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EFFECT OF AMINO ACIDS APPLICATION AND IRRIGATION WITH SALINITY WATER LEVELS ON CONTENT OF SOME AMINO ACIDS IN WHEAT AND OSMOTIC PRESSURE

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ABSTRACT

Two lisimeters experiments were conducted at Sakha Agric Res. Station from during the two successive winter seasons of 2005/2006 and 2006/2007 to study the effect of amino acids application on wheat crop tolerance to salinity. Split plot design was used the main plots were assigned by five levels of irrigation water salinity of 0.4, 2, 4, 6 and 8 dSm^{-1}. The sub plots were assigned by four methods of amino acids applications of control (without application), soaking wheat grains, foliar application and soaking + foliar application. The amino acids used are mixture of proline, Arginine and Glutamic, 10 ppm from each one. The results of the present work can be summarized as follows:

Content of proline and arginine in both grains and straw of wheat plant was increased with application of amino acids under all salinity levels. The values were higher with soaking of grains foliar application of amino acids in comparison with other treatments.

Amount of arginine content in wheat grains and straw were increased by adding amino acids, but this increase was higher in the grains in comparison with those values in straw by soaking grains and foliar application treatment in the first and second growing seasons. The same trend was obtained in the straw. Increasing salinity levels increased amount of amino acids content by both grains and straw. The highest values were recorded under soaking grains + foliar application treatments where the highest values in grain are 195.8 and 107.0 mg/kg in the first and second growing seasons, respectively. The same trend was obtained in the straw.

Data also, illustrated that values of osmotic pressure (O.P) in leaves were increased by adding amino acids, where the highest values were recorded with soaking of grains + foliar application of amino acids. The values are 9.95 and 12.02 atm. In the first and second growing seasons, respectively. Increasing salinity levels increased O.P values, where the highest values (13.90 and 12.32 atm) were recorded under 8 dS/m.

Keywords: Amino acids-salinity-osmotic pressure-wheat.

INTRODUCTION

Wheat is one of the most important cereal crops all over the world. It considers more consumed crop by population according to nutritional habits in Egypt. There is a great gap between amount of wheat production and consumption. To make shrinking to this gap, wheat production must be increased to face the increasing demands for population. One of these tools is to expand the cultivated area (horizontal expansion) in arable land and increase the yield per unit area of cropped land. Secondly, irrigation has already layed an important role in increasing food production in Egypt because the highest yield is obtained under irrigated lands. On the other hand, there is a limitation in water resources in Egypt. So, there urgent need to use water in a low quality.

Many researchers studied a number of management strategies to minimize the effect of saline water on agricultural under production (Hoffman, 1985 and Meiri and Plaut, 1985). However, under relatively high salinity stress the successful use of the management strategies of soil and water are limited. So, tailoring of plants to tolerate salinity stress environments is necessarily needed. This should depend upon the development of plant biotechnology research. Until the development had been achieved, the use and modified of some possible treatments of soil and plant should partly increased the crop salt tolerance through the alleviating some salinity adversities (Yeo, 1981 and Yang *et al.*, 1990).

Many trials have been done to promote the production of amino acids in plant tissue and to increase the osmotic pressure of cell sap and consequently increase the plant tolerance to salinity. Some of them exogenous application of some amino acids to plant foliar application and/or soaking seeds just before sowing, (Younis *et al*., 1992).

The objective of the present work, an attempt has been made to induce a further increase of salt tolerance in wheat plant through the possible modification of plant manipulation with some amino acids (proline + glutamic) and to obtain and acceptable yield and quality under saline condition.

MATERIALS AND METHODS

Two lysimeter experiments were conducted at Sakha Agriculture Research Station Farm during two successive winter growing seasons of 2005/2006 and 2006/2007. Aimed to study the effect of some amino acids application (Proline, Arginine and Glutamic) on wheat crop tolerance to salinity. The soil used for experiment was non saline and non alkaline. Table (1) show some soil chemical and physical properties were determined by using stander methods according to Black *et al.* (1965) and Jackson (1967).

Table 1. Some chemical and physical characteristics for the experimental site before cultivation in two growing seasons.

	SAR	Soluble anions meq/L				Soluble cation meq/L				Particles size distribution			Stru-cture	O.M	pH	$CaCO_3$ %	EC dS/m	SP %
		$CO_3^{=}$	HCO_3^-	Cl^-	SO_4^{--}	Ca^{++}	Mg^{++}	Na^+	K^+	Silt	Clay	Sand						
1st	7.2	0.0	2.5	5.9	11.1	4.5	1.3	12.3	0.4	23.3	57.1	20.3	Clay	1.8	7.2	1.8	2.5	79.6
2nd	10.4	0.0	3.0	5.0	27.7	6.5	4.4	24.3	0.5	24.6	56.6	20.7	Clay	2.1	7.4	1.7	3.6	86.7

The experimental design was spilt plot design with four replicates. The main plots were devoted to salinity level of irrigation water. The sub plots were assigned by the application methods of the used amino acids i.e. control treatment with out application (C), soaking grains (S), foliar application (F) and soaking plus foliar (S + F) with Concentration of 10 ppm for each amino acid as a mixture of Proline Arginine and Glutamic was used with every application method. The plot area is 2 m^2 which cultivated with Sakha 93.
Once Walt lots were sown with grains soaked four hours in each amino acid as mixture. Five artificial salinity levels of irrigation water were used to irrigation the lysemeters i.e., 0.4, 2, 4, 6 and 8 dSm^{-1}.

- Artificial saline water was prepared for different treatments using NaCl and $CaCl_2$ salts.
- All pots received the recommended doses of N, P and K fertilizers.

- The foliar applications of amino acids were added at tellering and panicle initiation stages.
- Total soluble solids (T.S.S) was determined using hand refractometer and osmotic pressure values were calculated according to Gusava (1967).
- At maturity stage, grain and straw yields kg/plot were determined and samples were taken from each plot, dried at 70º C and digested used sulphuric and perchloric acids mixture according to Peterburgski (1968).
- Amino acids (Proline Arginine and Glutamic) were determined by the method described by Marble *et al.* (1959).
- All data were subjected to statistical analysis using irristate program by using Snedecor and Cochran (1981).

RESULTS AND DISCUSSION

A. Proline content in wheat grain and straw:

Data presented in Table (2) show the effect of amino acids application and different levels of irrigation water salinity on proline content of wheat grain and straw. Data reveal that, proline content in grain increased with increasing salinity level of irrigation water up to 8 dS/m during the two seasons of study. The mean values of proline content in grain and straw ranged from 30.9 to 88.1 ppm and from 100.1 to 147.9 ppm, respectively in the first and second seasons, respectively of study whereas, it ranged from 45.4 to 184 ppm and from 84.6 to 133.8 ppm, respectively in the straw in the first and second season, respectively.

Data show a highly significant relation between proline content and salinity treatments in both seasons of study.

Concerning to amino acid application method, data revealed to high significant effects of method of application and proline content. The concentration of proline in wheat grains ranged from 36.9 to 85.5 ppm and from 102.5 to 157.1, respectively in the two seasons of the study. Whereas, it ranged from 50.8 to 267.5 ppm and 80.26 to 145.1 ppm, respectively in the straw, in the two seasons of study.

It is worthy to note that, foliar application hasn't clearly effect as the soaking treatment, while, soaking plus foliar spraying was the best treatment. The increasing of proline concentration in wheat grain is a common feature due to the increase of salt concentration in irrigation water. These results are in agreement with those obtained by Voetberg and Sharp (1991).

B. Arginine content in wheat grains and straw:

Data in Table (3) show the effect of amino acids mixture application and saline water on arginine content of wheat grain and straw point during the two seasons of study.

Argnine content high significantly increased with increasing saline of irrigation water up to 8 dS/m. The mean values ranged from 59.8 to 136.1 and from 62.1 to 88.6 ppm for grain in the two seasons, respectively. Whereas, they were ranged from 71.3 to 149.7 and 48.2 to 82.0 ppm for straw in the two seasons, respectively. Concerning application methods, data presented in Table (3) show high significant effects of either addition methods of amino acids on arginine content of grains and straw of wheat crop comparing to control treatment. The mean values ranged from 68.1 to 114.2 ppm and 62.3 to 101.2 ppm for grains in the two seasons, respectively. In the straw the mean values ranged from 51.4 to 194.6 ppm and from 53.5 to 96.0 ppm, respectively in both seasons of study.

Table 2. Proline content in wheat grains and straw (ppm) as affected by different treatments during both growing seasons.

Treatment	Proline content (ppm)			
	Grain		Straw	
	1st	2nd	1st	2nd
Salinity levels dS/m (S)				
0.4	30.9	100.1	45.42	84.6
2	35.4	110.9	127.8	90.1
4	40.3	121.6	173.7	120.7
6	71.6	140.4	179.6	124.5
8	88.1	147.9	184.1	133.8
L.S.D. 5%	3.31	3.65	5.70	3.61
1%	4.41	4.88	7.62	4.82
Application method of amino acids: (A)				
Control (C)	36.9	102.5	50.8	97.3
Soaking (S)	55.4	127.7	75.3	88.26
Foliar (F)	35.1	109.7	174.9	112.15
S+F	85.5	157.1	267.5	145.1
SXA	**	**	**	**
L.S.D. 5%	3.60	3.90	6.09	3.76
1%	4.89	5.29	8.27	5.09

The soaking treatment was surpassed to foliar treatment for arginine grains and straw content during the two seasons of study. The application treatment can be arranged according to arginine content in the descending order: soaking + foliar > soaking > foliar treatment.

This tend was in harmony with that observed by Amer and Kata (1990).

Glutamic content in wheat grain and straw:

Data presented in Table 4 show the effect of amino acids application on glutamic content (ppm) in wheat grains and straw. High significant effects on glutamic contents of grain and straw were detected due to the salinity treatments during the two growing seasons of study.

Glutamic content in grain and straw increased by increasing level of irrigation water salinity up to 8 dS/m. The mean values varied from 69, 3 to 196.1 and 62.9 to 93.3, respectively for grains and from 66.2 to 160.7 and 48.8 to 85.1, respectively for straw during the two seasons of study. Regarding to application methods of amino acids, data reveal significant different case between different methods. The control treatment achieved the lowest value of glutamic content where the soaking plus foliar application recorded the highest value of glutamic content (ppm) during the two seasons of study. On the other hand, soaking treatment was surpassed on foliar treatment for all tested amino acids.

The mean values ranged from 81.8 to 196.4 ppm and 64.3 to 106.7 ppm for grains in the two seasons, respectively. Whereas, they were ranged from 44.1 to 231.8 ppm and from 54.0 to 94.9 ppm, respectively for control and (soaking + foliar) treatment in both season. These results are in agreement with those obtained by Amer and Kata (1990).

Table 3. Arginine content in grain and straw ppm as affected by different treatments during both growing seasons.

Treatment	Arginine content (ppm)			
	Grain		Straw	
	1st	2nd	1st	2nd
Salinity levels dS/m (S)				
0.4	59.8	62.1	71.3	48.2
2	62.0	72.8	100.8	53.3
4	73.7	75.1	111.3	78.9
6	78.3	82.5	129.3	79.5
8	136.1	88.6	149.7	82.0
L.S.D. 5%	6.76	2.23	3.11	3.29
1%	8.97	4.28	4.2	4.39
Application method of amino acids (A)				
Control (C)	68.1	62.3	51.4	53.5
Soaking (S)	73.4	76.5	98.1	54.7
Foliar (F)	72.3	64.9	105.7	69.3
S + F	114.2	101.2	194.6	96.0
S X A	**	**	**	**
L.S.D. 5%	6.82	3.99	3.46	3.48
1%	9.22	4.46	4.64	4.73

Table 4. Glutamic content in wheat grain and straw as affected by different treatments during the two growing seasons.

Treatment	Glutamic content (ppm)			
	Grain		Straw	
	1st	2nd	1st	2nd
Salinity levels dS/m (S)				
0.4	69.3	62.9	66.2	48.8
2	91.4	76.7	104.6	54.5
4	114.4	77.5	107.0	80.9
6	167.8	87.8	157.5	82.0
8	196.1	93.3	160.7	85.1
L.S.D. 5%	0.92	7.23	0.64	1.42
1%	1.23	9.72	0.69	1.90
Application method of amino acid (A)				
Control (C)	81.8	64.3	44.1	54.0
Soaking (S)	130.3	80.9	85.6	70.6
Foliar (F)	102.6	66.7	115.3	61.5
S + F	196.4	106.7	231.8	94.9
S X A	**	**	**	**
L.S.D. 5%	0.97	7.66	0.85	1.68
1%	1.32	10.39	0.94	2.29

Osmotic pressure:

Data in Table 5 show the effect of different treatments on osmotic pressure of wheat plant. Osmotic pressure values were increased significantly with increasing irrigation water salinity up to 8 dS/m. The mean values ranged from 5.92 to 13.9 atm. and 8.12 to 12.32 atm. for the two seasons of study, respectively.

Table 5. Osmotic pressure (O.P atm) in wheat plant as affected by different treatments during the two growing seasons.

Treatment	1st	2nd
Salinity level dS/m (S)		
0.4	5.92	8.12
2	5.98	9.38
4	7.73	10.92
6	9.15	11.33
8	13.9	12.32
L.S.D. 5%	0.03	0.08
1%	0.05	0.11
Application method (A)		
Control (C)	7.98	8.17
Soaking (S)	8.3	11.0
Foliar (F)	7.9	10.3
S + F	9.95	12.02
S X A	**	**
L.S.D. 5%	0.04	0.12
1%	0.05	0.09

Regarding to methods of amino acids application, values of osmotic pressure increased high significantly in the double treatment (soaking + foliar), this treatment gave the highest mean values (9.95 and 12.02 atm) in the 1st and 2nd seasons, respectively. This trend can be based on the enhancing effect of amino acids on osmoregulation in the plant by increasing the hydration of the protoplasm (Rains *et al*, 1980).

Grain yield (kg/plot):

Data in Table 6 showed that salinity levels reveal significant effect on wheat grain yield. The mean values of wheat grain yield decreased with increasing the salinity levels of irrigation water up to 8 dS/m. The values were 1.89, 1.85, 1.80, 1.79 and 1.66 kg in the 1st season and 1.85, 1.84, 1.79, 1.7 and 1.65 in the 2nd season, with the levels of 6.4, 2, 4, 6 and 8 dS/m, respectively.

This may be due to the excessive salt in substrate appear to reduce the growth yield by restricting nutrient uptake to extent that deficiency was taken place there is also the possibility that the salt treated plants utilized energy for the osmotic adjustment process at expense of growth. These results are in agreement with Abou El-Soud (1987) and El-Mancy (1994). Data in the same table clearly illustrated that under addition of amino acids especially with double treatment (soaking grains + foliar application) clearly increased grain yield this the treatment gave the highest mean values in the two growing seasons (1.97 and 1.84) in the 1st and 2nd growing season' respectively. This trend can be based on the enhancing effect of amino acids on osmoregulation in the plant by increasing the hydration of the protoplasm (Rain *et al*., 1980).

Table (6): Effect of salinity levels and amino acids application on grain and straw yield of wheat in 1st and 2nd seasons.

Treatment	Grain		Straw	
	1st	2nd	1st	2nd
Salinity levels dS/m(S)				
0.4	1.89	1.85	3.68	3.6
2	1.85	1.84	3.55	3.48
4	1.80	1.79	3.14	3.2
6	1.79	1.7	2.94	2.74
8	1.66	1.65	2.72	2.67
L.S.D 5%	0.15	0.36	0.13	0.19
1%	0.22	0.24	0.27	0.27
Amino acids application method				
Control	1.68	1.72	3.09	3.05
Soaking	1.73	1.73	3.13	3.1
Foliar	1.79	1.77	3.22	3.13
S. + F.	1.97	1.84	3.39	3.28
L.S.D 5%	0.10	0.25	0.08	0.03
1%	0.13	0.34	0.11	0.05

2. Straw yield:

Data presented in Table 6 indicate that the straw yield was greatly reduced with increasing salinity levels of irrigation water up to 8 dS/m in both seasons. The mean values were decreased from 3.68 to 2.72 kg in the 1st and 3.60 to 2.67 kg in the 2nd season. These results are in agreement with those obtained by Grithed and Yadav (1982).

Highly significant effect were obtained by soaking grains + foliar spraying of amino acids (3.39 and 3.28 kg/plot) in the 1st and the 2nd seasons, respectively. The application of amino acids may has an essential role in osmoregulation and protect macromolecules through its accumulate in the cytoplasm and its function in protecting the conformation of macromolecules in a changing ionic environment (Moshatel, 1985)

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العلاقة بين اضافة الاحماض الامينية ومستويات ملوحة مياه الرى على محتوى القمح من بعض الاحماض الامينية والضغط الاسموزى

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نفذت تجربتان فى احواض اسمنتية بمحطة البحوث الزراعية بسخا ـ محافظة كفرالشيخ خلال الموسمين الشتويين 2006/2005 و 2007/2006 لدراسة اثر اضافة بعض الاحماض الامينية على تحمل محصول القمح لمستويات الملوحة المختلفة. حيث استخدم التصميم الاحصائى القطع المنشقة مرة واحدة وشغلت القطع الرئيسية بخمسة مستويات ملوحة لماء الرى هى 0.4 ، 2 ، 4 ، 6 ، 8 مليموز/سم وشغلت القطع المنشقة باربعة طرق لاضافة الاحماض الامينية هى نقع الحبوب فى مخلوط الاحماض الامينية المستخدمة لرش مخلوط الاحماض الامينية المستخدمة فى مرحلتى التفريع وتكوين السنابل على المجموع الخضرى والمعاملة نقع + رش بالاضافة الى معاملة الكنترول بدون اضافة. واستخدم المخلوط بنسبة متساوية من احماض البرولين والجلوتاميك والارجنين بحيث يكون التركيز 10 جزء فى المليون من كل حامض واستخدم هذا التركيز فى معاملات النقع ومعاملات الرش اوهما معا. وتم اعداد مستويات الملوحة بمياه الرى باستخدام املاح كلوريد الكالسيوم وكلوريد الصوديوم ويمكن تلخيص النتائج كالاتى:

1- محتوى البرولين والارجينين فى كل من الحبوب والقش قد زادت باضافة الاحماض الامينية تحت كل مستويات الملوحة. اعطت معاملة نقع البذور فى الاحماض الامينية اعلى قيم مقارنة بباقى المعاملات.
2- محتوى الارجينين بالحبوب والقش زادت مع اضافة الاحماض الامينية ولكن هذه الزيادة كانت عالية فى الحبوب مقارنة بالقيم فى حالة القش. أعطت المعاملة نقع البذور بالرش اعلى القيم فى الموسم الاول والثانى على الترتيب. نفس الاتجاه تم الوصول اليه فى حالة القش. زيادة مستوى الملوحة زاد من كمية الاحماض الامينية الممتصة بواسطة الحبوب والقش.
   أعلى قيم سجلت تحت معاملة (نقع البذور والرش) حيث كانت اعلى القيم فى الحبوب هى 195.8 ، 107 ميجرام/كيلوجرام فى الموسم الاول والثانى على الترتيب ، ونفس الاتجاه كان فى القش.
3- البيانات اوضحت كذلك ان قيم الضغط الاسموزى فى الاوراق زادت بزيادة اضافة الاحماض الامينية حيث كانت اعلى القيم تحت معاملة (نقع البذور + الرش بالاحماض الامينية. القيم كانت 9.95 ، 12.02 فى الموسم الاول والثانى على الترتيب.
4- زيادة الملوحة زادت من قيم الضغط الاسموزى حيث كانت اعلى القيم عند 13.9 ، 12.32 تحت المعاملة 8 ديسمنز/متر.