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ROLE OF SEED PRIMING AND SPRAYING SOME BIO AND CHEMICAL SUBSTANCES IN RAISING RICE SALINITY TOLERANCE AND PRODUCTIVITY

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ABSTRACT: ***The present investigation was carried out in 2015 and 2016 seasons at the experimental Farm of El-Sirw Agriculture at Research Station, Damietta province and lab of Rice Research and Training Center, Sakha, kafr-elsheikh province, Egypt. The objective of this study was to examine the effectiveness of seed priming and foliar spray thoric with solutions of some substances; salicylic acid (SA) 250 ppm, yeast (Saccharomyces cervisia) 2kg/fed, and the extraction of bacteria (Aizosprillium spp) 2% conc. at different growth stages (mid tillering, panicle initiation and booting stages) on the performance of three rice varieties viz; Giza177, Giza 179 and Egyptian hybrid one (EHR1) under saline soil conditions. An experiment was performed in spilt plot design with four replications. The tested rice varieties were distributed in the main plots while, the sub plots were devoted to the substances treatments. The salinity levels of experimental site were 7.0 and 7.3 dSm^{-1} in 2015 and 2016 seasons, respectively. The artificial salinity level in Lab experiment was 7.0 dSm^{-1}. Significant difference in the performance of tested rice varieties was found in both seasons under Lab and field conditions. Under Lab experiment, Giza177 produced the highest values of germination characters; seed germination, germination energy, final germination and vigor index. Germination characteristics were positively improved owing to seed soaked in Aizosprillium without significant difference with salicylic acid compared to control (untreated one). Under field conditions, Egyptian hybrid rice one produced the highest values of growth parameters, most of yield attributes and grain yield. The tested substances enhanced all studied characters compared with control treatment. The impact of salicylic acid either foliar spray or soaking was superior compared with other treatments for the most studied characters and grain yield followed by bacteria foliar spray and bacteria soaking. Yeast treatments came in the last order. It could be concluded that, rice seed soaking or plant foliar spray with extraction of salicylic acid or bacteria more effective than yeast and improved growth and yield of rice under salt stress.***

Key words: ***Rice, salicylic acid, Aizosprillium, yeast, seed soaking, saline soil***

INTRODUCTION

Salinity is one of the adverse factors which can reduce germination and productivity of crops worldwide. Soil salinization affects plants by several ways inducing water deficit in attributed to soils by reducing the osmotic potential of soil solutes which makes it difficult for roots to take up water from the soil (Sairam *et al.*, 2002). Egypt has long suffering from issues agriculture sector relating to mismanagement of agricultural lands (SIT 2010). so, there is an urgent need to increase agricultural land management for meeting the increasing populations by increasing crop productivity specially rice which is considered one of the most important

cereal crop, thus. affected by soil salinity, (Karan *et al.,* 2012). Rice responds to salt stress in the same manner as other glycophytes by using a number of strategies which include minimizing influx, maintaining efflux, and translocation and compartmentalizing potentially toxic ions such as Na^+ and Cl^- (Anil *et al.,* 2007). So, it has become necessary to use some materials to encourage growth processes in plants and reduce the detrimental effects of salinity by stimulating growth. Salicylic acid (SA), an endogenous growth regulator of phenolic nature, influences many physiological processes such as; seed germination (Cutt & Klessing 1992), ion permeability (Barkosky & Einhelling 1993), photosynthesis and plant growth rate (Rafique *et al.,* 2011). Salicylic acid also prevents the damaging action of various stress factors in many plant species (Afzal *et al.,* 2005). Bio-fertilizers, in strict sense, are not fertilizers that directly give nutrition to rice plants. Azospirillum, is one of the best-studied plant growth-promoting, Aizosprillium can utilize atmospheric nitrogen and contribute to plant nitrogen nutrition, Azospirillum can increase the nutrient uptake inside plant, and improve the balance of the root environment through protection against pathogens and equilibrate nutrient flow into the soil, resulted in enhancing crop yield. It also has ability to produce phytohormones, mainly auxins (indole-3-acetic acid), (Bashan and De-Bashan 2010; Babalola and Glick 2012 and Glick 2014) yeast is a cost-effective bio fertilizer that improves not only plant nutrition but also plant vigor during the early growth phase (Lonhienne *et al* 2015). Yeast (*Saccharomyces cervisia*) is rich phytohormones (cytokinins), vitamins, amino acids, enzymes and minerals, and contains tryptophane which is the precursor of indol acetic acid which promotes plant growth. (Darweesh *et al.,* 2003).

The objective of the current study is improvising salinity withstanding and enhancing productivity of some rice varieties by seed priming, and plant foliar spray using some bio and chemical substances under salt stress conditions.

MATERIALS AND METHODS

Laboratory experiments

Laboratory experiments were conducted at laboratory of salinity at Rice Research and Training Center, Kafr-elshiekh province, Egypt on 1st May and 30th April in 2015 and 2016 rice season respectively. The germination test was conducted using the Petri dish method in split plot design. Two pieces of blotting papers were used in each Petri dish as a substrate. Seed of Giza177, Giza 179 and Egyptian hybrid one cultivars were soaked at the solution of salicylic acid, bacteria and yeast for 48 hour, then twenty five seeds of tested rice varieties were placed in medium size Petri dish. Each treatment was replicated four times. The salinity irrigation water was used at the concentration of $7dSm^{-1}$ used for germination of seeds, and tap water was used in control treatment. The petri dishes were daily monitored.

Germination rate was computed using the formula proposed by (IRRI 2011):

Germination rate =(Number of seed that geminated/ Number of seed on the tray) *100

Germination energy = Percentage of seeds germinated at 72 h (Bam *et al.,* 2006).

Final germination percentage (FGP%) using the formula proposed by (Kandil *et al.,* 2012)

FGP%= Number of final germinated seed/Total number of seed tested

Vigor Index = number of germinated seeds / days of first count +….. + number of germinated seeds/days at final count (Islam *et al.,* 2012)

Field experiment

The field experiments were conducted at the Farm of El-Sirw Agricultural Research Station, Damietta Governorate, Egypt in the two seasons of 2015 and 2016, to observe the efficiency of seed soaking and foliar spray of salicylic acid at the rate of 250 ppm and bacteria (Aizosprillium) extraction 2% and yeast extract at the rate of 2kg/fed at various rice growth stages (mid tillering, panicle initiation and booting stages) on growth and yield of three varying rice varieties viz; Giza 177, Giza179 and EHR1. The previous crop was Egyptian clover in the two seasons. Representative soil samples were taken from each site at the depth of 0-30 cm from the soil surface. Samples were chemically analyzed according to (Black *et al* 1965). Results of chemical analysis of both seasons are listed in Table 1.

The experimental soil was fertilized with phosphorus in form of calcium superphosphate (15.5 % P_2O_5) at the rate of 53.6kg P_2O_5 ha^{-1} and potassium sulphate at the rate of kg 50 k_2O ha^{-1} according to saline soil recommendations. The experimental design was split plot design with four replications. The main plots were assigned to rice varieties, while the sub-plots were assigned to the different substances. Foliar applications were carried out at three rice growth stages, i.e. mid tillering (MT), panicle initiation (PI) and booting (BT). The plot area was 10 m^2 (5X 2 m). Seedlings, aged 30 days, were transplanted at the plant spacing of 20X20cm, apart. Nitrogen in the form of urea at the rate of 165 kg N ha^{-1} was applied in four splits, 15, 30 and 45 days after transplanting as well as mid booting stage as recommended for salt affected soil.

Seed at a rate of 140 kg ha^{-1} were soaked in water for 48 hr this for foliar spray with extract of bacteria, salicylic acid and yeast. The same rate of seeds were soaked in extract of bacteria, salicylic acid and yeast, then incubated for 24 hr regarding seed priming treatments. All other agronomic practices were followed as recommended package of rice under saline soil during the growing season.

Measurements of root and shoot lengths of seedlings

Randomly selected ten seedlings were randomly taken from nursery (26 days after sowing) and transferred to lab, then root and shoot length of seedling were measure.

At heading stage, plants of five hills were taken randomly from each plot to estimate dry matter^{-1}. Ten leaves were randomly taken to determine leaf area, chlorophyll content and sodium (Na^+), potassium (K^+) and Na^+/K^+ ratio. Leaf area of plant samples were measured by Portable Area Meter (Model LI– 3000A). Total chlorophyll content was determined in ten flag leaf using chlorophyll meter (Model–SPAD502) Minolta Camera Co. Ltd., Japan. Ten leaves were randomly taken from each plot, dried and ground to estimate Na, K and Na/K ratio using Flame Photometer according to (Chapman and Pratt 1978).

Table (1): Chemical of the experimental soil (0-30cm depth)

season	EC_e	pH	Ca^{+2}+Mg^{+2}	Na^{+1}	K^{+1}	HCo^-3	Cl	So_4^{+2}	N	P	K
	$dS.m^{-1}$		meq. l^{-1}						ppm		
2015	7.00	8.3	20.0	50.0	0.31	8.51	30.5	31.0	30	12	287
2016	7.3	8.4	21.1	52.5	0.31	8.88	31.6	32.2	31	12.5	309

At harvest, plant height, panicle length, tiller number/hill, panicle number/hill were estimated. Ten panicles were randomly collected to estimate the panicle weight, panicle length; number of filled grains and unfilled grains panicle^{-1} and 1000-grain weight. The six inner rows of each plot were harvested, dried, threshed, and the grain and straw yields were determined based on the moisture content of 14%. The yield was converted to grain yield ha^{-1}. The obtained data were subjected to analysis of variance according to (Gomez and Gomez 1984). Treatment means were compared by Duncan's Multiple Range Test (Duncan 1955). All statistical analyses were performed using analysis of variance technique by means of "COTATC" computer software package.

RESULTS AND DISCUSSION

1. Some Germination and seedling characters

1.1. Rice varieties performance

The results showed that tested rice varieties had highly significant effects on seed germination, germination energy, final germination and vigor index in both seasons (Table 2). Giza177 exhibited the highest rates of germinated%, as well the highest percentage of germination energy, final germination and vigor index in both season followed by Egyptian hybrid one. Giza179 came in the last rank in both seasons. The differences between rice varieties in seed germination characters and seedling vigor may be due to variation in hull, ecotype, pericarp and endosperm characters (kouio 2003 and Lee *et al.,* 2002). Furthermore, the 1000-grain weight of Giza 177 is heaviest indicating more starch resulted in fast germination and improved seedling despite its salt sensitively.

Table (2): Seed germination characteristics and vigor index of some rice varieties as affected by soaking in some substances under saline soil

Factor	Germination%		Germination energy%		Final germination%		Vigor index	
	2015	2016	2015	2016	2015	2016	2015	2016
Varieties								
Giza177	87.75a	86.58a	91.33a	87.03a	95.33a	94.66a	10.69a	10.32a
Giza179	71.58c	69.41c	80.33b	79.93b	84.33c	82.00c	8.15b	7.63c
EHR1	75.50b	78.41b	79.33b	72.84c	88.00b	88.33b	8.67b	9.08b
F test	*	*	**	**	**	**	**	**
Substances								
Control	76.2b	73.88b	80.44b	78.19b	86.22b	82.66b	8.98b	8.51b
Salicylic soaking	84.1a	83.00a	88.00a	79.83ab	91.55ab	91.55a	10.39a	9.94a
Bacteria soaking	83.66a	82.55a	90.22a	84.36a	92.88a	92.88a	9.94a	9.56a
Yeast soaking	69.11c	73.11b	76.00b	77.36b	86.22b	86.22b	7.38c	8.03b
F test	**	**	**	**	**	**	**	**
Interaction	NS	NS	NS	NS	NS	NS	NS	NS

*, ** and Ns indicate P < 0.05, P < 0.01 and not significant, respectively. Means of each factor designated by the same latter are not significantly different at 5% level using Duncan's Multiple Range Test.

1.2. Substances effect

The seed priming treatments including bio and chemical substances significantly varied in their effect on rice germination characters. Generally, seed priming improved germination characteristics. It was observed that couple treatments of SA and bacteria were more efficient in improving germination criterion than yeast treatment. On the other hand, the yeast did not show reasonable improvement in rice seed germination since it did not differ significantly than control treatment in the most of studied germination traits or less than control in some of them. Salt stress decreases seed germination characters this may be to declining water uptake by endosperm which cause decrease in protease, amylase activity and RNA content, in addition to ionic imbalance (sodium (Na^+) and chloride (Cl^-) ions (Hosseini *et al.,* 2003). Salicylic acid and bacteria seed priming might mitigate the adverse action of various stresses on seed germination by increasing the releasing of alpha amylase enzyme which accelerates starch decomposition to mono saccharide reflected on rice germination (Afzal *et al.,* 2005; Iqbal and Ashraf, 2010). Aizosprillium has been suggested as plant-growth promoting bacteria (Bashan and Holguin 1998) which led to enhancement of seed germination characters.

2. Seedling characters

2.1. Rice varieties performance

Data analysis variance referred that the three tested rice varieties greatly varied in their germination criteria in both seasons (Table 3). Egyptian hybrid one significantly produced the tallest shoots and roots of seedling without significant difference with Giza179 in seedling root length in both seasons. Shoot and root ratio was inconstant, Giza177 produced the highest ratio in the first season and Giza 179 produced the highest value in the second season. Despite rice is sensitive to salinity, EHR1 rice variety had the ability to tolerant salinity stress, may be due to increment of antioxidant enzymes and proline which are proposed to be important in plant stress. Similar were obtained by (Zayed *et al.,* 2017).

2.2. Substances effect

Data in Table 3 show that seedling shoot and root length and shoot/root ratio of rice were significantly affected by soaking in bio and chemical substances compared with control treatment in both seasons. Soaking in salicylic acid improved rice seedling shoot length in both seasons without significant difference with soaking in bacteria in the second season. Soaking in bacteria enhanced seedling root length in both seasons without significant difference with salicylic soaking in the second season. Shoot/root ratio was increased by salicylic acid in the first season as well, bacteria and yeast in the second season. The increase in root growth due to SA maintaining the hormonal balance (IAA and cytokine levels) in the plant tissues, which enhance cell division (Sakhabutdinova *et al.,* 2003) and cell replication in root tips, and thus increased root growth. Bacteria enhancing shoot and root length may be due to the ability of bacteria to active auxins and gibberellins, both of them are the key factor in improving rice seedling length (Basra *et al.,* 2006).

2.3. Interaction effect

The interaction between rice varieties and substances had a significant effect on seedling shoot and root lengths in both seasons (Table 4). Seedling shoot and root length of rice varieties soaked at different substances was increased compared with control treatment in both

seasons. The tallest seedlings were obtained with Egyptian hybrid one when soaked at salicylic acid in the first season and bacteria in the second season. Egyptian hybrid one soaked at bacteria produced the tallest roots in both seasons without significant differences with salicylic in the second season. Metabolites which are produced by SA and bacteria influence the early stage of plant development through the enhancement of root length of rice varieties. In addition, Azospirillum strains produce various Lectins which induce several signaling systems in plant roots as part of the recognition in the initial stages of development of plant (Trutneva *et al.,* 2014).

Table 3: Rice seedling shoot and root length as affected by some substances under saline soil

Factor	Seedling shoot length		Seedling root length		Shoot/ root ratio	
	2015	2016	2015	2016	2015	2016
Varieties						
Giza177	18.58b	17.95b	10.09c	11.04b	1.84a	1.62b
Giza179	19.28a	19.09ab	11.37b	10.89b	1.69b	1.75a
EHR1	19.64a	19.58a	13.03a	13.70a	1.50c	1.42c
F test	**	*	**	*	**	**
Substances						
Control	16.22d	16.44c	10.21d	10.70b	1.68b	1.53b
Salicylic soaking	21.58a	19.85a	11.88b	12.77a	1.81a	1.55b
Bacteria soaking	19.61b	20.45a	12.92a	12.71a	1.51c	1.60a
Yeast soaking	19.2c	18.75b	10.94c	11.33b	1.66b	1.65a
F test	**	**	**	**	**	**
Interaction	**	**	**	**	NS	NS

*, ** and NS indicate P < 0.05, P < 0.01 and not significant, respectively. Means of each factor designated by the same latter are not significantly different at 5% level using Duncan's Multiple Range Test.

Table 4: Shoot and root length (cm) as affected by interaction between rice varieties and different substances

Substance	Shoot length(cm)			Root length (cm)		
	2015					
	Giza 177	Giza 179	EHRI	Giza 177	Giza 179	EHRI
Control	15.6e	16.13d	16.93d	9.20e	10.43e	11.00d
Salicylic soaking	19.36c	22.0b	23.4a	9.30e	11.93cd	14.40b
Bacteria soaking	20.2c	19.20c	19.43c	11.66cd	11.56cd	15.66a
Yeast soaking	19.0c	19.8c	18.8c	10.20e	11.56c	11.06d
2016						
Control	15.60e	16.8de	16.93de	10.56c	10.53c	11.00c
Salicylic soaking	19.3bc	21.00b	19.20bc	11.26bc	11.33bc	15.73a
Bacteria soaking	18.5cd	19.43bc	23.40a	11.43bc	11.66bc	15.00a
Yeast soaking	18.3cd	19.13bc	18.80c	10.90bc	10.04c	13.06b

*and** indicate P < 0.05 and P < 0.01, respectively. Means of each factor designated by the same latter are not significantly different at 5% level using Duncan's Multiple Range Test.

3. Some minerals content (Na^+, K^+ and Na/K ratio) in rice leaves

3.1: Rice varieties performance

Rice varieties markedly varied in their sodium (Na^+), potassium (K^+) and sodium potassium ratio (Na/K) in both seasons (Table 5). The highest values of Na leaf content and Na/ K ratio were recorded by Giza 177 rice variety. Meanwhile, the lowest values was observed by Egyptian hybrid one without significant differences with Giza 179 in both seasons. Egyptian hybrid one produced the highest values of K^+ content without significant difference with Giza 179 while, Giza 177 gave the lowest values of K^+ content in both seasons. The variation among rice varieties tested rice varieties are mainly due to their ability variable in ion selectivity. Giza 179 and EHR1 showed high ion selectivity that enable them to uptake more potassium against than sodium, which resulted in low Na^+/K^+ ratio. Vice versa, Giza 177 showed low ion selectivity producing high Na^+/K^+ ratio confirming its salinity sensitivity. The current results confirmed that Giza179 and EHR1 are salt tolerant (Zayed *et al.,* 2017). Furthermore, there results refer that the Giza 179 and EHR1 had the gene related to ion selectivity in the terms of salt gene.

3.2. Substances effect

The potassium%, sodium % and Na^+/K^+ ratio of rice were significantly affected by different bio and chemical substances in both seasons. The tested substances significantly reduced Na^+ % and Na^+/K^+ ratio of rice compared with control treatment. On the other hand, K^+ leaf content increased by tested substances.

Table (5): Sodium%, potassium% and sodium potassium ratio of some rice varieties as affected by some substances under saline soil in 2015 and 2016 seasons.

Treatment	Na^+ %		K^+ %		Na^+/K^+	
	2015	2016	2015	2016	2015	2016
Varieties						
Giza177	1.93a	2.10a	0.85c	0.88c	2.27a	2.38a
Giza179	1.21b	1.24b	2.30ab	2.36ab	0.53b	0.53b
EHR1	1.20b	1.22b	2.70a	2.69a	0.44bc	0.44bc
F test	*	*	**	**	**	**
Substances						
Control	1.97a	2.05a	1.45ef	1.46de	1.36a	1.40a
Salicylic soaking	1.05e	1.08e	2.49b	2.27b	0.42d	0.48d
Bactria soaking	1.31d	1.35d	1.58e	1.68d	0.83c	0.80c
Yeast soaking	1.75ab	1.85ab	1.56e	1.63d	1.12b	1.14b
Salicylic spray	1.03e	1.15e	2.83a	2.91a	0.36de	0.40de
Yeast spray	1.43cd	1.52cd	1.78d	1.93c	0.80c	0.79c
Bacteria spray	1.59c	1.63c	1.99c	1.93c	0.79c	0.85c
F test	*	*	**	**	**	**
Interaction	Ns	Ns	Ns	Ns	Ns	Ns

*, ** and Ns indicate $P < 0.05$, $P < 0.01$ and not significant, respectively. Means of each factor designated by the same latter are not significantly different at 5% level using Duncan's Multiple Range Test.

The highest value of K% was obtained by salicylic foliar spray compared with other treatments in both seasons. The tested bio or chemical substances might be beefed up the K^+ anti-porters on cell membrane formation and uptake more potassium against sodium inducing low Na^+/K^+ ratio. Moreover, applying the tested substances seem to be effective to enable rice plants to discarded Na^+ from cytoplasm to vacuole and old leaves. Salt stress results in deterioration of plasma membrane so, application of SA acid may be mitigate this injury effect and maintain membrane stabilization which increases the uptake of nutrients (Parizi *et al.,* 2011). Sodium (Na^+) and K^+ homeostasis inside the cell was found to be an important for the activity of several cytosolic enzymes and for the reservation of membrane potential and cell volume regulation (Hussein *et al.,* 2007). Salicylic reduced Na% and increases K%, causing a signification reduction in Na^+/K^+ ratios (El-Hedek 2013).

4. Some growth characters

4.1. Rice varieties performance

Data in Table 6 indicated that leaf area index (LAI), dry matter^{-1} and chlorophyll content of rice varieties significantly varied in both seasons. Egyptian hybrid one surpassed other tested rice varieties. Giza 179 rice variety came in the second rank after EHR1 while, Giza177 came in the last order with respect to above mentioned traits. The superiority of EHR1 may be due to its affinity to increase antioxidant enzymes and proline which are important to protect the plants from the salinity injury (Zayed *et al.,* 2007 and 2017). The heterosis of hybrid rice is higher than of that inbred rice, so the hybrids produce large leaf area and high dry matter (Zayed *et al.,* 2017).

Table (6): Leaf area index (LAI), dry matter accumulation, chlorophyll content, of some rice varieties as affected by some substances under saline soil

Treatment	LAI		dry matter g/hill		chlorophyll (SPAD value)	
	2015	2016	2015	2016	2015	2016
Varieties						
Giza177	3.98c	3.09c	32.47c	31.56c	0.59c	0.53c
Giza179	5.04b	4.42b	41.76b	40.66b	0.63b	0.60b
EHR1	5.99a	5.35a	51.15a	49.91a	0.71a	0.69a
F test	**	**	**	**	**	**
Substance						
Control	4.29e	3.77f	33.92e	32.06f	0.55e	0.52f
Salicylic soaking	5.26b	4.63b	45.55b	43.69c	0.67b	0.64b
Bacteria soaking	4.56d	4.21d	36.40d	42.20d	0.67b	0.63c
Yeast soaking	4.89c	4.36c	44.69b	42.83d	0.63c	0.58e
Salicylic spray	5.60a	4.82a	47.91a	46.23a	0.71a	0.65ab
Yeast spray	5.38b	4.66b	42.83c	40.97e	0.64c	0.59d
Bacteria spray	5.71a	4.18e	47.48a	44.95b	0.72a	0.66a
F test	**	**	*	**	**	**

*and** indicate $P < 0.05$ and $P < 0.01$, respectively. Means of each factor designated by the same latter are not significantly different at 5% level using Duncan's Multiple Range Test.

4.2. Substances effect

Rice plants treated with substances resulted in a significant increase in leaf area index (LAI), dry matter hill^{-1}, chlorophyll content compared with control treatment in the two seasons.

A significant increment in leaf area index and dry matter was obtained by foliar spray with salicylic acid without significant difference with bacteria in the first season. Moreover, salicylic acid foliar spray without significant difference with bacteria foliar spray produced the highest value of chlorophyll content in both seasons. The beneficial influences of SA might be due to it is role as endogenous growth regulator of phenolic nature influences many physiological processes ion permeability photosynthesis and plant growth rate (Rafique *et al.,* 2011) Salicylic acid also prevents the damaging action of various stress factors in many plant species (Afzal *et al.,* 2005). These results are in agreement with those obtained by (Mohamed *et al.,* 2015).

4.3. The interaction effect

The interaction between rice varieties and varying substances shows a significant effect on leaf area index in the second season and dry matter in both seasons (Tables 7 and 8). Egyptian hybrid one treated with salicylic either spraying or soaking significantly increased dry matter hill^{-1} without variation with bacteria foliar spray and yeast soaking in both season. Aso EHRI and salicylic foliar spray produced the highest value of leaf area index. Meanwhile, control treatment with all test rice varieties gave the lowest values of leaf area index and dry matter hill^{-1} in both seasons. Giza 177 rice variety and yeast spray produced the lowest values of leaf area index and dry matter^{-1} hill compared with other varieties and other treatments.

Table 7: Leaf area index as affected by interaction between rice varieties and different substances in 2016 season

Substance	Giza 177	Giza 179	EHR1
Control	2.53i	3.89f	4.90d
Salicylic soaking	3.28h	4.86d	5.76b
Bactria soaking	3. 38g	4.33e	4.91d
Yeast soaking	3.43fg	4.38e	5.26c
Salicylic spray	3.00h	5.18c	6.28a
Yeast spray	3.38g	4.88d	5.73b
Bactria spray	3.30fg	4.12e	5.10b

Table 8: Dry matter accumulation (g/hill) as affected by interaction between rice varieties and different substances .

Substance	2015			2016		
	Giza 177	Giza 179	EHR1	Giza 177	Giza 179	EHR1
Control	26.33j	31.43i	44.0f	24.47j	29.57i	42.14f
salicylic soaking	36.33g	45.99ef	54.33ab	34.47g	44.13ef	52.47ab
Bacteria soaking	27.76j	34.99gh	46.44ef	35.90g	41.13h	49.58c
Yeast soaking	35.20gh	44.44f	54.43ab	33.34gh	42.58f	52.57ab
salicylic spray	37.40g	49.77cd	56.55a	36.10f	47.91cd	54.69a
Yeast spray	32.10hi	44.40f	51.99bc	30.24hi	42.54f	50.13bc
Bactria spray	37.00g	48.66de	56.77a	33.14gh	46.80de	54.91a

5. Yield Attribute characters:

5.1. Rice varieties performance

Data presented in Tables 9,11,12,13 and 15 indicated that plant height, tillers number hill^{-1}, panicle numbers hill^{-1}, panicle length, filled grains, unfilled grains, panicle weight, and 1000 grain weight of rice varied among the tested rice varieties in 2015 and 2016. Egyptian hybrid one confirmed its superiority over other rice varieties and gave the tallest plants, the maximum values of number of tillers and panicles, longest panicle, as well as the tallest panicle and the highest number of filled grains in both seasons. Concerning number of unfiled grains panicle^{-1}, the highest numbers of unfilled grains were in favor of Giza177 in the two seasons, while the lowest values of it were produced by Giza 179. EHR1 recorded the heaviest panicles weight in the two seasons of study. On the other hand, the lightest panicles weight was produced by Giza 177. At the same time, Giza 177 produced the heaviest 1000-grain, while the lightest ones were obtained by Giza179. The obtained variation among rice varieties regarding the current parameters might mainly be due to genetic makeup. Similar findings were obtained by Kishk 2006, Alam *et al,.* 2009 and Zayed *et al.,* 2017.

5.2. Substances effect

Seed priming using salicylic acid produced the maximum number of tillers, panicle numbers, and filled grains as well as panicles length in both seasons. The treatment of salicylic spray gave the heaviest panicles and 1000-grain weight without significant differences with the rest of treatments, except of yeast and bacteria seed priming treatments in both seasons. The control treatment had the lowest values of all yield traits, but the highest values of unfilled grain in the two seasons. On contrast, the seed priming in salicylic was found to be more efficient to reduce the hazard salinity effect on panicle fertility producing the lowest values of unfilled grains number hill^{-1}in both seasons. Similar findings were obtained by Mohamed *et al.,* 2015 and Gharib *et al.,* 2011.

Table (9): Plant height (cm), number of tillers hill^{-1}, number of panicles hill^{-1}, of some rice varieties as affected by some substances under saline soil

Treatment	Plant height(cm)		No. of tillers hill^{-1}		No. of panicles hill^{-1}	
	2015	2016	2015	2016	2015	2016
Varieties						
Giza177	82.84c	82.73c	14.65c	12.63c	12.53c	11.17c
Giza179	98.67b	98.48b	23.82b	25.20b	20.67b	22.63b
Egyptian hyprid1	101.1a	100.9a	25.99a	27.33a	23.43a	24.76a
F test	**	**	**	**	**	**
Substances						
Control	89.14c	89.20c	20.20f	20.85e	16.67e	18.70e
Salicylic soaking	96.76a	96.42a	22.75a	23.54a	20.48a	21.26a
Bacteria soaking	92.92b	93.09b	21.44cd	21.90c	19.08bc	19.77c
Yeast soaking	92.65b	92.65b	21.21de	21.69cd	18.83c	19.10d
Salicylic spray	97.75a	97.78a	22.25ab	22.15b	19.66b	20.06b
Yeast spray	93.95b	93.40b	21.36d	21.32d	18.86c	19.20d
Bacteria spray	97.75a	96.72a	22.03bc	21.27d	18.97bc	19.19d
F test	**	**	**	**	**	**
Interaction	**	**	**	**	**	**

* and ** indicate P < 0.05, P < 0.01, respectively. Means of each factor designated by the same latter are not significantly different at 5% level using Duncan's Multiple Range Test.

5.3. The interaction effect:

The interaction effects between rice varieties and tested substances had significant effects on plant height, number of tillers, number of panicles, number of filled grains and 1000-grain weight in 2015 and 2016 seasons Tables (10, 11, 14, and 15). The highest values of plant height, tillers number, panicle number were obtained by Egyptian hybrid one (EHR1) under seed soaking in salicylic acid in both seasons. Both of foliar spray and seed soaking in substances with tested varieties were improved filled grain.

Table 10: Plant height (cm) as affected by interaction between rice varieties and different substances

substances	2015			2016		
	Giza 177	Giza 179	EHRI	Giza 177	Giza 179	EHRI
Control	75.33i	95.1c-f	97.0b-f	75.50i	95.1ef	97.01def
Salicylic soaking	82.0h	101.5abc	106.7a	81.83h	101.4a-d	106.0a
Bacteria soaking	82.66h	99.86a-d	96.23b-f	83.33gh	99.53b-e	96.41def
Yeast soaking	83.66h	93.43def	100.8abc	83.94gh	93.30f	100.7a-e
Salicylic spray	86.00gh	101.4abc	105.8a	86.33gh	101.3a-d	105.6ab
Yeast spray	86.00gh	93.00def	102.8ab	85.00gh	92.83f	102.3a-d
Bacteria spray	90.76fg	103.6ab	97.80b-e	88.26g	103.5abc	98.33c-f

Table 11: Tillers and panicle number as affected by interaction between rice varieties and different substances

Substance	Tiller number $hill^{-1}$			Panicle number $hill^{-1}$		
	2015					
	Giza 177	Giza 179	EHYI	Giza 177	Giza 179	EHYI
Control	12.63i	23.26de	24.70b	10.46h	17.46f	22.10bc
Salicylic soaking	14.06h	25.76b	28.43a	12.13g	23.16b	26.16a
Bacteria soaking	14.86gh	23.70cde	25.76b	12.96g	21.10bc	23.19b
Yeast soaking	14.93gh	23.26de	25.43b	13.00g	20.66cde	22.85b
Salicylic spray	15.38gh	24.93bc	26.43b	12.83g	22.33bc	23.83b
Yeast spray	15.73g	22.96e	25.40b	13.43g	20.36de	22.80b
Bacteria spray	17.13f	23.50cde	25.46b	13.16g	20.90cde	22.86b
	2016					
Control	11.67h	24.72d	26.16c	10.37g	22.15d	23.59c
Salicylic soaking	13.51f	27.22bc	29.89a	11.81f	24.65bc	27.32a
Bacteria soaking	13.30fg	25.16d	27.25bc	12.05e	22.59d	24.68bc
Yeast soaking	13.46f	24.72d	26.91bc	10.83fg	22.15d	24.34bc
Salicylic spray	12.19gh	26.39c	27.89b	11.06fg	23.82c	25.32b
Yeast spray	12.70fgh	24.42d	26.86bc	11.46fg	21.85c	24.29c
Bacteria spray	12.62gh	24.29d	26.92bc	11.05g	21.72d	24.35bc

Table (12): Panicle length, panicle weight of some rice varieties as affected by some substances under saline soil in 2015 and 2016 seasons

Treatment	Panicle length(cm)		Panicle weight(g)	
	2015	2016	2015	2016
Variety				
Giza177	18.98b	19.70b	2.34c	2.23c
Giza179	18.45b	19.95b	2.71b	2.64b
EHR1	20.99a	22.75a	3.07a	3.04a
F test	**	*	*	**
Substances				
Control	17.94c	19.40	2.37c	2.27c
Salicylic soaking	20.49a	22.20	2.77ab	2.71ab
Bacteria soaking	18.7bc	20.31	2.73ab	2.67ab
Yeast soaking	18.13c	19.61	2.63b	2.55b
Salicylic spray	20.64a	22.37	2.97a	2.93a
Yeast spray	19.8ab	21.52	2.88a	2.83a
Bacteria spray	20.10a	19.52	2.75ab	2.68ab
F test	**	NS	**	**
Interaction	NS	NS	NS	NS

*, ** and Ns indicate $P < 0.05$, $P < 0.01$ and not significant, respectively. Means of each factor designated by the same latter are not significantly different at 5% level using Duncan's Multiple Range Test.

Table (13): Number of filled grains panicle^{-1}, number of unfilled grains panicle^{-1} and 1000-grain weight (g) of some rice varieties as affected by some substances under saline soil

Treatment	Number of filled grains		Number of unfilled grains		1000-grain weight(g)	
	2015	2016	2015	2016	2015	2016
Variety						
Giza177	92.14c	94.77c	26.78a	30.99a	24.51a	24.09a
Giza179	117.1b	118.9b	19.77c	17.25c	22.36b	22.17c
EHR1	121.3a	123.6a	25.03b	27.10b	23.09b	22.85b
F test	**	**	**	*	*	*
Substances						
Control	98.85d	98.53f	32.33a	31.13a	22.22d	21.98e
Salicylic soaking	117.6a	119.1a	19.02d	17.51d	23.5abc	23.37abc
Bacteria soaking	112.2b	115.7bc	23.33b	24.49b	23.08bcd	22.73cd
Yeast soaking	111.0b	112.3d	22.22c	24.73b	22.95cd	22.93bcd
Salicylic spray	115.3a	116.3b	21.33bc	24.8b	24.11a	23.87a
Yeast spray	111.5b	113.2cd	21.07cd	24.53b	23.93ab	23.54ab
Bacteria spray	111.5b	110.5d	20.83cd	24.28c	23.84abc	23.27abc
F test	**	**	*	**	**	**
Interaction	**	**	NS	NS	**	**

*, ** and Ns indicate $P < 0.05$, $P < 0.01$ and not significant, respectively. Means of each factor designated by the same latter are not significantly different at 5% level using Duncan's Multiple Range Test.

Table 14: Number of filled grains as affected by interaction between rice varieties and different substances in 2015 and 2016 seasons

Substance	2015			2016		
	Giza 177	Giza 179	EHRI	Giza 177	Giza 179	EHRI
Control	80.66k	103.6ef	112.2d	84.43h	104.2de	113.6c
Salicylic soaking	100.6efg	124.5ab	127.6a	105.4d	127.2a	130.6a
Bacteria soaking	89.66ij	122.1ab	124.9ab	96.20efg	124.5ab	127.5a
Yeast soaking	97.23fgh	114.0cd	121.9ab	97.15ef	115.6bc	124.3ab
Salicylic spray	97.33fgh	122.7ab	125.9ab	97.26ef	125.2ab	128.6a
Yeast spray	94.50ghi	121.6ab	118.5de	95.98efg	124.0ab	120.6abc
Bacteria spray	92.50hi	122.3ab	119.6cd	88.28fg	124.7ab	121.8abc

Table 15: 1000-grain weight as affected by interaction between rice varieties and different substances in 2015 and 2016 seasons

substances	2015			2016		
	Giza 177	Giza 179	EHRI	Giza 177	Giza 179	EHRI
Control	22.83cde	21.23e	22.6cde	22.59def	20.99f	22.36def
Salicylic soaking	23.63b-e	22.76cde	24.1bcd	23.72bcd	22.52def	23.86a-d
Bacteria soaking	25.1abc	21.53de	22.63cde	24.52abc	21.29ef	22.39df
Yeast soaking	23.83bcd	22.6cde	22.43de	23.92a-d	22.69def	22.19def
Salicylic spray	25.1abc	23.163b-e	24.13bcd	24.86ab	22.86c-f	23.89a-d
Yeast spray	25.43ab	22.88cde	23.563b-e	24.74ab	22.64def	23.26bcd
Bacteria spray	26.66a	22.4de	22.46de	25.42a	22.16def	22.22def

The highest values of filled grains were produced by the combination of EHR1 and seed soaking in salicylic acid. Filled grains increased in tested rice varieties as a result of seed priming by salicylic acid or its spray, as well as using bacteria and yeast extract may be due to alleviation of salinity harmful effect on panicle fertility.

6. Yields

6.1. Rice varieties performance

Rice varieties markedly differed grain yield biological yield and harvest index in both seasons Table (16). The greatest grain was yielded by Egyptian hybrid one followed by Giza179, but Giza177 came in the last order regarding grain yield. As for biological yield Egyptian hybrid one was the best followed by Giza179 in the first season and Giza177 in the second season. Meanwhile, Egyptian hybrid one produced the highest value of harvest index without differ with Giza179 in the second season. EHR1 kept its superiority whereas, it gave the higher grain yield comparing to the two inbred rice varieties owing to its high heterosis and salinity withstanding, Interestingly, Giza179 inbred rice variety came in the second rank after EHR1 regarding the grain yield and salinity tolerance. The yield results of the two previous mentioned varieties were tightly matching with their growth performance and yield attributes as well as their low Na^+/K^+ ratio. Giza177 rice variety possessed low yield as a result of low yield attributed, bad growth behavior and poor ion selectivity in the terms of high Na^+/K^+ ratio. Zayed *et al.,* 2017 ratified the similar trend.

Table (16): Yield (t ha^{-1}) and harvest index of some rice varieties as affected by some substances under saline soil

Treatment	Grain yield(t ha^{-1})		Biological yield(t ha^{-1})		Harvest index	
	2015	2016	2015	2016	2015	2016
Variety						
Giza177	2.09c	1.94c	6.54c	6.52b	0.21c	0.29b
Giza179	3.01b	2.90b	7.59b	7.67c	0.30b	0.38a
EHY1	3.88a	3.70a	9.30a	9.48a	0.39a	0.40a
F test	**	**	**	**	**	**
Substance						
control	2.49de	2.37e	7.01c	6.90c	0.25d	0.33b
Salicylic soaking	3.60a	3.56a	8.34ab	8.50a	0.36a	0.40a
Bacteria soaking	2.72cd	2.80cd	7.23c	7.49bc	0.27c	0.37ab
Yeast soaking	2.78c	2.65d	7.61bc	7.52bc	0.27c	0.35b
Salicylic spray	3.34b	3.25a	8.64a	8.86a	0.33b	0.35b
Yeast spray	3.30b	3.14b	8.35ab	8.37ab	0.33b	0.37ab
Bacteria spray	3.25b	2.96bc	8.57a	8.73a	0.32b	0.33b
F test	**	**	**	**	**	**
Interaction	**	**	NS	NS	NS	NS

*, ** and Ns indicate $P < 0.05$, $P < 0.01$ and not significant, respectively. Means of each factor designated by the same latter are not significantly different at 5% level using Duncan's Multiple Range Test.

6.2. Effect of substances

Grain and biological yields, and harvest index of rice significantly and positively affected by varying substances seed soaking and foliar spray treatments in both seasons (Table16). The impact of salicylic acid either soaking or foliar spray had high beneficial concerning grain and biological yields. The highest grain and biological yields were obtained by salicylic soaking compared with control treatment. Salicylic foliar spray significantly increased biological yield without significant difference with salicylic and bacteria foliar spray in both seasons Harvest index was increased by salicylic soaking in both seasons. The increase in grain yield by salicylic acid and bacteria may be due to germination improvement and early growth which reflected on higher yield attributes (number of panicle, panicle weight, number of filled grains and 1000-grain weight) and in turn increased grain yield. Also the mentioned substances had positive role in raising rice salinity tolerance by minimizing the Na^+ uptake magnifying K^+ uptake resulted in low Na^+/K^+ ratio. (Mohamed *et al.,* 2015) has been reported the similar pattern.

6.3. The interaction effect

The interaction between rice varieties and substances had a significant on grain yield in both seasons (Table 17). The interaction effect of grain yield result came to fix that all tested substances improved grain yield of the tested rice varieties. Furthermore, the results of grain yield interaction confirmed higher efficiency of salicylic acid treatment either seed priming or foliage spray in improving rice yield under salt stress as a results of raising rice salinity tolerance. The highest values of grain yield was obtained by Egyptian hybrid one when it was soaked in salicylic solution in both seasons.

Table 17: Grain yield t ha^{-1} as affected by interaction between rice varieties and different substances in 2015 and 2016 seasons

Substance	Giza177	Giza 179	EHR1	Giza 177	Giza 179	EHR1
	2015			2016		
control	1.63h	2.33fg	3.51c	1.49h	2.20e-h	3.42bc
Salicylic soaking	1.93gh	3.85bc	5.01a	1.94fgh	3.77c	4.99a
Bacteria soaking	1.74h	2.68ef	3.73bc	2.20e-h	2.56def	3.65bc
Yeast soaking	1.93gh	2.81ef	3.60bc	1.76gh	2.69de	3.51bc
Salicylic spray	2.40fg	3.45cd	4.18b	2.11e-h	3.36bc	4.12b
Yeast spray	2.53fg	3.21cde	4.16b	2.22e-h	3.11cd	4.10b
Bacteria spray	2.88def	3.26cde	3.61bc	2.20e-h	3.16cd	3.53bc

In summary, rice seed priming or plant foliar spray with extraction of salicylic acid or bacteria more efficient than yeast, they are beneficial in improving growth and yield of rice varieties under the harmful effect of salinity.

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دور معامله البذور والرش باستخدام بعض المواد الحيوية والكيماوية في زيادة تحمل الملوحة وإنتاجيه الأرز

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الملخص العربي

أقيمت هذه الدراسة خلال موسمي الزراعة ٢٠١٥و٢٠١٦ وذلك في محطة بحوث السرو الزراعية– محافظه دمياط وكذلك معمل مركز البحوث والتدريب في الأرز– سخا–كفر الشيخ. وكان الهدف الرئيسي من الدراسة هو اختبار فاعليه النقع والرش بمحلول بعض المواد الحيوية و الكيماوية وهى: حامض السليسيلك بتركيز٢٥٠ppm ومستخلص كل الخميرة ٢ كجم/فدان والبكتريا بتركيز ٢%, وذلك خلال مراحل نمو الأرز المختلفة (متوسط التفريع +بداية تكوين السنبلة +متوسط طور الحبلنه) على أصناف الأرز (جيزه١٧٧,جيزة ١٧٩ وهجين مصري واحد) تحت ظروف الأراضي الملحية. كان التصميم المستخدم في الدراسة هو القطع المنشقة مره واحده في أربعه مكررات حيث احتوت القطع الرئيسية على أصناف الأرز واحتوت القطع الشقية على المواد المختبرة السابق ذكرها وكان تركيز الملوحة ٧و٧.٣ مليموز/سم فى كلا الموسمين على التوالي ، وكان مستوى الملوحة المستخدم في المعمل ٧ ميلموز/سم. وكان ملخص أهم النتائج كما يلي:أعطى الصنف جيزة ١٧٧ أفضل النتائج في صفات الإنبات وهى نسبه الإنبات،طاقه الإنبات،نسبه الإنبات النهائية وذلك تحت الظروف المعملية . وأعطى النقع في البكتريا بدون فرق معنوي مع النقع في حامض السلسيلك أعلى القيم من الصفات المدروسة السابق ذكرها وذلك بالمقارنة بالكنترول (الغير معامله). تحت الظروف الحقلية أعطى الصنف هجين مصري واحد أفضل الصفات المدروسة واتبعه جيزة ١٧٩ ثم جيزة ١٧٧. عملت المواد المختبرة على زيادة جميع الصفات المدروسة بالمقارنة بالمعاملة الكنترول وكان تأثير حامض السيلسيلك والبكتريا سواء نقع أو رش أفضل من الخميرة. ويمكن التوصية بنقع البذور أو رش النبات بحامض السلسيلك او البكتريا وذلك لزيادة معدل النمو و لتحسين الانتاجيه لنبات الأرز المنزرع تحت ظروف الاراضى الملحية.

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