2.42	**4.46**	1.17	1.19	**1.18**
Mn	5.62	5.24	**5.43**	0.30	0.29	**0.30**	2.49	2.17	**2.33**	1.05	1.22	**1.14**
Mix	5.72	5.20	**5.46**	0.32	0.29	**0.31**	2.57	2.43	**2.50**	1.25	1.25	**1.25**
Mean	**5.46**	**5.26**		**0.30**	**0.28**		**2.52**	**2.34**		**1.14**	**1.14**	
LSD 5%												
Salinity (S)			**N.S.**			**N.S.**			**N.S.**			**N.S.**
Micronutrient (MN)			**0.18**			**0.02**			**0.08**			**0.07**
S X MN			**0.26**			**0.03**			**0.11**			**0.09**

Macronutrients uptake in stem:

Table 8 shows the effect of salinity, micronutrients foliar feeding and their interactions on stem macronutrients uptake. Data showed that salinity had significant negative effects on macronutrients uptake. The reductions in N, P, K and Mg uptake caused by salinity were amounted by 26, 26, 30 and 24%, respectively.

Data also show that foliar spray with micronutrients resulted in significant positive effects on stem macronutrients uptake, where the highest and the lowest macronutrients uptake were recorded by spraying the mixture of micronutrients treatment and spraying water (control) treatment, respectively. The increments were amounted by 31, 30, 28 and 39% over control treatment for N, P, K and Mg, respectively.

The interaction between salinity and micronutrients foliar spray showed marked effects on stem N and P uptake only. Combination between normal soil and spraying mixture of micronutrients gave the highest N and P uptakes (51.2 and 2.8mg/plant, respectively). While, the lowest values were recorded due to combination of salinity treatment and water foliar spray (32.5 and 1.7mg/plant, respectively).

Macronutrients concentration in leaves

Data presented in Table 9 revealed that salinity treatment showed significant negative effects on leaves potassium concentration only. Other macronutrients were not affected.

Micronutrient treatments, showed significant positive effects on macronutrient concentrations inleaves compared with control treatment. The most positive effect was achieved by foliar feeding with spraying plants with micronutrient mixture treatment as compared with control and other micronutrient treatments.

The interaction between salinity and micronutrient treatments showed marked effects on leaves macronutrient concentrations with an exception in case of leaves Mg. The highest N concentration resulted as a result of treated plants with Zn foliar feeding in combination normal soil condition. While, the highest P concentration was found as a result of salinity treatment in combination with Mn foliar feeding. Meanwhile, the highest K concentration was achieved due to combination of normal soil condition treatment and foliar feeding with micronutrient mixture treatment .

Macronutrients uptake in leaves

Table 10 shows that salinity resulted in significant decrements in N, P, K and Mg uptake in leaves. Decrements were amounted by 22, 20, 31 and 25% as compared with normal soil condition,respectively. Data also revealed that micronutrient treatments showed positive effects on increasing leaves macronutrients uptake. Micronutrients mixture treatment showed the highest studied macronutrients uptake. It is quite clear that using micronutrients foliar fertilizers leads to increase root growth which resulted in higher nutrients (micro and macronutrients) uptake (Abdalla & Mobarak, 1992; El-Fouly & Fawzi, 1996; Abou El-Nour el al., 2017).

Concerning the interaction effects, the highest macronutrients uptakes were recorded as a result of normal soil condition in combination with micronutrients mixture treatment. While, the lowest were resulted due to combination between salinity treatment and water foliar spray for P, K and Mg. Leaves N uptake showed the same ,since no marked difference between normal soil condition and salinity treatment.

Discussion

With increasing salt concentration in the root zone, plant growth was negatively affected due to increasing osmotic pressure and /or ion toxicity. Also, salinity affects photosynthesis by decreeing CO_2 availability (Prakash et al., 2010; Abou El-Nour et al., 2017; Yassen et al., 2018). However, spraying micronutrients (single nutrient or mixed) increased plant growth. It can be explained that foliar feeding is a rabid technique in correcting the nutritional disorders through applying such nutrients directly to the location of demand in which quickly absorption will be happened (Romheld & El-Fouly, 1999). They added, foliar feeding of nutrient can improve fertilizer use efficiency and reduce environmental pollution. Under salinity condition, foliar feeding can elevate the hazard effects of such stress (El-Fouly & Abou El-Nour, 1998), through stimulating roor growth and nutrient absorption (Abdalla & Mobarak, 1992; El-Fouly & Salama (1999); El-Fouly et al., 2010, 2011).

TABLE 8. Effect of salinity, micronutrients foliar spray and their interaction on stem macronutrients uptake of bean

Treatment	Nitrogen		Mean	Phosphorus		Mean	Potassium		Mean	Magnesium		Mean
	Normal	Salinity		Normal	Salinity		Normal	Salinity		Normal	Salinity	
Control	32.7	32.5	**32.60**	2.0	1.7	**1.83**	18.4	11.8	**15.12**	8.4	5.6	**6.98**
Fe	48.6	36.7	**42.63**	2.7	1.9	**2.28**	21.1	16.7	**18.90**	9.9	7.6	**8.77**
Zn	48.8	35.0	**41.88**	2.3	2.0	**2.12**	21.1	16.4	**18.77**	9.9	8.1	**8.97**
Mn	50.1	32.1	**41.10**	2.6	1.8	**2.22**	22.2	13.2	**17.73**	9.4	7.5	**8.47**
Mix	51.2	34.3	**42.73**	2.8	1.9	**2.38**	23.0	16.1	**19.52**	11.2	8.2	**9.70**
Mean	**46.26**	**34.12**		**2.49**	**1.85**		**21.15**	**14.86**		**9.75**	**7.41**	
LSD5%												
Salinity (S)			**5.19**			**0.18**			**2.27**			**0.91**
Micronutrient (MN)			**2.31**			**0.17**			**1.69**			**0.65**
S X MN			**3.27**			**0.24**			**N.S.**			**N.S.**

TABLE 9. Effect of salinity, micronutrients foliar spray and their interaction on leaves macronutrients concentration of bean

Treatment	Nitrogen		Mean	Phosphorus		Mean	Potassium		Mean	Magnesium		Mean
	Normal	Salinity		Normal	Salinity		Normal	Salinity		Normal	Salinity	
Control	4.14	5.63	**4.89**	0.31	0.27	**0.29**	2.30	**1.89**	**2.09**	1.12	1.12	**1.12**
Fe	5.48	5.26	**5.37**	0.27	0.28	**0.28**	2.35	**2.05**	**2.20**	1.18	1.19	**1.19**
Zn	5.74	5.55	**5.65**	0.30	0.29	**0.30**	2.15	**2.09**	**2.12**	1.26	1.22	**1.24**
Mn	5.42	5.30	**5.36**	0.27	0.35	**0.31**	2.26	**2.03**	**2.15**	1.13	1.13	**1.13**
Mix	5.66	5.32	**5.49**	0.33	0.37	**0.35**	2.37	**2.11**	**224**	1.31	1.22	**1.27**
Mean	**5.29**	**5.41**		**0.30**	**0.31**			**2.29**	**2.04**	**1.20**	**1.17**	
LSD 5%												
Salinity (S)			**N.S.**			**N.S.**			**0.07**			**N.S.**
Micronutrient (MN)			**0.29**			**0.01**			**0.08**			**0.05**
S X MN			**0.41**			**0.02**			**0.11**			**N.s.**

TABLE 10. Effect of salinity, micronutrients foliar spray and their interaction on leaves macronutrients uptake of bean

Treatment	Nitrogen			Phosphorus			Potassium			Magnesium		
	Normal	Salinity	Mean	Normal	Salinity	Mean	Normal	Salinity	Mean	Normal	Salinity	Mean
Control	43.9	47.5	**45.70**	3.3	2.2	**2.78**	24.4	15.5	**20.13**	11.9	9.4	**10.65**
Fe	64.7	52.9	**58.80**	3.2	2.8	**2.95**	27.2	20.6	**23.90**	14.1	12.0	**13.05**
Zn	68.6	52.4	**60.50**	3.6	2.8	**3.20**	25.7	19.8	**22.73**	15.0	11.5	**13.25**
Mn	71.2	48.0	**59.62**	3.6	3.2	**3.38**	29.7	18.4	**24.07**	14.9	10.2	**12.55**
Mix	72.8	50.8	**61.75**	4.3	3.5	**3.88**	30.5	20.2	**25.33**	16.8	11.6	**14.20**
Mean	**64.25**	**50.30**		**3.60**	**2.89**		**27.49**	**18.98**		**14.54**	**10.94**	
LSD 5%												
Salinity (S)			**5.37**			**0.34**			**1.39**			**0.52**
Micronutrient (MN)			**5.26**			**0.24**			**1.61**			**0.67**
S X MN			**7.44**			**0.34**			**2.27**			**0.94**

Reduction in the calculated macro- and micronutrients uptake may be due to the high concentration of NaCl in the root zone which has hazard effects on the uptake and translocation processes of essential nutrients (Thalooth et al., 2006). Also Jouyban, 2012 found that under salinity condition, the growth of plants is inhibited by affecting their ability to absorb, transfer and distribute nutrient. Furthermore, Yassen et al., (2018) reported that under excess of soluble salts in the root zone, high osmotic pressure of the soil solution increases and the growing plants cannot extract water. In such case, nutrients content and uptake decreased.

The results of this study showed that spraying micronutrients either as individual element or mixture of them increased significantly nutrients uptake. Baier & Boierova (1999) concluded that foliar feeding with nutrients increases nutrients uptake by roots. This is due to increasing root absorption capacity. These findings are in agreement with those reported by Abdalla & Mobarak (1992), Abou El-Nour (2002), El-Fouly et al. (2010, 2011), and recently Abou El-Nour et al. (2017) and Yassen et al. (2018).

The interaction between salinity and foliar feeding with micronutrients showed that foliar application treatments could partially counteract the hazard effect of salinity. El-Fouly et al. (2010, 2011), El-Fouly & Abou El-Nour(1998) found that spraying micronutrients improved growth and nutrients uptake of plants grown under salinity stress conditions, through improving root growth and consequently, nutrients absorption capacity

Conclusion:

It could be concluded that foliar feeding with mixed micronutrients (Fe+ Zn+ Mn) was better than foliar feeding with individual element for counteracting the hazard effect of salinity and improving nutrients uptake. Also, it is better to judging the nutritional status of the plants through calculating the nutrients uptake than depending on nutrients concentration.

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التغذية بالعناصر المغذبة الصغرى لتجنب الاثار الصارة للملوحة على نمو وامتصاص العناصر للفاصوليا

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أجريت تجربة اصص بالصوبة الزجاجية لقسم تكنولوجيا التسمبد وذلك لدراسة تاثير ملوحة ماء الرى (0.0 ، 0004 جزء / مليون كلوريد الصوديوم) والرش بالعناصر المغذية الصغرى المخلبية EDTA 12% (الحديد، الزنك، المنجنيز) بمعدل 1جم/لتر كعناصر مفردة اضافة إلى مخلوط منهم على النمو وامتصاص العناصر للفاصوليا. وقد اوضحت النتائج أن هناك تاثير معنوى سلبى على الوزن الجاف بينما ادى الرش بالعناصر المغذية الصغرى إلى زيادة فى الوزن الجاف للنباتات واظهرت المعاملة برش مخلوط العناصر تحت الظروف الطبيعية للتربة (الرى بالماء العادى) أعلى زيادة فى الوزن الجاف. كما اوضحت النتائج أن هناك تأثير سلبى للرى بالماء المالح على امتصاص العناصر الصغرى بينما لم يكن لها تاثير على امتصاص العناصر الكبرى باستثناء البوتاسيوم حيث ادت الملوحة إلى خفض الأمتصاص. هذا واوضحت النتائج أن التغذية الورقية بالعناصر الصغرى سواء الرش بالعنصر منفردا أو بمخلوط العناصر ادت إلى زيادات معنوية فى امتصاص كلا من العناصر الكبرى والصغرى وكانت اعلى الزيادات المسجلة نتيجة للرش بمخلوط العناصر الثلاثة. واظهرت النتائج وجود تاثير معنوى للتفاعل بين الملوحة والرش بالعناصر الصغرى حيث سجل التفاعل بين الرى بالماء العادى والرش بمخلوط العناصر الصغرى اعلى الزيادات فى امتصاص العناصر سواء الكبرى أوالصغرى باستثناء امتصاص النتروجين حبث سحلت النتائج اعلى نتروجين بالسيقان نتيجة الرى بالماء العادى والرش بعنصر الحديد.