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Research Article

Effect of Antioxidants and Salinity Stress on Seedling Parameters of Some Wheat Cultivars

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Abstract

Background and Objectives: Salinity is one of the major problems inhibiting early establishments of seedling. To check the impact of antioxidants on early seedling growth of some bread of wheat cultivars under salinity stress. Current investigation aimed to study the influence of antioxidants seed prim of some bread wheat cultivars to germinate under salinity concentrations on seedling parameters. **Materials and Methods:** A laboratory experiment was conducted in the Agronomy Department seed lab, Faculty of Agriculture Mansoura University, Egypt during November and December 2016. A factorial experiment assigned to Randomized Complete Block Design in four replication used. Four bread wheat cultivars i.e., Miser-1, Miser-2 and Gemmiza-12, three types of antioxidants, Salicylic acid, Ascorbic acid and Humic acid and three concentrations of antioxidants 0, 100 and 200 ppm under salinity levels of 0, 40, 80, 120 and 160 Mm. **Results:** The length of shoot and root, fresh and dry weight of shoot and root, seedling vigor index, total chlorophylls and germination tolerance index significantly affected by studying wheat cultivars. The tallest shoot and root as well as highest weight of fresh shoot, the highest values of seedling vigor index, the highest values of total chlorophylls and the highest values of germination tolerance index was obtained from Misr-1 cultivar. Soaking in humic acid as pretreatment significantly increased root length, fresh weight of shoot and root and seedling vigor index. Whereas, soaking in Ascorbic acid as pretreatment recorded the tallest shoot, root dry weight, total chlorophylls content and germination tolerance index. The results also designated that all these parameters were increased from increasing antioxidants concentrations until 200 ppm. Increasing salinity concentration from 40-160 mm significantly abridged the length, weight of fresh and dry shoot and root, seedling vigor index, total chlorophylls and germination tolerance index. **Conclusion:** In general, it could be concluded that priming bread wheat seed with Ascorbic acid or Humic acid as at concentrations of 200 ppm of Misr 1 or Gemmiza 12 cultivars enhanced seedling establishment under salinity stress (40 mM NaCl) to cultivate bread wheat under new reclaimed saline soil in Egypt.

Key words: Bread wheat cultivars, antioxidants types and levels, salinity stress levels, seedling characters, seedling total chlorophylls

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Competing Interest: The authors have declared that no competing interest exists.

Data Availability: All relevant data are within the paper and its supporting information files.

INTRODUCTION

Establishing of bread wheat seedlings at early growth stages, mainly affected the determinants of high yield severely affected by soil salinity. More than 20% of all cultivated lands around the world containing levels of salts high enough to cause salt stress on crop plants[1]. Salinity is a dangerous abiotic stress that limits crop productivity in arid and semi-aridlands[2]. For increasing bread wheat productivity to overcome the shortage of productivity by increasing from Egyptian population, we must increase the cultivated area from wheat by sowing with new salt reclaimed soils.

Seedling outstretched from prime seeds with 50 ppm SA followed by 50 ppm ascorbic acids had tallest and highest weight of fresh and dry shoot than other treated or non-priming under control and salinity[3]. Humic acid improves crop development in rain-fed areas as well as saline soils over and done with its positive role in soil physical and chemical properties[4]. Salicylic acid is an obviously be falling plant hormone of phenolic nature that has miscellaneous influences on lenience to abiotic stresses[5]. Soaking wheat seed in potassium humate simulated for getting most seedling growth[6]. Priming seeds with 0.00001 mM salicylic acid recorded the tallest radical and shoot[7]. Prim of wheat seed with humic produced higher root elongation as compared to prim seeds in alone water[8]. Wheat seedling growth enhanced by seed prim with PEG compared to humic matters. Application of humic acid under drought stress much affected the germination and growth seedling observed[9]. Humic acid application partly reduced the radical length, radicle number and fresh weight of barley germinated under control on shoot length. The inhibiting influence of salt on seedling growth differed improved by humic acid pretreatment[10].

Increase salt level significantly affected the growth of early seedling. Zarlasht cultivar was more sensitive to germination and performed rather acceptably at seedling stage[11]. Cultivars significantly differed in terms of the shoot and root growth of salt stresses. The alterations in genotypes significantly in genetic variation[12]. HD-2689, Raj4123 and HD-2045 varieties differed in root growth was tolerant concerning to salt stress than other varieties[13] Adversely affected by dry weight of shoot due to NaCl levels increases. Chamran cultivar recorded the lowest value. Chamran and Hamoon cultivars produced the highest weight of dry root[14]. Genetic variation in salt tolerance existed on the studied wheat varieties. Shoot growth affected more than radical growth of higher salinity levels. At 250 mM NaCl stresses, the Egyptian accession 11466 was the most salt tolerant. Whereas, at 300 mM NaCl stress the Pakistani accession 11299 and the Egyptian accession 11466 varieties were the salt tolerant[15]. The interaction between salt levels and genotypes had a significant influence on length of root and shoot and shoot and radical dry weight. There are genetic differences between genotypes and its effect on their resistance to salinity[16]. Salt stress inhibited seedling stage by acting in different parameters, especially shoot length, root length and shoot fresh weight[17]. Seedling fresh and dry weight and chlorophyll content significantly decreased as NaCl levels were increased and the control produced the highest values[18]. The length of shoot and root as well as seedling dry weight were significantly differed in study cultivars. Gourab, Shatabdi, Bijoy, Prodip, BARI Gom 26, BAW 1186 and BAW 1189 cultivars were more salt tolerance[19]. Consequently, the goals of this investigation were to investigate the influence of salinity and priming in antioxidants and its concentration on seedling parameters of some bread wheat cultivars in order to increase the cultivated area for bread wheat under the new reclaimed saline soil to overcome the shortage of wheat production in Egypt.

MATERIALS AND METHODS

Treatments and experimental design: A laboratory experiment assigned in November and December 2016 in seed lab, Agronomy Department, Faculty of Agriculture Mansoura University, Egypt. Factorial experiment assigned to Randomized Complete Block Design in four replication used. The four bread wheat cultivars of Miser-1, Miser-2 and Gemmiza-12, three types of antioxidants i.e., Salicylic acid, Ascorbic acid and Humic acid and three levels of antioxidants 0, 100 and 200 ppm beside five salinity levels i.e., 0, 40, 80, 120 and 160 Mm. The selected cultivars were obtained from wheat section Field Crop Institute, ARC and stored under normal conditions in paper bags. Each cultivar was prim in the three antioxidants at above concentrations of 12 h. Each cultivar irrigated with sodium chloride solution as above concentrations under the chamber condition at 25±1°C with darkness. Thereafter, seeds moistened with distilled water under control treatments. The prim seeds in antioxidants and non-primed seed of study cultivars sown in Petri dishes used fifty seeds per each treatment for each cultivar allowed to germinate on 720 Petri dishes moistened with five different solution of NaCl concentrations except the control in RCBD at four replication according to ISTA[20].

Studied characters: The bread wheat seed of study cultivars subjected for determination of seedling parameters in the laboratory experiment were measured as follows:

- The shoot length (cm) of the five seedlings from the seed to the tip of the leaf blade
- The root length (cm) of five seedlings from the seed to the tip of the root
- Weight of fresh shoot (g) of five seedling shoots were measured
- Weight of fresh root (g) of five seedling roots were logged
- Weight of dry shoot (g) of five seedling shoots were recorded after oven drying at 75°C for 48 h
- Weight of dry root (g) of five seedling roots recorded after oven drying at 75°C for 48 h
- Averages of total chlorophyll in seedling leaf samples assessed by SPAD-502 (Minolta Co. Ltd., Osaka, Japan)

Experimental analysis: The data collected was an analysis of variance technique using the MSTAT-C statistical package programmed in factorial experiment was assigned to RCBD as described by a procedure of Gomez and Gomez[21]. The lest significant differences test (LSD) for 5 and 1% level of probability used for comparing between treatment means[22].

RESULTS AND DISCUSSION

Cultivar performance: Averages of the length of shoot and root, weight of fresh and dry shoot and root, seedling vigor index, total chlorophylls and germination tolerance index as influenced by studied wheat cultivars are exposed in Table 1 and 2. Means of the length of shoot and root, weight of fresh and dry shoot and root, seedling vigor index, total chlorophylls and germination tolerance index significantly affected by studied wheat cultivars. The results revealed that Misr 1 cultivar produced the tallest shoot (9.72 cm) and root (9.24 cm) and highest weight of fresh shoot (0.347 g), the highest values of seedling vigor index (18.54), the highest values of total chlorophylls (1.50) and the highest values of germination tolerance index (57.15) as presented in

Table 1: Means of shoot and root length, shoot and root fresh weight, as affected by antioxidants types and levels and salinity concentrations of some wheat cultivars as well as their interactions

Characters/treatments	Shoot length (cm)	Root length (cm)	Shoot fresh weight (g)	Root fresh weight (g)
Cultivars				
Sakha 94	9.17	7.03	0.311	0.419
Misr 1	9.72	9.24	0.347	0.580
Misr 2	9.13	8.38	0.329	0.622
Gemmiza 12	8.48	8.28	0.312	0.652
F-test	*	*	*	*
LSD at 5%	0.09	0.11	0.006	0.011
Antioxidants types				
Humic acid	9.16	8.44	0.328	0.573
Salicylic acid	9.00	8.03	0.320	0.560
Ascorbic acid	9.22	8.23	0.327	0.571
F-test	*	*	*	*
LSD at 5%	0.07	0.09	0.005	0.009
Antioxidants levels				
Control	8.93	8.07	0.312	0.528
100 ppm	9.20	8.24	0.329	0.585
200 ppm	9.25	8.39	0.334	0.591
F-test	*	*	*	*
LSD at 5%	0.07	0.09	0.006	0.009
Salinity concentrations				
0 mM	11.27	14.26	0.421	0.693
40 mM	10.71	11.20	0.382	0.628
80 mM	9.59	7.42	0.332	0.567
120 mM	8.04	5.07	0.276	0.505
160 mM	6.02	3.21	0.214	0.448
F-test	*	*	*	*
LSD at 5%	0.11	0.12	0.006	0.012
Interactions F-test				
A×B	NS	*	NS	*
A×C	NS	*	NS	*
A×D	*	NS	*	NS
B×C	*	NS	NS	NS
B×D	NS	NS	NS	NS
C×D	NS	*	NS	*

*NS significant and not significant, respectively at 0.5%

Table 2: Means of shoot and root dry weight, seedling vigor index, total chlorophylls and germination tolerance index as affected by antioxidants types and levels and salinity concentrations of some wheat cultivars as well as their interactions

Characters/treatments	Shoot dry weight (g)	Root dry weight (g)	Seedling vigor index	Total chlorophylls	Germination tolerance index
Cultivars					
Sakha 94	0.048	0.116	15.57	1.24	35.27
Misr 1	0.048	0.118	18.54	1.50	57.15
Misr 2	0.044	0.109	14.43	1.42	48.38
Gemmiza 12	0.054	0.151	15.67	1.47	56.74
F-test	*	*	*	*	*
LSD at 5%	0.002	0.002	0.18	0.03	1.03
Antioxidants types					
Humic acid	0.048	0.121	16.37	1.42	50.78
Salicylic acid	0.048	0.124	15.67	1.38	45.62
Ascorbic acid	0.049	0.126	16.12	1.43	51.76
F-test	NS	*	*	*	*
LSD at 5%	-	0.002	0.16	0.02	0.89
Antioxidants levels					
Control	0.043	0.116	15.53	1.35	48.40
100 ppm	0.050	0.126	16.28	1.43	49.77
200 ppm	0.052	0.128	16.34	1.45	49.98
F-test	*	*	*	*	*
LSD at 5%	0.002	0.002	0.16	0.03	0.89
Salinity concentrations					
0 mM	0.064	0.149	24.43	1.76	0.00
40 mM	0.056	0.134	20.77	1.58	93.02
80 mM	0.049	0.123	15.79	1.37	75.82
120 mM	0.042	0.112	11.89	1.22	51.14
160 mM	0.032	0.100	7.38	1.10	26.96
F-test	*	*	*	*	*
LSD at 5%	0.003	0.003	0.20	0.04	1.16
Interactions F-test					
A×B	NS	*	NS	NS	*
A×C	*	*	NS	NS	NS
A×D	*	NS	NS	*	NS
B×C	NS	*	*	NS	NS
B×D	NS	NS	NS	NS	*
C×D	NS	*	NS	NS	NS

*NS significant and not significant, respectively at 0.5%

Table 1 and 2. In addition, sown Gemmiza 12 cultivar recorded the highest root fresh weight (0.652 g), the highest weight of fresh root (0.652 g). Whereas, the shortest root, the lowest weight of fresh and total chlorophylls and germination tolerance index were created from sown Sakha 94 cultivar. In addition, the shortest root, the lowest weight of dry shoot and seedling vigor index obtained from sown Misr 2 cultivar. It could be noticed that the tallest shoot and root as well as highest weight of fresh shoot, the highest values of seedling vigor index, the highest values of total chlorophylls and the highest values of germination tolerance index was obtained from Misr-1 cultivar. The differences between studied cultivars due to genetic variation. Shoot growth affected more than radical growth of higher salinity levels. At 250 mM NaCl stresses, the Egyptian accession 11466 was the most salt tolerant. Whereas, at 300 mM NaCl stress the Pakistani accession 11299 and the Egyptian accession 11466 were the salt tolerant[13-16,23] reported similar conclusions.

Antioxidants types effects: The results clearly pointed out that the length of shoot and root, weight of fresh and dry shoot, seedling vigor index, total chlorophylls and germination tolerance index significantly affected by antioxidants types, except, shoot dry weight insignificantly influenced as shown in Table 1 and 2. The results exposed that using humic acid as pretreatment significantly increased root length (8.44 cm), shoot (0.328 g) and root (0.573 g) fresh weight and seedling vigor index (16.37). In addition, using Ascorbic acid as pretreatment recorded the tallest shoot (9.22 cm), root dry weight (0.126 g), total chlorophylls content (1.43) and germination tolerance index (51.76). Meanwhile, Salicylic acid as pretreatment recorded the shortest shoot and root, the lowest weight of fresh shoot and root seedling vigor index, total chlorophylls and germination tolerance index. It could be specified that priming seed in humic acid as pretreatment significantly increased root length, shoot and root fresh weight and seedling vigor index. Whereas, priming in Ascorbic acid recorded the tallest shoot, root dry weight, total chlorophylls content and germination tolerance index. Humic acid application partly reduced the radical length and radicle fresh weight of barley germinated under control. The inhibiting effect of salt on seedling growth was differed improved by humic acid pretreatment[10].

Antioxidants concentrations effects: Averages of the length of shoot and root, weight of fresh and dry shoot and root, weight of dry shoot and root, seedling vigor index, total chlorophylls and germination tolerance index significantly affected by antioxidants concentrations as presented in Table 1 and 2. The results indicated that the tallest shoot (9.25 cm) and root (8.39 cm), the highest weight fresh shoot (0.333 g) and root (0.591 g), the highest weight of dry shoot (0.052 g) and root (0.128 g), the maximum seedling vigor index (16.34), total chlorophyll (1.45) and germination tolerance index (49.98) produced from increasing antioxidants concentrations until 200 ppm. Seed priming in antioxidants at a rate of 200 ppm as seed pretreatment increased the length of shoot and root, weight of fresh and dry shoot, seedling vigor index, total chlorophylls and germination tolerance index by 3.5, 3.2, 6.3, 10.7, 17.3, 9.4, 5.0, 6.3 and 3.2%, respectively compared without soaking in antioxidants. The tallest shoot and root, the highest weight fresh shoot and root as well as the highest weight of dry shoot and root, the maximum seedling vigor index, total chlorophyll and germination tolerance index were produced from increasing antioxidants concentrations until 200 ppm. In addition to, concentration increasing up to 500 and 750 mg L^{-1} of humic acid had the most effective impact on seedling growth parameters[24]. Similarly[8-10,25] came to the same conclusions.

Salinity concentrations effects: Means of the length of shoot and root, weight of fresh and dry shoot, shoot and root dry weight, seedling vigor index, total chlorophylls and germination tolerance index significantly affected by salinity concentrations as shown in Table 1 and 2. The results revealed that increasing salinity concentration from 40-160 mm significantly abridged the length of shoot and root, weight of fresh and dry shoot and root shoot, seedling vigor index, total chlorophylls and germination tolerance index. The highest values from the above-mentioned parameters were obtained from without salinity. The lower values from the above-mentioned characters were recorded from highest salinity level of 160 mM. Increasing salinity levels up to 160 mM decreased shoot and root length, shoot and root fresh weight, seedling vigor index, total chlorophylls and germination tolerance index by 46.5, 77.4, 49.4, 35.3, 50.0, 32.8, 69.7, 38.8 and 73%, respectively as compared with the control treatments. Shoot and root length and radicle number were much inhibited by salt due reducing cell division, nucleic acid and protein synthesis[26]. Salinity soils under drought produced poor plant establishment caused a reduction yield per plant[27]. Seedling influenced by salinity during germination by making an osmotic pressure that averts water uptake or by toxic influenced by sodium and chloride ions[28].

Interaction effects

Interaction between cultivars and antioxidants types effect: The results in Fig. 1 and 2 clearly demonstrated that the tallest roots and the highest root fresh weight were obtained from sown Misr 1 or Gemmiza 12 cultivars with pretreatment with Ascorbic acid, respectively. Whereas, the shortest roots and lowest root fresh weight were produced from sown Sakha 94 cultivar with pretreatment with Ascorbic acid. In addition, the highest weight of dry root and germination stress index were produced from sown Gemmiza 12 cultivar with pretreatment with Ascorbic acid as graphically illustrated in Fig. 3 and 4. Whilst, the lowest weight of dry root and germination stress index were obtained from sown Sakha 94 cultivar with pretreatment with Salicylic acid. It could be decided that the tallest roots and the highest root fresh weight were obtained from sown Misr 1 or Sakha 94 cultivars with pretreatment with Ascorbic acid.

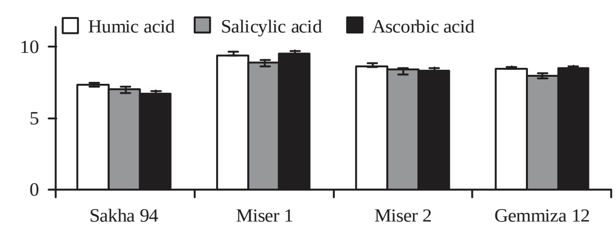

Fig. 1: Means of root length (cm) as affected by the interaction between wheat cultivars and antioxidants types
LSD values at 5%

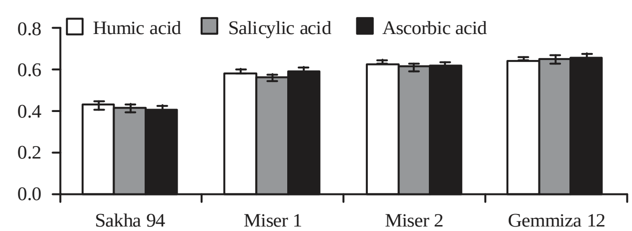

Fig. 2: Means of root fresh weight (g) as affected by the interaction between wheat cultivars and antioxidants types
LSD values at 5%

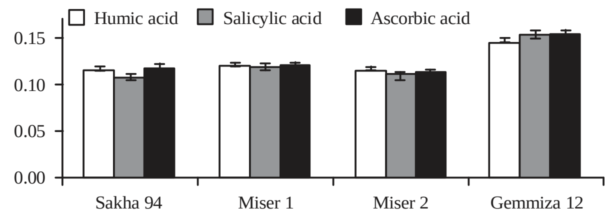

Fig. 3: Means of root dry weight (g) as affected by the interaction between wheat cultivars and antioxidants types
LSD values at 5%

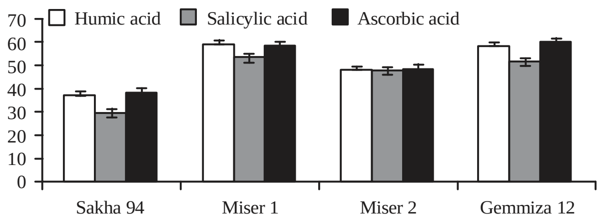

Fig. 4: Germination stress tolerance index as affected by the interaction between wheat cultivars and antioxidants types
LSD values at 5%

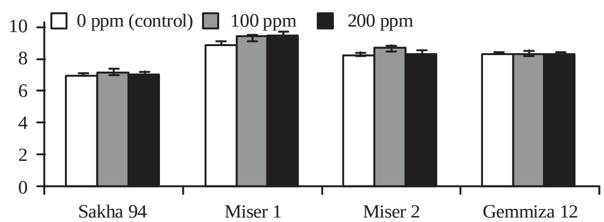

Fig. 5: Means of root length (cm) as affected by the interaction between wheat cultivars and antioxidants levels
LSD values at 5%

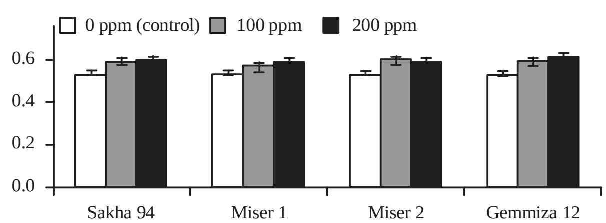

Fig. 6: Means of root fresh weight (g) as affected by the interaction between wheat cultivars and antioxidants levels
LSD values at 5%

Interaction between cultivars and antioxidant concentration effect: The tallest roots was recorded from

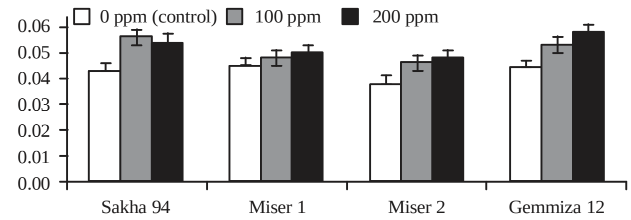

Fig. 7: Means of shoot dry weight (g) as affected by the interaction between wheat cultivars and antioxidants levels
LSD values at 5%

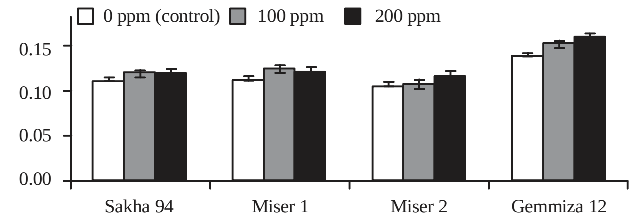

Fig. 8: Means of root dry weight (g) as affected by the interaction between wheat cultivars and antioxidants levels
LSD values at 5%

sown Sakha 94 cultivar with highest antioxidant level of 200 ppm as showed in Fig. 5. In addition, the highest root fresh weight, maximum weight of dry shoot and root were obtained from sown Gemmiza 12 cultivar at highest antioxidant level of 200 ppm as showed in Fig. 6, 7 and 8. Meanwhile, the lowest values of above characters were produced from all studied cultivars at the control treatments. It could be abridged that he highest root fresh weight, maximum weight of dry shoot and root were obtained from sown Gemmiza 12 cultivar at highest antioxidant level of 200 ppm.

Interaction between cultivars and salinity levels effect: The tallest shoot and the great shoot fresh weight were recorded from sown Sakha 94 cultivar at the control treatments, whereas, the lowest values was recorded from the same cultivar at higher salinity level of 160 mM as graphically illustrated in Fig. 9 and 10. In addition, the highest weight of dry shoot and total chlorophyll were gotten from sown Gemmiza 12 cultivar at without salinity. The less values of these parameters were produced from sown Sakha 94 cultivar at higher salinity level of 160 mM as graphically illustrated in Fig. 11 and 12. It could brief that the highest weight of dry shoot and total chlorophyll were gotten from sown Gemmiza 12 cultivar at without salinity. HD-2689, Raj-4123 and HD-2045

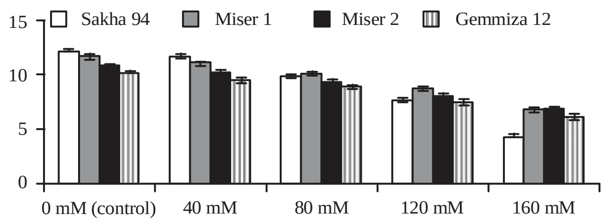

Fig. 9: Means of shoot length (cm) as affected by the interaction between wheat cultivars and salinity concentrations
LSD values at 5%

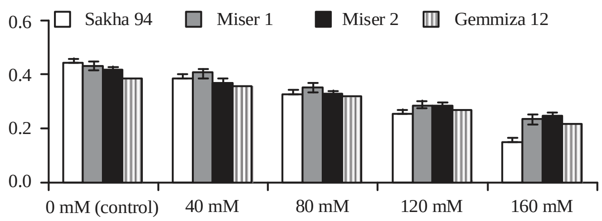

Fig. 10: Means of shoot fresh weight (g) as affected by the interaction between wheat cultivars and salinity concentrations
LSD values at 5%

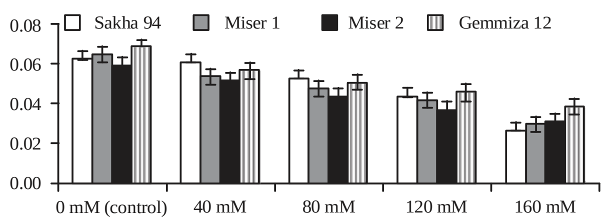

Fig. 11: Means of shoot dry weight (g) as affected by the interaction between wheat cultivars and salinity concentrations
LSD values at 5%

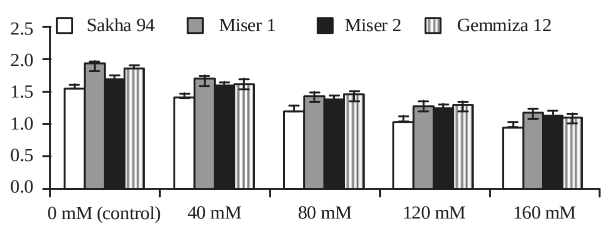

Fig. 12: Means of total chlorophylls as affected by the interaction between wheat cultivars and salinity concentrations
LSD values at 5%

cultivars differed in root growth was tolerant about salt stress than other cultivars[13]. The interaction between salt levels and

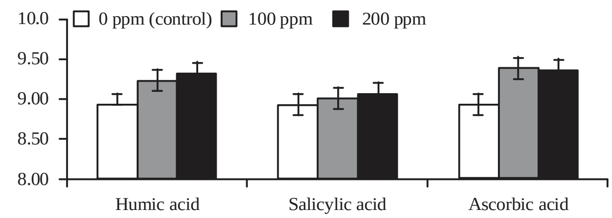

Fig. 13: Means of shoot length (cm) as affected by the interaction between antioxidants types and levels
LSD values at 5%

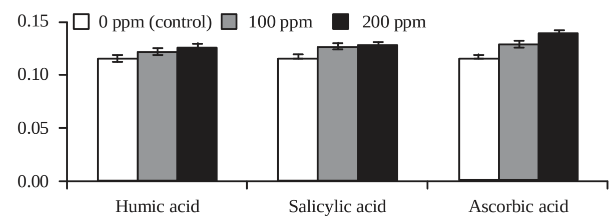

Fig. 14: Means of root dry weight (g) as affected by the interaction between antioxidants types and levels
LSD values at 5%

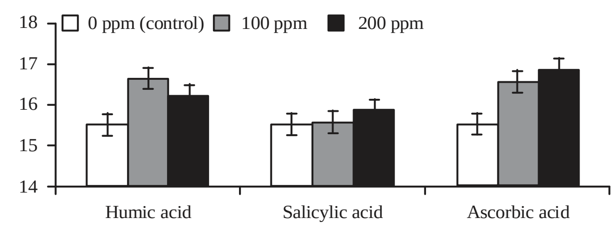

Fig. 15: Means of seedling vigor index as affected by the interaction between antioxidants types and levels
LSD values at 5%

genotypes had a significant influence on the length of shoot and radical, dry weight of shoot and radical. There are genetic differences between genotypes and its effect on their resistance to salinity[16].

Interaction between antioxidants types and concentration effect: The tallest shoot, the great weight of dry root and the highest values of seedling vigor index were recorded from pretreatment of Ascorbic acid at concentration of 200 ppm, however, the lowest values were obtained from sown all cultivar at without antioxidant concentration as graphically illustrated in Fig. 13, 14 and 15. It could perceived that the tallest shoot, the great weight of dry root and the highest values of seedling vigor index were recorded from priming in

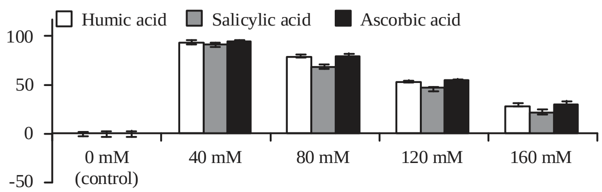

Fig. 16: Germination stress tolerance index as affected by the interaction between antioxidants types and salinity concentrations

LSD values at 5%

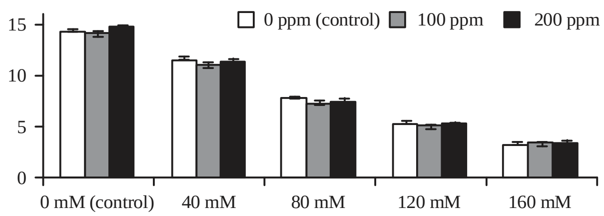

Fig. 17: Means of root length (cm) as affected by the interaction between antioxidants levels and salinity concentrations

LSD values at 5%

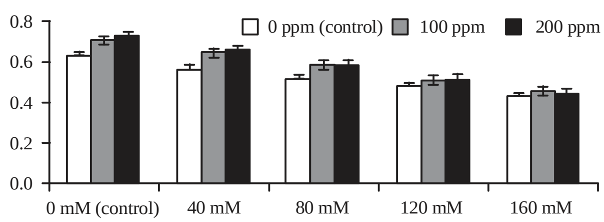

Fig. 18: Means of root fresh weight (g) as affected by the interaction between antioxidants levels and salinity concentrations

LSD values at 5%

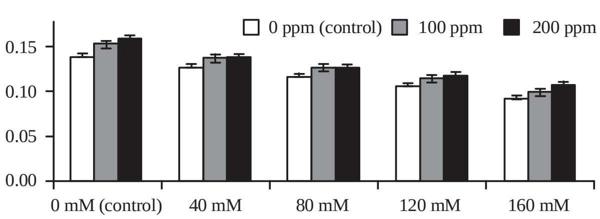

Fig. 19: Means of root dry weight (g) as affected by the interaction between antioxidants levels and salinity concentrations

LSD values at 5%

Ascorbic acid at concentration of 200 ppm. Seedling raised from prime seeds with 50 ppm SA followed by 50 ppm ascorbic acids had much higher lengths and fresh and dry weight of shoot than other treated or non-priming under control and salinity[3].

Interaction between antioxidants types and salinity levels effect: The results clearly showed that the highest values of germination tolerance index and produced from using Humic acid or Ascorbic acid at salinity level of 40 mM as pretreatment, respectively, whilst, the lowest values was recorded from using Salicylic acid at salinity level of 160 mM as graphically illustrated in Fig. 16. It could detected that the highest values of germination tolerance index produced from using Humic acid or Ascorbic acid at salinity level of 40 mM as pretreatment.

Interaction among antioxidants concentrations and salinity levels effect: The tallest roots, the highest fresh and dry root weight were produced from increasing antioxidants concentrations up to 200 ppm at the control treatments (without salinity) as graphically illustrated in Fig. 17, 18 and 19. Whereas, the less values of these characters were obtained from without antioxidants (the control) at highest level of salinity of 160 mM. It could be abridged that the tallest roots, the highest fresh and dry root weight were produced from increasing antioxidants concentrations up to 200 ppm at the control treatments. Application of exogenous SA in the salt-stressed seedlings reduced salt adverse effects and increased wheat plant resistance by increase in growth processes, regulation and balance with osmotic potential, the induction to antioxidant responses and carbohydrate metabolism. In this study, the highest SA effect observed mostly at SA 400 mg L^{-1}[29].

It could noticed that the length of shoot and root, weight of fresh shoot and root, weight of dry shoot and root, seedling vigor index, total chlorophyll and germination tolerance index insignificantly influenced by the interaction between cultivars×antioxidants types×antioxidants concentration, the interaction between cultivars×antioxidants types×salinity level, the interaction between antioxidants types× antioxidants concentrations×salinity level, the interaction between cultivars, antioxidants types×antioxidants concentrations×salinity level.

CONCLUSION

From the above results, it could be recommended that to maximize seedling establishment and germination tolerance index by sown Misr-1 or Gemmiza-12 cultivars with Ascorbic acid or Humic acid priming at concentrations of 200 ppm under increasing the salinity concentration to 40 mM for increasing the bread wheat cultivated area, under the new reclaimed saline soil to overcome the shortage of wheat production in Egypt.

SIGNIFICANCE STATEMENT

This study discovered that sown Misr 1 or Gemmiza 12 cultivar and using Ascorbic acid or humic acid as pretreatment as antioxidants at concentrations of 200 ppm maximized seedling establishment and germination tolerance index with increasing salinity concentration from 40 mM. This will be helpful for researchers to increase wheat production through increasing its cultivated area under the new reclaimed saline soil and to overcome the shortage of wheat production in Egypt.

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