J. Plant Production, Mansoura Univ., Vol. 5 (2): 267- 281, 2014

INFLUENCE OF SOME ANTIOXIDANTS ON EMERGENCE, GROWTH AND YIELD OF DIRECT-SEEDED RICE

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ABTRACT

A laboratory experiment has been implemented to evaluate the influence of seed soaking in antioxidants solutions [Ascorbic (100 ppm) , α - tocopherol (100 ppm) , salicylic (100 ppm) and water as a control] on seed and seedlings vigor of rice Giza 177 cultivar during 2012 season. Also, field experiments were conducted to evaluate presowing treatments of previous antioxidants solutions and foliar spray treatments with [Ascorbic (200 ppm) ,α- tocopherol (200 ppm) , salicylic (200 ppm) and without foliar as a control] and their effect on emergence, growth and yield during 2011and 2012 seasons. The results indicated that soaking of rice seed with antioxidant ascorbic solution (100 ppm) increased seed and seedlings vigor as compared with traditional treatment of seed (soaking in water).Soaking rice seed in antioxidants solutions had a significant effect on number of plants /m^2 and grain yield , while other characters of growth and yield did not affected. All of growth and yield characters under study significantly affected by foliar spray with antioxidants solutions. Foliar spray with ascorbic (200 ppm) gave the highest values of growth and yield characters compared with other treatments. Interaction between application antioxidants solutions as a soaking and as a foliar spray showed significant effect on number of plants /m^2 and grain yield characters. Stepwise regression analysis demonstrated that field emergence % , seedling dry weight, plant height, number of plants/m^2, panicle length, panicle weight, number of grains/panicle are significantly contributing variables to variation in grain yield . Positive and significant correlation coefficient were obtained between grain yield and field emergence %, number of plants/m^2, panicle length (cm), panicle weight (g) and number of grains/panicle.

It could be concluded that soaking rice seed of Giza 177 cultivar with ascorbic acid (100 ppm) as presowing treatment beside ascorbic acid (200 ppm) as a foliar spray in field is an effective way to improve emergence, growth and yield of direct-seeded rice.

Keywords: Rice, antioxidants, direct-seeded, emergence, growth and yield.

INTRODUCTION

Rice is one of the most important cereals in the world feeding well in excess of 4 billion people (Basra *et al*.,2006). Rice transplanting requires a large amount of labor, which often results in increasing production costs. In addition, under a changing socioeconomic environment, workers are not available or are reluctant to undertake tedious operations such as transplanting seedlings. Alternate methods that require less labor without sacrificing productivity are needed. Considering labor costs, direct seeding is an appropriate alternative to traditional transplanting. However, poor germination, uneven crop stand, and high weed infestation are the main constraints to its adoption (Balasubramanian and Hill, 2002).

Of different techniques being used to overcome the problem of poor seed germination in crop plants, pre-sowing seed treatment with different

chemicals has gained much importance recently because of its effectiveness and cheapness (Iqbal & Ashraf, 2005). Farooq *et al*.,(2006 a) demonstrated that rice seed treatments with salicylate and ascorbate were more effective in vigor enhancement, germination rate and seedling growth. Also Farooq *et al.,* (2006 b) reported that soaking seed with Ascorbic acid (10 mg /l) for 48 h promoted germination and improved germination characters of rice seed. Farooq *et al*., (2007) reported that salicylic acid seed treatment for 48 h resulted in earlier, synchronized, enhanced germination and improved fresh seedling dry weight compared with untreated seed. Application of 300 mg/l of ascorbic acid (AsA) as a foliar spray caused an increase in biomass of root and shoots fresh and dry weights both under saline and none saline conditions, rate of photosynthesis increased with foliar application of Ascorbic acid both under saline and none saline conditions (Rizwan *et al*.,2011).Rice plants treated with α- tocopherol, and salicylic acid (SA)showed 6% and 13.5% increases in grain yield in the respective order as a result of decreased respiration and increased membrane integrity (Mohammed , 2011).This study aimed to evaluate the effectiveness of some antioxidants solutions as a soaking and foliar treatments in improving germination and yield of direct-seeded rice.

MATERIALS AND METHODS

This study was carried out during 2011 and 2012 growing seasons at the Laboratory of Seed Technology Research Unit, Mansoura and Tag AL - Ezz, Agric. Res. Station Farm, ARC, Dakahlia Governorate, Egypt, to study the effect of some antioxidants solutions i.e. ascorbic acid (100 ppm), α-tocopherol (100 ppm) and salicylic acid (100 ppm) and water (control) as a soaking solutions on seed germination and seedlings vigor. In addition, antioxidants solutions effect as a foliar spray treatments of ascorbic acid (200 ppm), α-tocopherol (200 ppm) , salicylic acid (200 ppm) and without foliar spray application on growth and yield of rice Giza 177 cultivar. The seed were obtained from Central Administration of Seed (CAS).

1-Laboratory experiment :

Rice seeds were soaked in either ascorbic acid (100 ppm),α-tocopherol (100 ppm) and salicylic acid (100 ppm)or water as a control for 24 h and incubated in growth chamber at 25 ^{o} C and germination was observed daily to study the following characters:

Seed and seedling vigor measurements:

1-Germination percentage (G%) : It was calculated by counting only normal seedlings 14 days after planting according to (ISTA rules , 1999).

2-Speed germination index (SGI): It was calculated as described in the Association of Official Seed Analysis (AOSA,1983) .

3- ermination rate (GR): It was determined according to Bartllett (1937).

4-Seedlings length (cm): It was measured of ten normal seedlings 14 days after planting.

5-Seedlings dry weight (g): Ten seedlings were dried in hot-air oven at 85 ^{o}C for 12 hours and weighted 14 days after planting.

2- Field experiment:

The experimental design was strip plot design with four replicates. The horizontal plots included the following four soaking treatments for 24 h as follows:

1- ascorbic acid (100 ppm).
2- α- tocopherol (100 ppm).
3- Salicylic acid (100 ppm).
4-Water as a pregermination traditional practice.

The vertical plots were allocated to the following four foliar treatments at twice after 30 and after 60 days from planting:

1- Ascorbic acid (200 ppm.) 2- α- tocopherol (200 ppm.)
3- Salicylic acid (200 ppm.) 4- Without foliar.

Treatments of foliar spray with antioxidants solutions were carried out by hydraulic sprayer at the rate 250 ml/plot, where the plot area was 10.5 m^2. Rice seed was at a rate of 60 kg /fed. The winter crop was wheat and after harvesting the land was well prepared and Calcium Superphosphate (15.5 % P_2O_5) at a rate of 100 kg/fed was added on the dry soil before ploughing. Urea (46 % N) at a rate 100 kg/fed was added at twice doses after 20 and 50 days from sowing.

Field measurements:

a- Emergence characters:

1-Field emergence %: It was determined after 14 days from planting 400 seed at area 1.25 $m^{2.}$

2- Emergence Index: It was calculated using the formula of Scott *et al*., 1984:

EI = {TiNi/S}.

Where Ti is the number of days after sowing, Ni is the number of seeds germinated on day i, and S is the total number of seeds planted.

b -Growth and yield characters:

1- Plant height(cm): Average of plant height was measured in a sample of 10 plants from soil surface to the panicle top of main stem.
2- Number of plants/m^2: It was determined by counting the number of plants /m^2 at maturity stage.
3- Panicle length (cm): The main panicle length was measured from a base up to top.
4- Panicle weight (g): Ten main panicle were weighted.
5- Number of grains / panicle: Average numbers of grains formed on 10 main panicle were randomly chosen.
6- Grain yield (ton/fed): The grain yield was recorded in kg/square meter and then it was converted to record grain yield (ton/fed).

All obtained data were subjected to the statistical analysis according to the technique of analysis of variance (ANOVA) of completely randomized design for laboratory experiment and strip plot design for field experiment, as described by Gomez and Gomez (1984). The data of grain yield and (field emergence %, seedling length, seedling dry weight, plant height, number of plants/m^2, panicle length and panicle weight) were subjected to simple correlation and stepwise regression analysis techniques (Draper and Smith, 1966)

RESULTS

Seed and seedling vigor measurements :

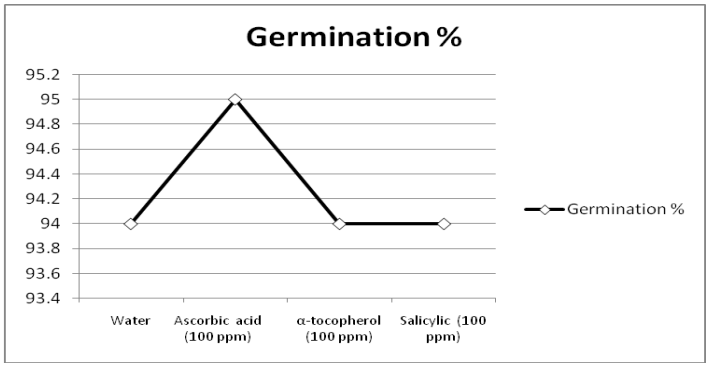
Seed germination percentage, field emergence % , emergence index, speed germination index ,seedling length (cm) and seedling dry weight (g) of rice seed soaking with antioxidants solutions i.e. ascorbic acid (100 ppm), α-tocopherol (100 ppm), salicylic acid (100 ppm) and water which as a pregermination traditional practice are shown in Figs. 1and 2. No significant differences of germination % were observed at laboratory condition among soaking treatments under study. While at field condition, treated rice seed with ascorbic acid (100 ppm) significantly affected and recorded the highest values of field emergence % and emergence index compared with other treatments, follow α-tocopherol (100 ppm) and salicylic acid (100 ppm). There was no significant differences of field emergence % and emergence index between soaking rice with α-tocopherol (100 ppm) and salicylic acid (100 ppm). On other hand, the lowest values of aforementioned characters were obtained by soaking in water compared with other treatments.

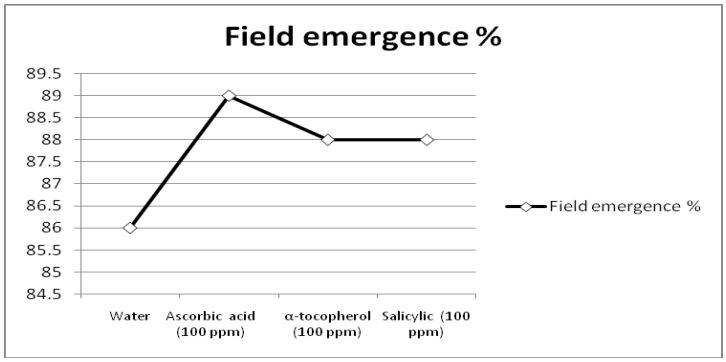
Also, soaking rice seed in ascorbic acid solution (100 ppm) recorded the fastest germination as shown in speed germination character which led to the tallest seedling length (cm) and heaviest seedling dry weight (g) compared with other treatments. But, soaking in water recorded the shortest seedling length (cm) and lightest seedling dry weight (g) as result of slowest speed germination index compared with other treatments as illustrated in Fig.2.

Growth and yield measurements:

Plant height (cm), number of plants/m^2, panicle length (cm), panicle weight (g), number of grains/panicle and grain yield (ton/fed) as affected by antioxidants solutions (soaking and foliar) are shown in Tables (1 and 2). Soaking rice seed in antioxidants solutions had insignificant effect on plant height (cm),panicle length (cm), panicle weight (g) and number of grains/panicle over both seasons. While, number of plants/m^2 and grain yield (ton/fed) significantly affected by soaking in antioxidants solutions. Rice seed were treated with ascorbic acid solution (100 ppm) produced the highest number of plants/m^2 and grain yield (ton/fed). No significant differences could be detected among number of plants/m^2 character concerning soaking rice seed in α-tocopherol (100 ppm) and salicylic acid (100 ppm) in both seasons. On contrast, the lowest number of plants/m^2 and grain yield (ton/fed) were obtained with soaking in water as a pregermination traditional practice over both seasons.

Foliar spray with antioxidants solutions had significant effect on all traits as presented in Tables (1 and 2) . Application of ascorbic acid (200 ppm) as a foliar recorded the highest values of growth and yield characters, followed by α-tocopherol (200 ppm) , then salicylic acid (200 ppm) as shown in Tables (1 and 2) .No significant differences could be observed among plant height character regarding both foliar spray by ascorbic acid (200 ppm) and foliar spray with α-tocopherol (200 ppm) during both seasons. But, the lowest values of the same traits were obtained with control treatment (without foliar application) during both seasons.





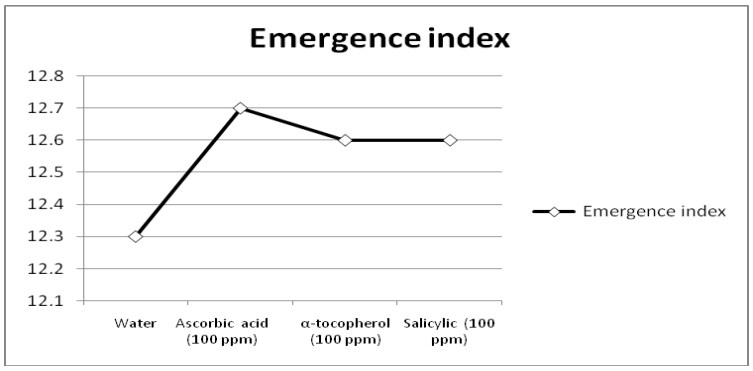


Fig.1. Germination %, field emergence % and emergence index of rice seed as affected by soaking in antioxidants solutions.

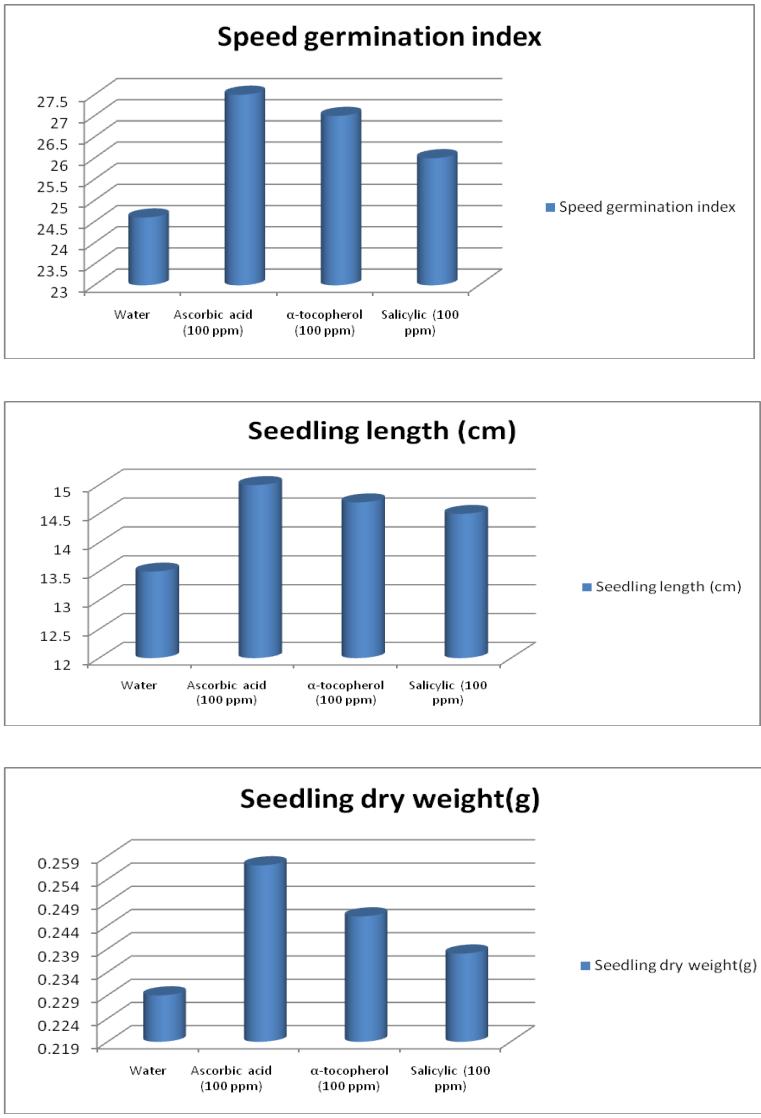


Fig.2. Speed germination index, seedling length (cm) and seedling dry weight (g) of rice seed as affected by soaking in antioxidants solutions.

Interaction between soaking antioxidants solutions and foliar spray antioxidants solutions indicated insignificant effects on all traits except number of plants/ m^2 and grain yield Tables (1 and 2). Both number of plants/ m^2 and grain yield (ton/fed) significantly affected by interaction between antioxidants solutions soaking and antioxidants solutions as a foliar spray during both seasons. The soaking rice seed in ascorbic acid treatment (100 ppm) beside foliar spray with ascorbic acid (200 ppm) recorded the highest values of number plants/ m^2 and grain yield (ton/fed) in both seasons as presented in Figs. 3 and 4. No significant differences were obtained among number of plants/ m^2 respecting the application foliar spray with ascorbic acid (200 ppm) + rice seed soaking in α-tocopherol (100 ppm) and foliar spray of ascorbic acid (200 ppm) + rice seed soaking in salicylic (100 ppm) treatments in both seasons. The lowest number plants/ m^2 and grain yield (ton/fed) were obtained with treatment [soaking rice seed in water + without foliar spray application] in both seasons.

Data in Tables (3 and 4) revealed that field emergence % , seedling dry weight, plant height, number of plants/m^2, panicle length, panicle weight, number of grains/panicle as significantly contributing variables to variation in grain yield (ton/fed).The prediction equation for grain yield (ton/fed was computed as follow :

$$\mathbf{Y= - 83.9 + 0.12\ X_1 + 1.9\ X_2 + 0.18\ X_3 + 0.01\ X_4 + 0.65\ X_5 + 3.5\ X_6 + 0.26\ X_7.}$$

Where,

Y = Grain yield (ton/fed). Constant = - 83.9.

X_1 = Field emergence %. X_2 = Seedling dry weight (g)

X_3 = Plant height (cm). X_4 = Number of plants/m^2.

X_5= Panicle length (cm). X_6 = Panicle weight (g).

X_7 = Number of grains/panicle.

Table (1) : Plant height (cm), number of plants/m^2 and panicle length (cm) characters of Giza 177 cultivar as affected by antioxidants solutions as a seed soaking , foliar and their interaction in both seasons.

Characters	Plant height (cm)		No. of plants/ m^2		Panicle length (cm)	
Seasons Treatments and interactions	2011	2012	2011	2012	2011	2012
Seed soaking in antioxidants (S):						
Water.	81.3	79.5	339.9	327.0	17.4	16.7
Ascorbic acid (100 ppm)	81.6	79.9	348.0	329.5	17.5	16.8
α- tocopherol (100 ppm)	81.6	79.7	344.4	328.7	17.4	16.8
Salicylic acid (100 ppm)	81.5	79.6	342.4	328.2	17.4	16.8
F . test	NS	NS	**	**	NS	NS
LSD at 5 %	-	-	2.2	0.6	-	-
Foliar with antioxiadants (F)						
Ascorbic acid (200 ppm)	82.6	80.5	353.0	334.7	17.9	16.9
α- tocopherol (200 ppm)	82.3	80.4	346.3	334.7	17.5	16.8
Salicylic acid (200 ppm)	81.4	79.9	341.1	330.2	17.3	16.8
Without foliar application	79.8	77.9	334.4	322.0	16.9	16.5
F . test	**	**	**	**	**	**
LSD at 5 %	0.9	0.4	2.0	0.5	0.1	0.1
Interactions of (S × F)	NS	NS	**	**	NS	NS

*** =significant ** = highly significant NS= Non significant**

Table (2): Panicle weight (g), number of grains/panicle and grain yield (ton/fed) characters of Giza 177 cultivar as affected by seed soaking in antioxidants and foliar with antioxidants solutions in both seasons.

Characters	Panicle weight (g)		No. grains/panicle		Grain yield (ton/fed)	
Seasons Treatments and interactions	2011	2012	2011	2012	2011	2012
Seed soaking in antioxidants (S):						
Water	3.40	3.36	115.8	115.0	3.822	3.778
Ascorbic acid (100 ppm)	3.42	3.37	116.0	116.7	3.899	3.813
α - tocopherol (100 ppm)	3.41	3.36	115.9	115.8	3.853	3.801
Salicylic acid (100 ppm)	3.41	3.36	115.8	115.3	3.827	3.791
F . test	NS	NS	NS	NS	**	**
LSD at 5 %.	-	-	-	-	0.013	0.008
Foliar with antioxiadants (F)						
Ascorbic acid (200 ppm)	3.49	3.40	119.7	117.5	3.951	3.857
α - tocopherol (200 ppm)	3.44	3.37	116.8	116.0	3.880	3.806
Salicylic acid (200 ppm)	3.39	3.35	114.9	115.5	3.825	3.780
Without foliar application	3.32	3.31	111.8	114.4	3.744	3.740
F . test.	**	**	**	**	**	**
LSD at 5 %	0.01	0.01	1.2	0.3	0.009	0.005
Interactions of (S × F)	NS	NS	NS	NS	**	**

*** =significant ** = highly significant NS= Non significant**

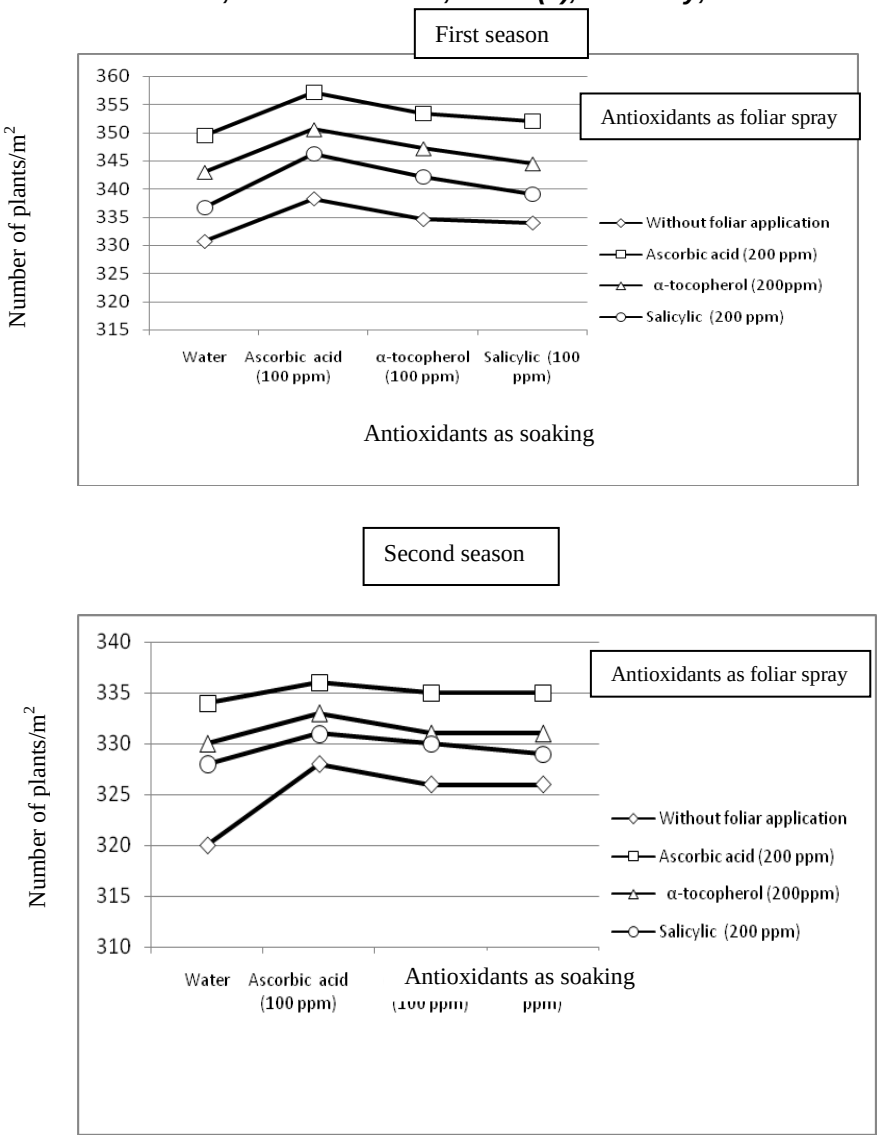


Fig.3. Effect of the interactions between seed soaking in antioxidants solutions and foliar spray by antioxidants solutions on number of plants/m^2 in the first and second seasons.

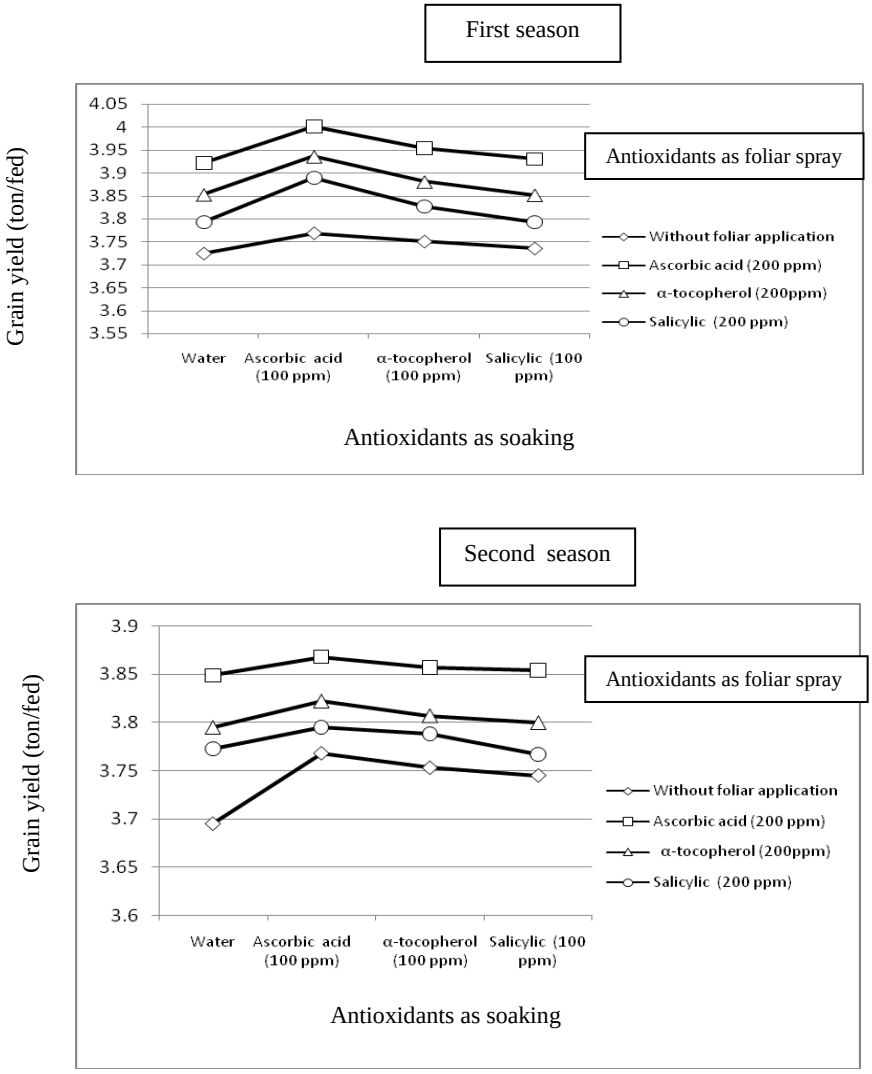


Fig.4. Effect of the interactions between seed soaking in antioxidants solutions and foliar spray by antioxidants solutions on grain yield (ton/fed) in the first and second seasons.

The relative contribution for seven characters of Table (4) towards grain yield (ton/fed) was 98.3 %, while 1.7 % of grain yield variation could be attributed to removed variable which was (seedling length). Simple correlation for the characters of Table 5 and grain yield (ton/fed) are presented. Positive and significant correlation coefficients were recorded between grain yield (ton/fed) and (field emergence %, number of plants/m^2, panicle length (cm), panicle weight (g) and number of grains/panicle) which were (0.76, 0.95, 0.87, 0.89 and 0.92), respectively. While the correlation coefficients between grain yield (ton/fed) and (seedling length, seedling dry weight and plant height) were positive but not significant.

Table (3): R, R square and Adjusted R square of contribution some studied characters towards grain yield according to stepwise regression analysis.

R	R square	Adjusted R square	Std. Error of the Estimate
1.000 [a]	0.997	0.983	0.190

Table (4): Accepted and removed variables affected grain yield (ton/fed) according to stepwise regression analysis.

Accepted variables	Unstandardized Coefficients	Removed variables
	B Std. Error	Seedling length (cm)
Constant	- 83.9	
Field emergence %	0.12	
Seedling dry weight (g)	1.9	
Plant height (cm)	0.18	
Number of plants/m^2	0.01	
Panicle length (cm)	0.65	
Panicle weight (g)	3.5	
Number of grains/panicle	0.26	

Table (5): Simple correlation coefficients (R) for grain yield (ton/fed) and some characters under study.

Characters	Field emergence %	Seedling dry weight (g)	Seedling length (cm)	Plant height (cm)	Number of plants/m^2	Panicle length (cm)	Panicle weight (g)	Number of grains/panicle
Grain yield (ton/fed)	0.76 *	0.05	0.67	0.53	0.95**	0.87**	0.89**	0.92*

DISCUSSION

Poor germination is one of the main problems in adopting direct-seeded rice culture. In the present study, soaking in ascorbic acid (100 ppm) proved much effective in increasing germination measurements as reported in Figs 1 and 2. Although treatments were not different significantly for germination percentage under laboratory conditions, there was significant effect when sown under field conditions as recorded by Anwar, *et al*.,(2013). Effective impact for soaking with antioxidants solutions at germination stage may be due to ascorbic acid (AsA), which is another important organic molecule serves as detoxification of reactive oxygen species (Khan *et al*., 2006) and a co-factor for many enzymes (Arrigoni & De Tullio, 2000). It is also involved in biosynthesis of many other plant hormones, including ethylene, gibberellic acid, and abscisic acid (Barth *et al*., 2006).

The increase in seedling dry weight after antioxidants soaking treatment as observed in present study might be a result of increased shoot lateral growth through increased cell division by maintaining the hormonal balance (IAA and cytokinin levels) in the plant tissues, which enhanced the cell division (Sakhabutdinova *et al*., 2003).

Soaking rice seed in antioxidants solutions in this study caused increment in field emergence % and index emergence which led to increase in number of plants/m^2 led to high grain yield as shown in Tables 1 and 2.

Foliar spray with antioxidants solutions make positive effect on growth and yield characters of Giza 177 rice cultivar as shown in Tables (1 and 2). It may be due to chlorophyll contents were increased with foliar application of ascorbic acid and photosynthetic efficiency depends on photosynthetic pigments which play an important role in photosynthesis (Taiz & Zieger, 2006). Also, tocopherol is a strong antioxidant that assists in maintaining membrane stability (Munné-Bosch & Falk, 2004), intracellular signaling and transport of electrons in the photosystem-II system (Munné-Bosch & Alegre, 2002). Moreover, previous studies also suggest the possible

roles of tocopherol and SA in maintaining membrane integrity (Farooq *et al*., 2008)., causing increased membrane stability and decreased respiration rates, which might be due to decreased generation of ROS. The ROS reacts with the proteins, lipids and DNA causing oxidative damage and impairing normal function of the cells (Foyer & Fletcher, 2001).

Finally , it could be concluded that soaking rice seed of Giza 177 cultivar with ascorbic acid (100 ppm) as presowing treatment beside ascorbic acid (200 ppm) as a foliar spray in field is a good mean to improve growth and yield of direct-seeded rice.

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تـأثيربعض مضـادات الأكسـدة علـى الإنبثـاق ،النمـو و المحصـول فـي الأرز المنـزرع بالطريقة البدار

فيصل إبراهيم يوسف السيد .

قسم بحوث تكنولوجيا البذور- معهد بحوث المحاصيل الحقلية- مركز البحوث الزراعية .

تم تنفيذ تجربة معملية بمعمل قسم بحوث تكنولوجيا البذور بالمنصورة خلال عام ٢٠١٢ م في تصميم التام العشوائية في أربع مكررات بهدف دراسة نقع تقاوي الأرز صنف جيزة ١٧٧ بمحاليل مضادات الأكسدة [أسكوربيك (١٠٠ جزء/ مليون) ، ألفا توكوفيرول (١٠٠ جزء/ مليون) ، سالسيليك (١٠٠ جزء/ مليون) و تقاوي منقوعة في ماء صنبور كمعاملة تقليدية] على حيوية التقاوي وقوة البادارت ، كما أجريت تجربة حقلية بمحطة بحوث تاج العز الزراعية خلال عامي ٢٠١٢ و ٢٠١٣ م في تصميم الشرائح المتعامدة في أربع مكررات لدراسة تاثير النقع بمحاليل مضادات الأكسدة

[أسكوربيك (١٠٠ جزء/ مليون) ،ألفا توكوفيرول (١٠٠ جزء/ مليون) ، سالسيليلك (١٠٠ جزء/ مليون) و تقاوي منقوعة في ماء صنبور كمعاملة تقليدية] والرش بمحاليل مضادات الأكسدة [أسكوربيك (٢٠٠ جزء/ مليون) ، ألفا توكوفيرول (٢٠٠ جزء/ مليون) ، سالسيليلك (٢٠٠ جزء/ مليون) و بدون رش ككنترول] على بعض صفات النمو والمحصول للأرز صنف جيزة ١٧٧ المنزرع بطريقة البدار ويمكن تلخيص أهم النتائج فيما يلي :-

١- أظهرت النتائج أن نقع تقاوي الأرز لصنف جيزة ١٧٧ بمحلول الأسكوربيك (١٠٠ جزء/ مليون) أدى إلى ارتفاع دليل سرعة الإنبات ، طول البادرات ، الوزن الجاف للبادرات ، النسبة المئوية للإنبثاق و دليل الإنبثاق .

٢- أوضحت النتائج أن نقع تقاوي الأرز لصنف جيزة ١٧٧ بمحاليل مضادات الأكسدة كان لها تأثير معنوي على صفتي عدد النباتات/م٢ ومحصول الحبوب (طن/فدان) ، حيث سجل النقع في محلول الأسكوربيك (١٠٠ جزء/ مليون) أعلى القيم للصفتين السالف ذكرهما ، بينما باقي صفات النمو والمحصول لم يكن لمعاملات النقع عليها أي تأثير معنوي.

٣- أشارت النتائج أن الرش بمحاليل مضادات الأكسدة له تاثير معنوي على صفات النمو والمحصول تحت الدراسة ، وأعطت معاملة الرش بمحلول الأسكوربيك (٢٠٠ جزء/ مليون) أفضل النتائج في صفات النمو والمحصول.

٤- أشارت النتائج أن التفاعل بين النقع بمضادات الأكسدة والرش بمضادات الأكسدة أثر معنويا على صفتي عدد النباتات/م٢ ومحصول الحبوب (طن/فدان) ، حيث حققت المعاملة [نقع بالأسكوربيك (١٠٠ جزء/ مليون) + رش بالأسكوربيك (٢٠٠ جزء/ مليون)] أفضل النتائج لصفتي عدد النباتات/ م٢ ومحصول الحبوب (طن/فدان) مقارنة بباقي المعاملات تحت الدراسة .

٥- أظهرت نتائج تحليل الانحدار المتعدد المرحلي أن صفات [النسبة المئوية للإنبثاق ، الوزن الجاف للبادرات (جم) ، طول النبات (سم) ، عدد النباتات /م ٢، طول السنبلة (سم) ، وزن السنبلة (جم) و عدد الحبوب / سنبلة] كانت اكثر الصفات تأثيرا على صفة محصول الحبوب (طن/فدان) في حين أن صفة طول البادرات (سم) لم تكن مؤثرة على صفة محصول الحبوب ، كذلك أظهر تحليل الارتباط البسيط أن صفات [النسبة المئوية للإنبثاق ، عدد النباتات /م ٢ ، طول السنبلة (سم) ، وزن السنبلة (جم) و عدد الحبوب /سنبلة]كان لها ارتباط معنوي موجب مع صفة محصول الحبوب (طن/فدان) في حين أن صفات [طول البادرات (سم) ، الوزن الجاف للبادرات (جم) و طول النبات (سم)] كان لها ارتباط موجب مع محصول الحبوب (طن/فدان) ولكنه ارتباط غير معنوي .

توصي هذه الدراسة بنقع تقاوي الأرز جيزة ١٧٧ قبل الزراعة في محلول الأسكوربيك (١٠٠ جزء/ مليون) وكذلك رش الأرز في الحقل بمحلول الأسكوربيك (٢٠٠ جزء/ مليون) لتحقيق أفضل تكشف حقلي والحصول على أعلى إنتاجية لمحصول الأرز عند الزراعة بطريقة البدار.

قام بتحكيم البحث

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