Journal BiNET
Scientific Publication

Published with Open Access at Journal BiNET
Vol. 14, Issue 02: 1210-1221

Journal of Bioscience and Agriculture Research

Journal Home: www.journalbinet.com/jbar-journal.html

Effects of priming and mycorrhiza on improving balance of sodium and potassium and changes of antioxidants in leaves of maize under soil salinity

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ABSTRACT

For study the effects of priming and mycorrhiza on improving the balance of sodium and potassium and some changes antioxidants in the leaves of maize under soil salinity. This experiment was laid out in a randomized complete block design as factorial with three replications in two years 2014/15- 2015/16 in two place of saline and non-saline on hybrid corn NS640. The first factor inoculated and non-inoculated with mycorrhiza (Glomus mossea), the second factor in four level osmopriming with Nacl solution, priming with salicylic acid, priming with tap water and non-prime(control). Solutions concentration and Prime duration were determined in separate experiments. The results showed that the enzymes catalase and peroxidase, Superoxide dismutase, soluble proteins and potassium increased in leaves in both the saline and non-saline, inoculation with mycorrhiza and primed with salicylic acid than non-inoculation and non-primed that this increasing in saline soils was more. The sodium in inoculation with mycorrhiza and prime with salicylic acid than non-prime and non-inoculation in both the saline and non-saline especially saline environment is leading to a decrease in leaf. Colonization percent, the percentage of emergence and emergence rate of inoculation with mycorrhiza and primed with salicylic acid than non-inoculation and non-prime in both environments has been increasing, especially in non-saline environment.

Key Words: *Salicylic acid, Salt, Tap water and Percentage of colonization*

Cite Article: Kazemi, J. S., Aboutalebian, M. A. and Mesgarbashee, M. (2017). Effects of priming and mycorrhiza on improving balance of sodium and potassium and changes of antioxidants in leaves of maize under soil salinity. Journal of Bioscience and Agriculture Research,14(02),1210-1221. **Crossref:** https://doi.org/10.18801/jbar.140217.149

I. Introduction

Corn plant from cereals and the growing season is relatively short and high performance (Zhu et al., 2004). Khuzestan province located in southwestern Iran has around 1.2 million hectares of arable land, fifty thousand hectares corn cultivated and produces more than 250 tons (Ministry of

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Agriculture, 2014). Thirty percent of corn planted was in soil with high salinity. Seeds priming by different methods with mycorrhiza fungi is one approach that can improve emerge and yield in seeds planted in saline lands. According to reports primed seeds in environmental stress such as salinity, seedling growth with more vigor produces (Harris et al., 2002). Janda (1999) reported that priming with salicylic acid and tap water stimulates growth of corn and increased production of antioxidants. Prime with salicylic acid at a concentration of 1.4 mM in corn increased resistance to salinity stress conditions (Hussein et al., 2007). Similar results in tomatoes with salicylic acid primed be obtained due to increase the activity of enzymes such as aldose rodactaze and ascrobate peroxidase and concentrations of osmolytes such as soluble proteins in leaves (Tari et al., 2004). Chang and Sung (1998) reported that hydro and osmo prime with salt than others priming treatments to improve the appearance of sweet corn seedling. Hydro-Priming will speed up germination, establishment , enhance the yield of the barley (Rashid et al., 2006) and beans (Rashid et al., 2004). Wu et al. (2014) reported that priming with salicylic acid to reduce the negative effects of salinity and resistance of maize seedlings by increasing significantly the content of carotenoids and antioxidant, content of proline and osmolytes. When the seeds have been primed by different methods are inoculated with mycorrhiza has been improved biomass and yield in saline conditions (Hameed et al., 2014). Mycorrhiza increases uptake/activity of nitrogen, phosphorus, magnesium and other elements, play roles in plant competition (Sultana et al., 2017; Sultana and Siddique, 2015; Evelin et al., 2012;) and also improves soil structure, increased plant resistance to stress conditions such as drought, salinity and facilitate fertilizer recommendation (Sultana et al., 2015; Wu et al., 2014). Plants that have been inoculated with mycorrhiza increases growth and yield, potential of osmotic and ionic balance maintain normal levels that will cause resistance to stress conditions (Hameed et al., 2014). Increase the activity of antioxidants such as catalase, peroxidase, superoxide dismutase were higher in mycorrhiza plants that reduces the lipid peroxidation because antioxidants reduce the effects of reactive oxygen species before they damage the membrane lipids and reduce lipid peroxidation (Evelin and Kapoor, 2013). Other research in mycorrhiza plants in Salinity showed that the content of sodium in the root to shoot more, and the ratio of sodium to potassium in leaf mycorrhiza than non-mycorrhiza decreased (Evelin et al., 2009). The purpose of this experiment is survey seeds priming and mycorrhiza on improving and the balance of sodium and potassium, and changes in antioxidant enzymes in maize leaves under salinity stress conditions.

II. Materials and Methods

Site description: This research was conducted during the two years 2014/15 and 2015/16 at two locations in the Gotvand city in Khuzestan province with the height of 76 meters above sea level and Coordinates 32 degrees north latitude and 48 degrees east longitude. Both the soil profile locations in Table 01. Electrical conductivity of irrigation water for both locations was 1.1 dS/ m. The division Emberger climate is semi-arid and dry. Meteorological data from weather stations in the city, which is 5 km from the study, were obtained (Table 02).

Table 01. Soil analysis

Type of soil	Organic materials (%)	pH	EC (dS/m)	soil texture	ppm (p)	Pp m(k)	N (%)
non-saline	1.4	8	2.5	Loamy	13	220	0.28
Saline	.89	8.4	7	Loamy	9	195	0.178

Table 02. Meteorology data

Year	parameters	July	August	September	October	November	December
2014/15	The average temperature (°C)	36.6	36.4	33.7	27.8	20.1	16.3

	Average rainfall(mm)	0	0	0.5	22.1	14.7	71.9
	Total sunshine	339.6	344.3	333.9	334.3	211.1	190.4
	The average temperature(° C	36.6	37.8	35.1	39.7	21.2	14.5
	Average rainfall(mm)	0	0	0	0	54.9	93.6
2015/16	Total sunshine	305.6	369	310.8	253	189	169.1

Experimental details: To prepare the field, it was irrigated before conducting the experiment and after the field got wet enough, it was a 30-cm deeply by moldboard plowing in a few days before sowing and followed by a disking to slice plant residue and incorporate fertilizers into the soil.. In both years, planting data was 20July and harvesting data was 11 December. After preparing the soil for surving soil conditions sampling do. Fertilize were according to soil test results. Phosphorus and potassium and 1/3 nitrogen fertilizers before planting strips were used and the remaining nitrogen fertilizer was applied at four leaf stage and flowering. Each plot contained six rows with each row between two rows of 75 cm and a length of 5 m, depth of planting each seed 4-6 cm was considered. The distance between the two plants 16 cm and plant density per hectare was 74 thousand plants. Priming was performed before planting and seeds for plantings transferred to the field after Prime. Mycorrhiza strips underneath the seeds were placed 20 grams per square meter. Characteristic of mycorrhiza was 150 spores per gram. Mycorrhiza products Turan manufacturing company.

Sampling: To measure the amount of soluble proteins, sodium, potassium and the antioxidant enzymes (catalase, peroxidase, superoxide dismutase) in the 4-6 leaf stage sampling was performed using the upper leaves and to keep fresh samples were placed in containers of liquid nitrogen were transferred to the laboratory for analysis. In addition to calculating the root colonization at flowering (tasseling) stage of plant roots and transported to the laboratory approximately one gram samples were stained color. Phillips and Hayman(1970) was used. The percentage of root colonization was determined by the intersection of grid lines.

Chemical analysis

Protein extraction and enzymatic extraction: Some of the fresh materials (shoots) were worn with liquid nitrogen inside a porcelain mortar. Centrifuge samples at 12000 rpm for 10 minutes at 4 ° C was distributed between the supernatant at -20 ° C until testing was held. This solution was used to measure enzyme and protein.

Catalase (CAT), Peroxidase (POD), Superoxide dismutase (SOD): Activities of antioxidant enzymes were measured using the methods of Samantary (2002).

Sodium and potassium were measured by photometry.

In this method, the elements in the solution by flame or atoms and are excited and thermal energy electrons and atomic nuclei pushed farther into orbit. The radiation intensity is directly related to the concentration and thus determine the light intensity comparison.

Emergence percentage (EP) were calculated using Eq. (1) with the following formulae (Ellis and Roberts, 1988):

$$EP = \frac{n}{N} \times 100 \qquad (1)$$

n: the total number of emerged seedlings and *N*: total number of planted seeds.

Seedling emergence rate (ER) were calculated using Eq. (2) (Farooq et al., 2006).

$$ER = \frac{\sum n}{\sum (t_x)(n_x)} \quad (2)$$

Where, n: the total number of seeds emerged; n_x: the number of newly emerged seeds at time t_x; $\bar{t}$: average seed emergence time

Statistical analysis: The experiment was laid out in a randomized complete block design as factorial with three replications on hybrid corn NS640. The first factor inoculated and non-inoculated with mycorrhiza (*Glomus mossea*), the second factor in four level osmopriming with Nacl solution, priming with salicylic acid, priming with tap water ,and non-prime (control). Nacl solution and salicylic acid concentration and duration as well as the duration of tap water were determined in preliminary tests in laboratory. The concentration of salicylic acid 0.5 mM within 14 hours, osmopriming with Nacl solution at a concentration of 2 dS/m within 22 hours, tap water within 18 hours were selected as the best combination of on-farm seed priming. Analysis of variance was done using the PROC GLM procedure of the SAS package 9.1 (SAS Institute, Cary, NC, USA) and test the significance of variance sources, while LSD test (P = 0.05) was used to compare the differences among treatment means.

III. Results and Discussion

Results showed that the effects of Place, Mycorrhiza, Prime, Place × Prime, Place × Mycorrhiza and Mycorrhiza × Prime, Prime × Place × Mycorrhiza on the emergence rate was significant (Table 03). The average comparison indicated that the maximum emergence rate in non-saline environments, inoculation with mycorrhiza and primed with salicylic acid is derived that showed increase of about 37 percent compared to non-inoculation and non-prime. In non- saline compared to saline environment emergence rate is higher. The highest rate of emergence rate in saline environments reached in inoculation with mycorrhiza and prime with salicylic acid that compared to no-prime and inoculation with mycorrhiza showed increasing 27.5 % and compared to non-inoculation and non-prime showed increasing 70 % (Table 10). In both saline and non-saline environment, inoculated and non-inoculated with mycorrhiza, priming treatments increased emergence rate than non-primed and prime with salicylic acid to the tap water and Nacl solutions is a further increase. It seems that one of the reasons mycorrhiza symbiosis and help with water uptake and phosphorus, which makes seeds germinate faster. Ying-Ning et al. (2013) found that the coexistence lead to adequate food prepared especially phosphorous, increase the level of absorption by increasing growth hypha and water absorption by decrease of osmotic effect was done. Prime with salicylic acid reduces osmotic potential and water absorption will be more and more active enzymes that eventually led to the germination rate is increased because of better activity in some enzymes in the seeds of access to food during germination in seeds primed easier and these seeds better able to complete the germination process in the short term and environmental stress such as salinity and well tolerated (Kant et al., 2006). Harris et al. (2002) reported that hydro-priming will speed up germination, seedling establishment in rice and corn, and this makes development faster, earlier flowering and maturity and the yield and resistant to drought and salinity is more. Results showed that the effects of Place, Year, Year × Place, Mycorrhiza, Year × Place × Mycorrhiza, Prime × Place and Year × Mycorrhiza on emergence percentage was significant (Table 03). The averages comparison indicated that the highest percentage of germination in the first year, non-saline place and inoculation with mycorrhiza obtained. In the first year to the second year of higher emergence percentage is achived. The highest percentage of emergence in the first year in non-saline and inoculation with mycorrhiza achieved and show increase of 2.6 percent compared to the non-inoculation. In the first year in saline environment inoculation with mycorrhiza increased 11.3 percent compared to the non-inoculated (Table 09). In this study, in both years the highest emergence percent was observed in non-saline environments. Results and difference emergence percentage between inoculated and non-inoculated with mycorrhiza represents a positive impact of mycorrhiza on the saline environment compared to the non-saline because mycorrhiza role in reducing sodium, phosphorus and water uptake in salty stress has an important role in increasing the percentage of emergence. In the first year to the second year in Aguest average temperature was lower (Table 02). The positive effect of priming on germination time required for germination, especially in terms of stress reduced, this could be due to faster absorption of water by the seeds pre-treated (Kaya et al., 2006).

The results showed that the effects of Place, Mycorrhiza, Prime, Place × Mycorrhiza, Place × Mycorrhiza × Priming and Priming× Place on the Catalase was significant (Table 03). The average comparison indicated that the maximum amount of enzyme in saline environments, inoculation with mycorrhiza and prime with salicylic acid achieved that shows increase 64.5% compared to non-primed. In saline environment than non-saline more enzyme in the leaves had accumulated (table 10). The results showed that the effects of Place, Year, Year × Place, Mycorrhiza, Priming, Mycorrhiza × Priming, Priming × Place, Year × Mycorrhiza, Mycorrhiza × Place was significant on the amount of the Peroxidase (Table 03). The comparison showed that the average maximum amount of enzyme in the first year and inoculation with mycorrhiza obtained that compared to non- inoculation increase of about 69 percent in the same year shows (Table 06). The comparison showed that the average maximum amount of enzyme in saline and inoculated with mycorrhiza achived that compared to non-inoculated increase of about 21.7% in the same environment showed (Table 04). The comparison indicated that the average maximum amount of enzyme in saline place and priming with salicylic acid were obtained that compared to no-primed shows an increase of 75 percent. In saline place of concentration of enzyme in the leaves than to non-saline place has further increase (Table 05). The comparison average showed the highest enzyme in inoculation with mycorrhiza and primed with salicylic acid obtained that compared to non-prime in this environment shows an increase of about 80 percent (Table 08). The results showed that the effects of Place, Year × Place, Mycorrhiza, Prime× Place, Mycorrhiza × Prime × Place was significant on the level of the superoxide dismutase (Table 03). The comparison indicated that the average maximum amount of enzyme in saline environments, inoculation with mycorrhiza and prime with salicylic acid was achived that compared to inoculation with mycorrhiza and non-primed showed increase 18.9% and compared to non- inoculation and non-prime showed increase 25.9%. In the saline place concentrations of the enzyme in leaves compared to the non-saline was more (Table 10). The comparison showed that the average maximum amount of enzyme in the first year and saline places was obtained that compared to non-saline show an increase of about 34.5 percent of that year (Table 07). The diferent stress product reactive oxygen species (ROS) that has deleterious effects on plant growth and physiologic (Venkateswarlu et al., 2012). These cells need to be protected from oxidative damage, evidence shows that priming can increase the enzyme that destroys ROS called catalase, peroxidase and superoxide dismutase on seeds and leaves until cope with stress, improve plant activity (Chang and sung, 1998). Our study revealed that most of the catalase amount in saline place, inoculation with mycorrhiza and prime with salicylic acid has been obtained in the saline place than non-saline more enzymes in the leaves accumulate. Our results showed that the highest amount of peroxidase in the first and second, inoculation with mycorrhiza obtained. The enzyme concentration in the leaves in the first year to the second year had a greater increase, in saline places concentration of enzymes in the leaves compared to the non- saline further increased and prime with salicylic acid in both environments leads to the accumulation of enzyme more. In saline place superoxide dismutase accumulation in leaves compared to the non-saline place is more and in this place enzyme amount in inocluted with mycorrhiza and prime with salicylic acid are more and the highest enzyme amount has been achieved in the first year and saline environment. Grow places is one of the most important factors in the production and accumulation of antioxidants in plants , the unfavorable environment due to increase accumulation of the enzyme amount in the plant as a resistance mechanism in the plant and probably one of the reasons for the increase peroxidase and superoxide dismutase. Plant habitat important factor in the increase of antioxidant enzymes, which means that the less favorable environment for the growth is the accumulation of more enzymes. In the first year of temperatures favorable conditions for plant growth. resulted in higher germination rate and the biomass is higher, leading to higher enzyme as well as priming with salicylic acid, Nacl and tap water reduces osmotic potential and maintain cell membranes and continue the activity of enzymes in seeds and seedlings which leads to an increase in germination rate and biomass production and accumulation of antioxidants in the plant. Salinity Stress increases levels of antioxidant enzymes in plants (Rasool et al., 2013). The use of salicylic acid in plants under salinity can reduce the toxic effects and increases resistance to stress in wheat and tomatoes (Tari et al., 2004). In Salinity stress , plants that have been primed with salicylic acid increases antioxidant enzymes amount (catalase, peroxidase, superoxide dismutase) and increases plant resistance (Yusuf et al., 2008). The use of Salicylic acid increases the rate of photosynthesis, maintain membrane stability, improved growth parameters, the efficiency of photosynthesis, and increased production of antioxidant enzymes in response to salt stress in plants.

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Results showed that the effects of Place, Mycorrhiza, Prime, Place × Prime, Place × Mycorrhiza, Place × Mycorrhiza × Prime on the soluble proteins was significant (Table 03). The average comparison showed that the maximum amount of soluble proteins in saline environments, inoculation with mycorrhiza and prime with salicylic acid achieved that showed increase 17.4% compared to inoculation with mycorrhiza and non-prime and compared to non- inoculation and non-prime showed increase 32.3%. In saline environment than non-saline more soluble proteins in the leaves had accumulated. In non-saline environments, inoculation with mycorrhiza and prime with salicylic acid shows increase 14.4% compared to inoculation with mycorrhiza and non-primed (Table 10). In plants that are under stress one of the ways to counter rising is osmolytes (soluble carbohydrates, soluble proteins, etc.). Osmolytes addition to osmotic adjustment in prevention of oxygen free radicals, detoxification and swept the reactive oxygen species are involved (Orcutt and Nilsen, 2000). In Salty stress, soluble proteins increase in maize salt-sensitive varieties (Andre et al., 2009). Ashraf et al. (1998) on wheat under salinity similar to the results achieved. Soluble proteins involved in the regulation of the osmotic plant (Ashraf and Harris, 2004). Our results showed that in the saline environment ,inoculation with mycorrhiza and prime with salicylic acid show a further increased soluble protein in the leaves is stored that role in reducing the negative effects of salty stress and help the plant to grow better. In wheat under salt stress with salicylic acid primed the amount of soluble proteins and amino acids like proline increased and protein content of less that this reduces osmotic potential and reduce tension (Evelin et al., 2009). Wu et al. (2014) reported that priming with salicylic acid decreased negative effects of salinity stress and the resistance of corn seedlings by increasing the content of carotenoids and antioxidant content of proline and soluble proteins and other osmolytes increased significantly.

The results showed that the effects of Place, Year, Mycorrhiza, Priming, Priming × Place and Place × Mycorrhiza on amount of sodium was significant (Table 03). The comparison showed the highest average sodium amount was in saline place and not primed that compared to the lowest intake of sodium in the environment that is primed with salicylic acid showed increase27.5% . The lowest amount of sodium in non-saline environments and prime with salicylic acid stored (Table 05). The comparison indicated the highest average sodium obtained in the saline place and non-inoculated with mycorrhiza that compared to inoculated with mycorrhiza leads to a increase of 30.7%(Table 4). The results showed that the effects of Place, Year, Mycorrhiza, Prime, Place × Mycorrhiza, Place × Priming and Priming× Place×Mycorrhiza on potassium concentration was significant (Table 03). The comparison of means showed that the highest amount of potassium in saline environments, inoculation with mycorrhiza and prime with salicylic acid resulting that compared to inoculation with mycorrhiza and non-prime showed increase of approximately 14.3% and compared to non-inoculation and non-prime indicated increase 30.1% (Table 10). Our results from the present study indicated that plants in the saline place grow compared to the same plants in non-saline plcace accumulated sodium content more leaves and when inoculated with mycorrhiza take place or in both eniverments priming with salicylic acid compared to no-primed the entrance sodium to the plant is reduced because the mycorrhiza prevents the entry of sodium in exchange for entry potassium to the plant increased and the competition between sodium and potassium in favor of potassium acts and sodium in hypha and root maintains that this potassium increased due to the resistance salinity. In saline place of the sodium and potassium in the leaves increased but inoculation with mycorrhiza and enhancing the symbiosis and priming due to increase the entry of potassium and sodium ions will reduce entry and both sodium and potassium ions. Zhu et al. (2010) reported that corn plants inoculated with mycorrhiza reduced sodium uptake, salinity increased sodium absorption in the plant and reduce the absorption of phosphorus, potassium, calcium and magnesium in the *Androgaphis paniculta*. Sodium increase due to potassium lowers the entry because sodium ions compete with potassium ions to connect to a situation. Colonization of plants slowly increases the amount of potassium ions under salinity stress conditions (Porcel et al., 2016). In mycorrhiza plants sodium ion concentration at the root was 51% higher than non-mycorrhiza plants (Porcel et al., 2016). Mycorrhiza plants to reduce the damage caused by salinity and increase the strength and absorption of nutrients by the hypha of fungi and reducing the toxic effects on plant tissue (Evelin et al., 2012).

The results showed that the effects of Place, Year, Place × Year, Mycorrhiza, Place × Mycorrhiza, Year × Mycorrhiza, Year× Place× Mycorrhiza, Place × Mycorrhiza × Prime on the colonization percentage was significant (Table 03). The means comparison indicated that the highest colonization percentage in non-saline environment, inoculation with mycorrhiza and prime with salicylic acid has been obtained that compared to non-primed and inoculation showed increase 15.5 percent. In saline environments highest colonization percentage in inoculation with mycorrhiza and prime with salicylic acid were obtained that compared to inoculation and non-prime showed increase 30.3% and compared to non-inoculation and non-prime showed increase more dublicated (Table 10).The means comparison showed that the highest colonization percentage in the second year, the non-saline place and inoculation with mycorrhiza achieved that showed increase of 55 percent compared to non-inoculation with mycorrhiza. In the second year, saline place and inoculation with mycorrhiza compared to non-inoculation showed increase 67.6%. In both saline and non-saline environment colonization percentage was more in the second year (Table 09). Colonization depends on some factors such as temperature, humidity, pH and salty on the soil and etc. Our results from the present study indicated that in both saline and non-saline environment, inoculation with mycorrhiza and priming with salicylic acid due to conducive to enhancing the colonization, result of the increase in non-saline environment more. Sheng et al. (2008) that results in corn and showed that the salinity has been suspended the colonization and growth hypha sensitive to salt stress that the findings (Roohanipor et al., 2013) correspond. Ying-Ning et al. (2013) observed that in citrus fruits that have a symbiotic mycorrhiza overcome the salinity. Colonization will lead to sufficient food supply, especially phosphure, increase the level of absorption by increasing growth hypha and water absorption by reducing the osmotic potential were performed he also confirmed that symbiotic with mycorrhiza occurs naturally in saline environments and salt stress in some plants such as bananas, vetch, tomatoes, olives, corn, lotus and palm trees reduces (Rabie and Almadini, 2005). Our results showed that in the second year colonization percentage and coexistence is more that can be caused by the presence of mycorrhiza (*Glomus mossea*) in the environment and land cultivation during the second year and adapted to the conditions environment.

Table 03. Significance levels of analysis of variance combined over two locations (saline and non-saline) and two growing seasons

Source of	d.f.	ER	EP	CAT	POD	SOD	SP	Na	K	CP
Place(PL)	1	***	***	***	***	***	***	***	***	***
Year (Y)	1	n.s.	***	n.s.	**	n.s.	n.s.	***	***	***
Y×PL	1	n.s.	*	n.s.	*	*	n.s.	n.s.	*	***
Rep(Y × PL)	8									
Mycorrhiza(M)	1	***	***	***	***	***	***	***	***	***
Priming (P)	3	***	***	***	***	***	***	***	***	***
PL×M	1	***	***	*	**	***	***	***	***	***
PL × P	3	***	***	***	**	*	**	***	*	n.s.
Y × M	1	n.s.	*	n.s.	**	n.s.	n.s.	n.s.	n.s.	**
Y × P	3	n.s.	n.s.	n.s.	n.s.	n.s.	n.s.	n.s.	n.s.	n.s.
Y × PL×M	1	n.s.	*	n.s.	n.s.	n.s.	n.s.	n.s.	n.s.	**
Y × PL×P	3	n.s.	n.s.	n.s.	n.s.	n.s.	n.s.	n.s.	n.s.	n.s.
M × P	3	***	n.s.	n.s.	***	n.s.	n.s.	n.s.	n.s.	**
PL × M× P	3	***	n.s.	*	n.s.	***	*	n.s.	*	*
Y × M × P	3	n.s.	n.s.	n.s.	n.s.	n.s.	n.s.	n.s.	n.s.	n.s.
Y × PL × M × P	3	n.s.	n.s.	n.s.	n.s.	n.s.	n.s.	n.s.	n.s.	n.s.
Rep×M×P(Y×PL)	56									
CV (%)		*12.15*	*9.7*	*14.08*	*16.4*	*11.8*	*7.5*	*9.6*	*10.2*	*8.3*

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ER: Emergence Rate, EP: Emergence Percentage, CAT:Catalaze, POD:Peroxidaze, SOD:Super oxide dismutase, SP:Soluble Proteins, Na:Sodium, K:Pottasium, CP:Colonization Percentage
* Significance at 0.05 probability level, ** Significance at 0.01 probability level, *** Significance at 0.001 probability level.

Table 04. Interaction between Place × mycorrhiza on the amount of POD, Na and SP

Place	Mycorrhiza	POD(μ M H2O2 / mn / protein)	Na (mg/g)	SP (mg/g)
Non-saline	Non-inoculated	0.05d	1.68c	12.2d
	Inoculated	0.09c	1.31d	13.1c
Saline	Non-inoculated	0.115b	3.61a	18.15a
	Inoculated	0.14a	2.5b	16.08b
LSD 0.05		*0.023*	*0.1715*	*0.327*

POD: Peroxidaze, SP: Soluble Proteins, Na: Sodium

Table 05. Interaction between place × prime on amount of CAT, POD, SOD, SP, Na, K, CP, ER and EP

Place	Priming	CAT (μ M H2O2 / mn / protein)	POD (μ M H2O2 / mn / protein)	SOD	SP (mg/g)	Na (mg/g)	K (mg/g)	CP (%)	ER	Ep (%)
Non-Saline	Tap water	0.57de	0.08cd	192.5d	12.3e	1.44e	11.4e	41a	0.164a	87.6b
	Nacl	0.58d	0.07d	187.7de	12.2ef	1.57de	11.3e	42a	0.163a	86.5b
	SA	0.62d	0.087cd	200.37d	13.1d	1.26f	12.3d	42.16a	0.174a	90.08a
	Cotrol	0.51e	0.06d	177e	11.9f	1.7d	10.7f	41.6a	0.142b	83.08c
Saline	Tap water	0.85b	0.12ab	252.5bc	15.9ab	2.94b	15.2b	30.16c	0.13b	76.3d
	Nacl	0.89b	0.10bc	259.2ab	15.8b	3.08b	15.07b	33.4bc	0.127b	74.6d
	SA	1.13a	0.14a	272a	16.2a	2.6c	16.5a	33.8b	0.137b	81.5c
	Cotrol	0.71bc	0.08cd	238.8c	15.4c	3.59a	14.5c	33.4bc	0.052c	69.5e
LSD 0.05		*0.169*	*0.023*	*13.94*	*0.327*	*0.1715*	*0.482*	*3.25*	*0.0163*	*2.33*

ER: Emergence Rate, EP: Emergence Percentage, CAT: Catalaze, POD: Peroxidaze, SOD: Super oxide dismutase, SP: Soluble Protein, Na: Sodium, K: Pottasium.

Table 06. Interaction between Year × mycorrhiza on the amount of POD, SOD and EP

Year	Mycorrhiza	POD(μ M H2O2 / mn / protein)	SOD	EP (%)
2014/2015	Non-inoculated	0.075c	209.04b	79.75b
	Inoculated	0.127a	236.68a	85.04a
2015/2016	Non-inoculated	0.073c	208.6b	76.6c
	Inoculated	0.102b	235.75a	83.2a
LSD 0.05		*0.023*	*13.94*	*2.33*

EP: Emergence Percentage, SOD: Super oxide dismutase

Table 07. Interaction beweenYear× Place on the amount of SOD

Year	Place	SOD
2014/2015	Non-saline	191.7c
	Saline	257.9a
2015/2016	Non-saline	187.04c
	Saline	241.2b
LSD 0.05		*13.94*

SOD: Super oxide dismutase

Table 08. Interaction between mycorrhiza ×prime on the amount of POD, CP and ER

Mycorrhiza	Priming	POD (μ M H2O2 / mn / protein)	CP (%)	ER
Non- inoculated	Tap water	0.076c	26.4cd	0.1379cd
	Nacl	0.07cd	28.4c	0.137cd
	SA	0.082c	27.5c	0.147bcd
	Cotrol	0.049d	24.1d	0.0537e
Inoculated	Tap water	0.12b	44.7b	0.157ab
	Nacl	0.108b	47ab	0.153abc
	SA	0.144a	48.5a	0.164a
	Cotrol	0.08c	45.9ab	0.132d
LSD 0.05		*0.023*	*3.25*	*0.0163*

POD: Peroxidaze, CP: Colonization Percentage, ER: Emergence Rate

Table 09. Interaction between year × place × mycorrhiza on the amount of CP and EP

Year	Place	Mycorrhiza	CP(%)	EP(%)
2014/2015	Non-saline	Non-inoculated	27f	86.58ab
		inoculated	50.4b	88.91a
	Saline	Non-inoculated	24g	72.9d
		inoculated	39.6d	81.16c
2015/2016	Non-saline	Non-inoculated	34.66e	84.83b
		inoculated	53.75a	87ab
	Saline	Non-inoculated	25.83fg	68.5e
		inoculated	43.3c	79.4c
LSD 0.05			*3.25*	*2.33*

EP: Emergence Percentage, CP: Colonization Percentage

Table 10. Interaction between place × mycorrhiza ×prime on the amount of CAT, SOD, SP, CP and ER

Place	Mycorrhiza	priming	CAT(μ M H2O2 / mn / protein)	SOD	K (mg/g)	SP (mg/g)	CP (%)	ER
Non-saline	Non-inoculated	Tap water	0.45bc	175i	10.98fg	12.11gh	30.8f	0.153cd
		Nacl	0.52bc	173.5i	10.8fg	11.9h	30.1fg	0.157cd
		SA	0.55bc	179.5i	11.73f	12.7fgh	31.3f	0.163bcd
		Cotrol	0.38c	152.8j	10.26g	10.7i	27.7gh	0.135ef
	Inoculated	Tap water	0.76abc	205.16g	11.93ef	12.9fg	51.6b	0.175ab
		Nacl	0.64abc	202g	11.8ef	12.5fgh	52.6ab	0.169abc

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		SA	0.79abc	221.2f	12.93de	13.9e	54.9a	0.185a
		Cotrol	0.50bc	187h	11.26fg	12.15gh	47.5c	0.148de
Saline	Non-inoculated	Tap water	0.802abc	240.5de	14.3c	15.4cd	26.5hi	0.122fg
		Nacl	0.87abc	245.16d	14.1c	15.0d	24i	0.116g
		SA	1.07ab	260.3c	15.45b	15.8cd	29.6fg	0.131fg
		Cotrol	0.60bc	225.16f	13.6cd	13.4ef	20.4j	0.094h
	Inoculated	Tap water	1.016abc	264.6c	16.26b	16.9ab	40.8d	0.1485de
		Nacl	1.011abc	273.3ab	16.05b	16.2bc	40.8d	0.148de
		SA	1.3a	283.6a	17.7a	17.73a	44.7c	0.153cd
		Cotrol	0.79abc	238.5e	15.48b	15.1d	34.3e	0.120fg
LSD 0.05			*0.169*	*13.94*	*0.482*	*0.327*	*3.25*	*0.0163*

ER: Emergence Rate, CAT: Catalaze, SOD: Super oxide dismutase, SP: Soluble Protein, CP:Colonization Percentage

IV. Conclusion

The limiting factors such as salinity in the environment to withstand and endure the conditions of mechanisms such as the production of antioxidant enzymes, reducing the potential of osmotic by producing osmolytes are doing and insemination and symbiosis with mycorrhiza and priming with salicylic acid based results in increased production of antioxidant enzymes in the plant, the K leave, seedling establishment and soluble proteins as well as reducing sodium, especially in salinity helped. For reasons of rising temperatures and high soil salinity in salted nodulation was less and has not been above 50%. Coexist with mycorrhiza and priming with tap water, Nacl solution especially salicylic acid increased resistance corn plant So inoculation with mycorrhiza and primed with salicylic acid as an approach to the development of corn in the land with salt restriction can be considered.

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HOW TO CITE THIS ARTICLE?

Crossref: https://doi.org/10.18801/jbar.140217.149

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Kazemi, J. S., Aboutalebian, M. A. and Mesgarbashee, M. (2017). Effects of priming and mycorrhiza on improving balance of sodium and potassium and changes of antioxidants in leaves of maize under soil salinity. Journal of Bioscience and Agriculture Research,14(02), 1210-1221.

MLA (Modern Language Association)

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Kazemi, J. S., Aboutalebian, M. A. and Mesgarbashee, M. “Effects of priming and mycorrhiza on improving balance of sodium and potassium and changes of antioxidants in leaves of maize under soil salinity”. Journal of Bioscience and Agriculture Research,14 no.02(2017):1210-1221.