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Some Anti-oxidants, Phsysio-morphological, and Yield of Varying Rice Varieties Affected by Salinity Levels.

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ABSTRACT

Tow field experiments were conducted at El-Sirw Agricultural Research Station, Damietta Governorate, Egypt during 2015 and 2016 seasons. The main objectives of this study is to estimate the physiological and biochemical performance of some rice varieties under various salinity levels. The experiments were performed in randomized complete block design with four replicationsfor each salinity level apart and the results were statistically analyzed as split plot design after homogeneity test as combined. Soil survey of the experimental farm was annually done to find the following used salinity levels viz; 2, 6 and 10dSm^{-1}.Giza177, Giza178, Giza179 and Egyptian hybrid one (EHR1) ricevarieties were used. Anti –oxidants, physio- morphological and growth parameters were measured at heading stage as well as grain yield and yield attributing characteristics were measured at harvest. The obtained results indicated that: increasing salinity levels led up to decreased potassium percentage (K %), increased sodium percentage (Na %) and Na^+/K^+ ratio in rice plant. Furthermore, increment of salinity levels reduced dry matter accumulation (g),relative water content RWC(%), chlorophyll a,b and total chlorophyll (µg ml^{-1}) and, increased a/b ratio and antioxidant system peroxidase (POD)(µmol min^{-1} g^{-1} protein) Catalase (CAT)(µmol min^{-1} g-^{1} protein),proline (mg g^{-1} FW).Increasing salinity levels decreased the studied growth characteristics; flag leaf area, chlorophyll content (SPAD value), plant height, panicle weight, panicle length, number of filled grains, 1000-grain weight and grain yield/ha^{-1}but increased unfilled grains per panicle. EHR1gave the highest values of most studied characters followed by Giza179 while, Giza178 came in the third order. Giza177 gave the lowest values of the most studied traits. Egyptian hybrid one under the three salinity levels was distinction compared with other rice varieties in both seasons. Based on current biochemical and physiological traits and yield under different salinity levels, the tested rice varieties could be ranked as follows; EHR1>Giza179>Giza178 regarding their salinity tolerance. Giza 177 was found to be more salt sensitive variety.

INTRODUCTION

Salinity is one of the major abiotic stresses limiting crop productivity worldwide. Rice is a salt sensitive crop for soil salinity but it is the only crop that has been recommended as a desalinization crop due to its ability to grow under submerge conditions, also the standing water in rice fields can help to leach the salts from the topsoil to lower levels (Lafitte *et al*., 2004). Salinity affects major physiological and biochemical processes in plant. Rice plants which treated with NaCl (200 mMNaCl, 14 days) reduced of the Chlorophyll b content of leaves (41%) than the Chl. a content (33%) (Amirjani, 2011).Chutipaijit *et al*.(2011) reported that rice exposed to 100 mMNaCl showed 30% and 45% in Chl a and Chl b, respectively. Surekha Rao *et al*.(2012) conducted that Chla, Chlb and total Chl showed a significant decrease under salinity stress.Chlorophyll b is more sensitive than chlorophyll a to salinity. Leaf relative water content (LRWC) is a measure of plant water status and reflects the metabolic activity of tissues and is used as a meaningful index for dehydration tolerance (Anjum *et al*., 2011). Salinity stress reduced RWC as compared with control plants. Amirjani(2010).

Salinity inducesreactine oxygen species (ROS) in plant cells and the excess production of ROS is toxic to plants and causes oxidative damage leading to cell death. Plants possess enzymatic and non-enzymatic antioxidant defense systems to protect cells against the damaging effects of ROS. (Hasegawa *et al*., 2000; Apel and Hirt, 2004 and Hossain *et al*., 2014). The major ROS-scavenging antioxidant enzymes are catalase (CAT) and guaiacol peroxidase (POX) and the main non-enzymatic antioxidant is proline. Catalase and peroxidase are the H_2O_2 detoxifying enzymes and mostly associated with peroxisomes where they remove H_2O_2 formed during photorespiration. Many authors have reported that salt stress strongly affects the components of antioxidant defense system in plants, (Noctor and Foyer, 1998; Hasegawa *et al*., 2000; El-Shabrawi *et al*., 2010; Nounjan and Theerakulpisut, 2012) where an increase in catalase and peroxidase activity in rice cultivars were recorded with increasing salt concentrations(Mittal and Dubey, 1991; Yaghubi 2014 and Joseph *et al*., 2015). Proline is the most common compatible solute that plays an important role in osmotic adjustment. It also suppresses production of free radicals (Hasegawa *et al*., 2000; Okuma *et al*., 2004). Also proline contributes to the protection of membranes, proteins and enzymes from damaging effects of salinity stress (Hossain *et al*., 2014).

Leaf pigments, photosynthesis, stomata conductance, growth, yield and yield components were significantly declined by increasing salinity levels up to 8.5 dSm^{-1}. Amino acids, Na^{+1}, Ca^{+2}, Na^+/K^+ and $Na^{+1/}Ca^{+2}$ and unfilled grain in the terms of sterility were significantly increased with increasing salinity level,(Zayed*et al*., 2014). Selection of salt tolerant cultivars is one of the most effective methods to increase the productivity of saline soils; thereby the aim of current study was to identify the optimum criteria for salinity tolerance in rice.

MATERIALS AND METHODS

Twofield experiments were conducted at El-Sirw Agricultural Research Station, Damietta Governorate, Egyptduring 2015 and 2016 seasons. Each experiment associated to each salinity level was laid in randomized complete block design with four replications. Three salinity levelsviz; 2,6 and 10 ds m^{-1}. The tested salinity levels were determined after soil survey and measuring Ece of different sites then selected the current studied levels.

Four rice varieties, namely; Giza177, Giza178, Giza179 and Egyptian Hybrid One were used in this study. Soil texture was clayey. Soil samples were taken before land preparation at the depth of 0-30 cm from the soil surface. The soil samples were completely mixed, dried and grounded, and then physically and chemically analyzed according to Black *et al*. (1965).

Table1.Thechemical analysis of the experimental sites during 2015 and 2016 seasons

Salinity levels	seasons	EC (dSm^{-1})	pH	Cation and anion meq L^{-1} (soil paste)							Available ppm		
				Na^+	Ca^{++}	Mg^{++}	K^+	HCo_3^-	Cl^-	SO_4^{--}	N	P	K
S1	2015	2.0	8.2	13.1	4	3	1.40	6	11	3.0	34	18	487
S2		6.0	8.1	30	14	16	0.36	7	35	18	31	14	311
S3		10	8.0	49.0	31	20	0.31	14	40	36	24	11	300
S1	2016	2.0	7.8	12.1	5	3	1.42	6	11	3.0	33	19	483
S2		6.0	8.0	28	17	15	0.34	7	35	18	31	14	310
S3		10	8.2	50.0	26	24	0.30	14	43	33	24	12	298

Seeds were sownon April, 25thand the seedlings of 30 days age were transplanted at 20X 20 cm spacing in both seasons. The phosphorus and potassium fertilizers were applied in the forms of calcium super phosphate (15.5 % P_2O_5) and potassium sulphate(48%K_2O) in the rates of 37 kg P_2O_5 and 50 k_2Oha^{-1},respectively. Nitrogen in the form of urea (46.5 % N) was added into three equal splits, 1/3 at 15, 30 and 45 days after sowing at the above-mentioned levels. Zinc fertilizer at the rate of 24 kg $ZnSO_4$ ha^{-1} was mixed with sand and manually broadcasted at the beginning of flooding. Then, the irrigation treatments were applied as aforementioned. Each Irrigation treatment was tightly surrounded by deep ditches with 2 m wide and 1 m depth to isolate each other. The plot size was $10m^2$(2m width* 5m length).

Growth characteristics and Photosynthetic Pigments:

At heading stage, plants of five hills wererandomly taken from each plot to estimate flag leaf area and chlorophyll content. Flag leaf area of plant samples were measured by Portable Area Meter (Model LI– 3000A). Total chlorophyll content was determined in ten flag leaf by using chlorophyll meter (Model–SPAD502) Minolta Camera Co. Ltd., Japan. Samples of three hills from each plot were taken to determine.

Dry matter accumulation, photosynthetic pigments (chlorophyll a, chlorophyll b and total chlorophyll) using the spectro-photometric method according to Moran, 1982.Relative water content (RWC %) was measured according to Ritchie and Nguyen, (1990)

Determination of antioxidants and minerals content:

Proline content of leaves was determined according to the method of Bates *et al*., (1973).

Enzyme extraction: Leaf sample (500 mg) was frozen in liquid nitrogen and finely ground by pestle in a chilled motor, the frozen powder was added to 10 mL of phosphate buffer (pH 7.0). The homogenate was centrifuged at 15000 × g for 10 min at 4 °C and supernatant was used as enzyme source for catalase (CAT; EC 1. 11. 1. 6), peroxidase (POD; EC 1. 11. 1. 7)

Assays of antioxidant enzyme activities:

Assay of CAT activity: The assay mixture in volume of 3 mL contained 0.5 mL of 0.2 M phosphate buffer (pH 7.0), 0.3 mL of (v/v) H_2O_2 and 0.1 ml of enzyme. The final volume was made 3 ml by adding distilled water. Change in optical density was measured at 240 nm at 0 min and 3 min on UV-Vis spectrophotometer. (Aebi and Bergmeyer, 1983 and Lum *et al*., 2014). Assay of POD activity: The assay mixture of 3 ml contained 1.5 ml of 0.1 M phosphate buffer (pH 7.0), 1 ml freshly prepared 10 mMguaiacol, 0.1 ml enzyme extract and 0.1 ml of 12.3 mM H_2O_2. Absorbance was read at 436 nm and then increase in the absorbance was noted at the interval of 30 s on UV-Vis spectrophotometer. (Jebara *et al*., 2005 andLum *et al*., 2014).

Potassium (K) and sodium (Na) were determined using Flame Photometer according to Chapman and Pratt (1978).

Yield and yield attributes:

At harvest, plant height was estimated; ten panicles were collected randomly to estimate the panicle weight, panicle length, number of filled grains and unfilled grains per panicle and 1000-grain weight. The six inner rows of each plot were harvested, dried, threshed, and the grain yield was determined at the moisture content of 14%,the yield converted to grain yield ton/ha^{-1}.

Before the computations of the combined experiments, it is necessary to determine whether the error variances of the tests are homogenous to test the homogeneity of variance. After Combined analysis, the data were statically analyzed in split plot.All statistical analysis was performed using analysis of variance technique by means of "Co-STAT" computer software package. The treatment means were compared using least significant differences.

RESULTS AND DISCUSSION

The results of the present study will be discussed under the following topics;

A- Some physiological characteristics

B- Growth characteristics

C-Yield and its attributes

A- Some physiological characters:

The potassium, sodium and Na/K ratio values were significantly affected by different salinity levels in couple study seasons (Table 2). As salinity level raised, Na and Na/K ratio was gradually increased while the potassium was markedly declined attributed to antagonism (Table 2).

Data listed in Table 2 revealed that different salinity levels had a significant effects onpotassium%, sodium % and Na^+/K^+ ratio of rice varieties in both seasons. Increasing salinity levels gradually minimized potassium percentage. Similar to the last point, increasing salinity levels significantly raised sodium percentage as well as,Na^+/K^+ ratio.

Table 2. Potassium(K)%, sodium(Na) % and Na$^+$/K$^+$ ratio of rice varieties as affected by salinity levelsdS m^{-1} in 2015 and 2016 seasons.

Characters	K %		Na %		Na/K	
Treatments	2015	2016	2015	2016	2015	2016
Salinity levels (dS m-1)						
2	2.85	2.98	0.78	0.75	0.27	0.25
6	2.01	2.18	1.37	1.60	0.68	0.73
10	1.35	1.27	1.93	1.79	1.43	1.41
LSD at 0.05	0.05	0.26	0.03	0.03	0.72	0.12
Varieties						
Giza 177	1.00	1.33	1.86	1.88	1.86	1.41
Giza 178	2.36	2.51	1.33	1.22	0.56	0.49
Giza 179	2.64	2.87	1.04	1.01	0.39	0.35
EHR1	2.93	2.89	1.13	1.15	0.38	0.40
LSD at 0.05	0.07	0.20	0.02	0.03	0.41	0.16
Interaction	NS	NS	NS	NS	NS	NS

The symbols of * and ** indicate the significant at 5% and 1% levels probability, respectively, while NS means not significant.

Amirjani(2010) and Zayed *et al.* (2014) came to similar trends.The tested rice varieties had significant variation intheirpotassium, sodium (%) and Na$^+$/K$^+$ ratio. EHR1 rice varietyhad higher potassium % and low sodium as well as Na$^+$/K$^+$, compared with other rice varieties, followed by Giza 179, Giza178 came in the third rank.Giza177 rice variety gave the lowest potassium content and high sodium (%) as well as Na$^+$/K$^+$ ratio. The obtained data indicate that the salt sensitive variety Giza 177 did not have any mechanismreacted to ion selectivity and the opposite was fact true with other tested varieties. The salt tolerant varieties had antiporters related K$^+$ selectivity which may increase K uptake against Na+ uptake reducing Na$^+$/K$^+$ ratio (Hossain *et al.*, 2014 and Zayed *et al.*, 2014).

Table 3. Some photosynthetic pigments as affected by salinity levels (dS m^{-1}) and rice varieties during 2015 and 2016 seasons

Characters	Chlorophyll a (µg ml^{-1})		Chlorophyll b (µg ml^{-1})		total Chlorophyll (µg ml^{-1})		a / b ratio	
Treatments	2015	2016	2015	2016	2015	2016	2015	2016
Salinity levels (dS m^{-1})								
2	15.80	16.79	6.53	6.74	22.33	23.54	2.44	2.44
6	14.98	16.24	4.31	3.74	19.29	19.91	3.56	3.56
10	13.92	15.40	3.12	3.07	17.04	18.47	4.67	4.67
LSD 0.05	0.41	0.38	0.82	1.35	1.21	2.04	0.79	1.92
Varieties								
Giza 177	13.17	14.97	4.06	3.87	17.23	18.75	3.37	3.69
Giza 178	14.70	15.98	4.53	4.25	19.23	20.23	3.44	3.70
Giza 179	15.49	16.54	4.91	4.89	20.39	21.59	3.62	4.95
EHR1	16.24	17.08	5.11	5.05	21.35	21.97	3.78	4.95
LSD 0.05	0.59	0.64	0.49	0.87	0.63	0.89	NS	1.19
interaction	NS	**	NS	NS	NS	NS	NS	NS

The symbols of * and ** indicate the significant at 5% and 1% levels probability, respectively, while NS means not significant.

Results in Table3 indicated that Chlorophyll a, Chlorophyll b, total chlorophyll and chlorophyll a/b ratiosignificantly affected by salt stress inthe two seasons, increased by increasingsalinity levels. On the other hand, chlorophyll a/b ratio was increased by increasing salinity levels. Tested rice varieties showed great variation in their Chlorophyll a, Chlorophyll b and total chlorophyll in the two seasons, while a/b ratio was detected in the second season only.EHR1 showed the highest concentrations of chlorophyll a and Chlorophyll b and total chlorophyll as compared to other rice varieties. Giza179 rice variety came in the second ranking followed by Giza178, while the lowest concentrations of major pigments were found by Giza177 rice variety. The lowest value of chlorophyll a/b ratio was obtained by Giza177 without significant difference with Giza178. The highest value was obtained byGiza179 since they have the same value. The interaction between salinity levels and rice varieties had a significant effect on chlorophyll a in the second season only (Table5). Chlorophyll a content of rice varieties was minimized under high and medium salinity levels. EHR1 provided its superioritycompared with other tested rice varieties under normal condition as well as thetested salinity levels. Similar data were observed byAmirjani(2010) Hossain *et al.* (2014)and Zayed *et al*. (2014).

Data in Table 4 related to dry matter accumulation and relative water content as affected by salinity levels in 2015 and 2016 seasons. Dry matter accumulation and Relative water content significantly decreased by increasing salinity level from 2- 10 d S/m in both seasons. Relative water content of different rice varieties was markedly affected by salinity levels in both seasons. EHR1 variety without significant difference with Giza 179 produced the optimum values of relative water content and dry matter accumulation as compared with other varieties in the two seasons. Whereas, Giza 178 was the second order, Giza 177 gave the minimum values in the two seasons. The interaction between salinity levels and rice varieties had a significant effect on relative water content in the second season only (Table4). EHR1 gave the highest value of relative water content under normal conditions and the lowest one was obtained by Giza177 with higher salinity level (Table 5). High relative water content was found in the tolerant varieties implying that its ability to regulate its stomata conductance and their ability to adjust their osmatic pressure keeping high water content. Jahan *et al.* (2013) found similar trends.

Table 4 . Dry matter accumulation (g) and relative water content (RWC %) as affected by salinity levels (dSm^{-1}) and rice varieties during 2015 and 2016 seasons

Traits	dry matter accumulation (g)		RWC (%)	
	2015	2016	2015	2016
Salinity levels (dS m-1)				
2	52.29	60.09	72.52	76.11
6	39.26	53.08	68.61	71.94
10	30.60	43.43	62.45	65.36
LSD at 0.05	3.20	9.25	0.73	1.58
Varieties				
Giza 177	30.19	30.02	66.78	68.35
Giza 178	41.29	50.48	67.75	71.42
Giza 179	45.02	64.40	68.31	71.87
EHR1	46.36	63.89	68.59	72.92
LSD at 0.05	3.10	6.24	1.05	0.82
interaction	NS	NS	NS	**

The symbols of * and ** indicate the significant at 5% and 1% levels probability, respectively, while NS means not significant.

Table 5. Effect of the interaction between salinity levels (dS m^{-1}) and rice varieties on Chlorophyll a (µg ml^{-1}) during 2015 season and RWC% during 2016 seasons.

Characters	Chlorophyll a(µg ml^{-1})			RWC (%)		
Salinity levels	2dSm^{-1}	6 dSm^{-1}	10dSm^{-1}	2dSm^{-1}	6dSm^{-1}	10dSm^{-1}
Varieties	2015			2016		
Giza177	16.17	15.10	13.64	74.99	69.39	60.66
Giza178	16.32	16.42	15.21	75.75	72.09	66.42
Giza179	16.81	16.58	16.23	76.54	72.87	66.20
EHR1	17.87	16.85a	16.52	77.17	73.41	68.17
LSD at 0.05	1.12			1.42		

Table6. Some antioxidants as affected by salinity levels (dS m^{-1}) and rice varieties during 2015 and 2016 seasons.

Characters	Peroxidase (POD) (µmol min^{-1} g^{-1} protein)		Catalase (CAT) (µmol min^{-1} g^{-1} protein)		Proline (mg g^{-1} FW)	
	2015	2016	2015	2016	2015	2016
Salinity levels (dS m^{-1})						
2	1.85	2.19	0.086	0.049	0.16	0.22
6	2.95	3.29	0.098	0.139	0.21	0.31
10	4.65	5.13	0.161	0.295	0.32	0.42
LSD at 0.05	0.27	0.33	0.011	0.012	0.06	0.13
Varieties						
Giza 177	1.09	1.09	0.084	0. 072	0.12	0.21
Giza 178	1.87	1.87	0.109	0.103	0.24	0.33
Giza 179	4.08	4.08	0.127	0.129	0.27	0.36
EHR1	5.58	5.58	0.140	0.143	0.29	0.37
LSD at 0.05	0.23	0.26	0.009	0.01	0.031	0.044
Interaction	NS	NS	NS	NS	**	**

The symbols of * and ** indicate the significant at 5% and 1% levels probability, respectively, while NS means not significant.

Data for antioxidant defense systemswhich represented in Peroxidase (POD), catalase (CAT) and proline contents are presented in (Table6). Increasing salinity levels dramatically raised antioxidant system.

Tested rice varieties showed great variation in their antioxidant system. EHR1 provided its superiority via increment POD, CAT(antioxidants enzymes) andProline (non-enzymatic antioxidant)which proposed to be important in plant stress tolerance. Giza 179 rice variety came in the second rank followed by Giza178. The lowest values of POD, CAT and proline were observed by Giza177. CAThad ap in the removal of H_2O_2generated in peroxisomes by oxidases involved in b-oxidation offatty acids, photorespiration and purine catabolism. The CATisozymes have been studied extensively in higher plants and prolinecan be regarded as non-enzymatic antioxidants that microbes,plants require to mitigate the adverse effects of ROSPolidoros and Scandalios, (1999) and Chen (2005). The interaction between salinity levels and rice varieties had a significant effect on proline content in both seasons (Table 6). The three rice varietiesEHR1, Giza178 and Giza179 did not show any significantthe difference among them under higher salinity levels and produced the highest value of chlorophyll content. Giza177 gave the lowest value of proline content. Zayed *et al*. (2004) found that the differance in their salinity tolerance are associated with different performance of proline content under various salinity levels.

Table7. Effect of the interaction between salinity levels (dS m^{-1}) and rice varieties on proline (mg g^{-1} FW) in 2015 and 2016 seasons.

Traits	Proline (mg g^{-1} FW)		
Salinity level	2dS m^{-1}	6 dS m^{-1}	10dS m^{-1}
Varieties	2015		
Giza177	0.082	0.217	0.317
Giza178	0.249	0.307	0.433
Giza179	0.270	0.349	0.457
EHR1	0.292	0.353	0.478
LSD at0.05		0.05	
	2016		
Giza177	0.082	0.217	0.317
Giza178	0.249	0.307	0.433
Giza179	0.270	0.349	0.457
EHR1	0.292	0.353	0.478
LSD at0.05		0.076	

B- Growth characters:

Data in Tables 8 and 9 show that flag leaf area and chlorophyll content (SPAD value) were significantly affected by salinity levels in both seasons. Increasingsalinity levels gradually reduce flag leaf area and chlorophyll content as compared with normal conditions which gave the highest values of the mentioned traits in the two seasons. Salinity reduces the plantgrowth through osmotic effects which reduces the ability of plants to take up water and this causes reduction in growth. Furthermore, reducing water uptake under salt stress is combined with reducing nutrient uptake restricted biochemical and pigments development growth as well as metabolism. Also, salinity may be reduced the photosynthetic of plant to a level that cannot sustain growth. The results are in accordance with the findings of Shereen *et al.* (2005).

Rice varieties show significant difference in flag leaf area, chlorophyll content(SPAD value) and plant height in the two seasons (Tables 8 and 10). EHR1gave the highest value of flag leaf area, in both seasons. Giza178 rice variety gavethe highest value of chlorophyll content andcame in the second rank in plant height. Giza179 came in the second rank after EHR1in flag leaf area. Giza177 gave the lowest values of aforesaid traits in both seasons.

Table 8. Flag leaf area cm^2 and chlorophyll content (SPAD value) of some rice varieties as affected by different salinity levelsdS m^{-1} in 2015 and 2016 seasons.

Traits	**Flag leaf area**		**Chlorophyll content**	
Treatments	**2015**	**2016**	**2015**	**2016**
Salinity levelsdS m^{-1}				
2	39.67	39.57	40.48	41.01
6	22.30	22.33	39.81	40.34
10	18.37	18.39	38.71	39.14
LSD0.05	0.27	0.46	0.44	0.59
Varieties				
Giza177	21.39	21.37	37.63	38.00
Giza178	27.05	27.12	40.93	41.44
Giza179	27.30	27.23	39.36	39s.93
EHR1	27.30	31.35	40.75	41.29
LSD0.05	0.49	0.55	0.48	0.42
Interaction	**	**	**	**

The symbols of * and ** indicate the significant at 5% and 1% levels probability, respectively, while NS means not significant.

Table 9. Effect of interaction between different salinity levels and rice varieties on flag leaf area and chlorophyll content of some rice varieties in 2015 and 2016 seasons.

Traits	**Flag leaf area**			**Chlorophyll content**		
Salinity levels	**2dS/m**	**6dS/m**	**10dS/m**	**2dS/m**	**6dS/m**	**10dS/m**
Varieties	2015			2015		
Giza177	33.5	18.26	12.42	41.33	38.33	33.25
Giza178	39.33	22.4	19.42	39.66	42.37	40.75
Giza179	40.36	22.07	19.46	39.40	38.58	40.10
EHR1	45.50	26.56	22.18	41.53	39.97	40.75
LSD at0.05	0.85			0.83		
	2016			2016		
Giza177	33.48	18.19	12.43	41.67	38.88	33.46
Giza178	39.29	22.64	19.44	40.2	42.87	41.25
Giza179	40.10	22.09	19.50	40.06	39.14	40.59
EHR1	45.43	26.40	22.21	42.13	40.46	41.28
LSD at0.05	0.96			0.73		

The interaction between salinity levels and rice varieties had a significant effect on flag leaf area, chlorophyll content and plant height in both seasonsTables (10& 11). EHR1under normal condition produced the maximum values of flag leaf area, chlorophyll content and plant height in the two seasons. Giza178 rice variety under medium salinity level gave the highest value of chlorophyll content. The minimum values of the mentioned traits were obtained by Giza 177 under higher salinity levels in 2015 and 2016 seasons.

C-Yield components characters:

Panicle length, panicle weight, 1000- grain weight, filled grains and unfilled grains of rice varieties were influenced by salinity levels in both seasons (Table10, 12& 14). Increasing salinity levels significantly decreased panicle length, filled grains, panicle weight, and 1000 grain weight compared with normal condition in both seasons. On the contrary, unfilled grains was significantly increased by increasing salinity levels in the two seasons. The reduction in filled grains /panicle as salinity levels increasing is mainly attributed to raising unfilled grains that maybe a consequence of decreased pollen viability or decreased receptivity of the stigmatic surface. These results are confirmed with the findings ofAbdullah *et al.* (2001)

Rice varieties had a significant difference of panicle length, panicle weight, filled grains perpanicle, unfilled grainsper panicle and 1000 grain weight in the two seasons. The longest and heaviest panicle as well as, the highest value of filled grain was obtained by EHR1in both seasons thus gave. The highest value of unfilled grain and 1000-grain weight were in favor Giza177which gave the lowest values of panicle length, panicle weight, and filled grains.

Table 10. Plant height (cm), panicle length (cm) and panicle weight (g) of some rice varieties as affected by different salinity levels in 2015 and 2016 seasons.

Traits	**Plant height (cm)**		**Panicle length(cm)**		**Panicle weight (g)**	
Treatments	**2015**	**2016**	**2015**	**2016**	**2015**	**2016**
Salinity levels(dSm^{-1})						
2	100.5	100.7	22.22	22.59	3.51	3.70
6	93.62	93.78	19.66	20.04	2.65	2.84
10	84.90	84.98	16.93	17.31	2.24	2.43
LSD at0.05	0.15	0.55	0.17	0.28	0.10	0.11
Varieties						
Giza177	82.81	82.89	17.93	18.32	2.47	2.67
Giza178	95.99	96.16	19.86	20.21	2.68	2.87
Giza179	91.91	92.01	19.10	19.48	2.80	2.99
EHR1	101.4	101.5	21.52	21.91	3.25	3.43
LSD at0.05	0.29	0.57	0.28	0.28	0.098	0.12
Interaction	**	**	**	**	**	**

Table 11. Effect of the interaction between different salinity levels and rice varieties on Plant height (cm), panicle length (cm) and Panicle weight (g) of some rice varieties in 2015 and 2016 seasons

Traits Salinity level dS m-1	**Plant height (cm)**			**Panicle length (cm)**			**Panicle weight (g)**		
	2	**6**	**10**	**2**	**6**	**10**	**2**	**6**	**10**
Varieties				2015					
Giza177	100.5	84.87	63.06	20.6	19.53	13.68	3.1	2.56	1.75
Giza178	101.5	94.85	91.58	23.5	18.82	17.27	3.31	2.48	2.24
Giza179	95.46	92.72	87.55	20.5	19.52	17.28	3.46	2.61	2.34
HER1	104.7	102.0	97.44	24.3	20.76	19.51	4.16	2.96	2.62
LSD at0.05	0.51			0.48			0.21		
				2016					
Giza177	100.6	84.8	63.2	20.99	19.89	14.08	3.29	2.75	1.98
Giza178	101.6	95.21	91.64	23.79	19.22	17.64	3.50	2.67	2.43
Giza179	95.7	92.78	87.57	20.89	19.88	17.67	3.65	2.80	2.53
HER1	104.8	102.2	97.50	24.69	21.16	19.88	4.35	3.15	2.79
LSD at0.05	0.99			0.49			0.22		

The interaction between salinity levels and some rice varieties had a significant effect on panicle length, panicle weight, filled grains, unfilled grains and 1000 grain weight in both seasons, Tables (11, 13&15). EHR1under normal conditions gave the highest values of panicle length, panicle weight, filled grains per panicle and 1000 grain weight. The lowest values of unfilled grainper paniclewere observed by Gizaa177 under normal condition. Furthermore, EH1under higher salinity levels produced the lowest values of unfilled grainper panicle. Whereas, Giza177 under tested salinity levels gave the lowest values of panicle length, panicle weight, filled grainsper panicle and highest values of unfilled grainsper panicle.

Table 12. Number of filled grains/panicle and unfilled grains /panicle of some rice varieties as affected by different salinity levels in 2015 and 2016 seasons.

Traits	Number of filled grains / panicle		Number of unfilled grains / panicle	
Treatments	2015	2016	2015	2016
Salinity levels(dSm^{-1})				
2	149.1	151.0	14.25	14.85
6	119.3	121.1	23.60	25.09
10	84.44	85.6	42.43	43.22
LSD at0.05	0.81	1.13	1.89	0.69
Varieties				
Giza177	90.84	92.27	31.60	32.28
Giza178	122.0	123.9	23.57	26.86
Giza179	114.1	115.6	25.72	26.56
HER1	143.5	145.2	31.60	25.18
LSD at0.05	1.39	1.16	1.78	0.91
Interaction	**	**	**	**

The symbols of * and ** indicate the significant at 5% and 1% levels probability, respectively, while NS means not significant

Table 13. Effect of the interaction between different salinity levels on Number of filled grains and unfilled grains of some rice varieties in 2015 and 2016 seasons

Traits Salinity levels	Number of filled grains/panicle 2dS/m	6dS/m	10dS/m	Number of Unfilled grains/panicle 2dS/m	6dS/m	10dS/m
Varieties			2015			
Giza177	122.0	97.23	53.3	10.33	25.78	58.69
Giza178	162.3	125.3	78.4	13.33	19.04	38.35
Giza179	140.0	122.2	79.8	14.66	23.19	39.32
HER1	172.0	132.4	126.2	18.66	26.40	33.37
LSD0.05		2.41			3.08	
			2016			
Giza177	123.8	98.7	54.23	10.89	26.37	59.58
Giza178	164.6	127.5	79.63	13.96	22.28	39.31
Giza179	142.3	124.0	80.46	15.36	24.42	39.92
HER1	173.4	134.3	128.0	19.19	27.29	34.09
LSD0.05		2.01			1.59	

D- Grain yield:

As evident in Table14 grain yield of tested rice varieties influenced by salinity levels. Grain yield apparently decreased by increasing salinity levels, the highest value of grain yield was obtained under normal condition and the lowest one was obtained by higher salinity levels in both seasons. Salinity decreased grain yield through decreasing number of filled grains per panicle. Similar data wasobtained byKhatun and Flowers, (1995).

Rice varieties show that variation in grain yield EHR1gave the highest grain yield in both season, Giza 178 came in the second rank followed by Giza179. On the other side, Giza 177 gave the lowest value of grain yield in both seasons.Grain yield is depended on yield components and are severely affected by salinity, this results was confirmed by Khan *et al.*, (1997).

The interaction between salinity levels and rice varieties had a significant effect on grain yield in both season (Table15). EHR1 under the normal condition was produced the highest value of grain yield. Thus, EHR1 gave the maximum values of grain yield under the medium and high salinity levels. On contrary, the lowest grain yield was produced by Giza177 under tested salinity levels in both seasons. The relative ranking between Giza178 and Giza179 was inconsistent under tested salinity levels in both seasons.

Table 14. 1000- grain weight (g) and Grain yield (t/ha) of some rice varieties as affected by different salinity levels in 2015 and 2016 seasons

Traits	1000- grain weight(g)		Grain yield(ton/ha)	
Treatments	2015	2016	2015	2016
Salinity levels (dSm^{-1})				
2	24.45	24.77	10.77	10.90
6	22.12	22.46	5.93	6.11
10	21.16	21.56	4.05	4.17
LSD at0.05	0.01	0.17	0.11	0.18
Varieties				
Giza177	25.33	25.66	4.67	4.84
Giza178	19.01	19.37	7.38	7.50
Giza179	24.33	24.64	7.23	7.37
HER1	21.63	22.04	8.38	8.52
LSD at0.05	0.16	0.28	0.13	0.16
Interaction	**	**	**	**

The symbols of * and ** indicate the significant at 5% and 1% levels probability, respectively, while NS means not significant

Table 15. Effect of interaction between different salinity levels and rice varieties on flag leaf area, dry matter and chlorophyll content of some rice varieties in 2015 and 2016 seasons

Traits	1000- grain weight(g)			Grain yield(ton/ha)		
Salinity levels	2 dSm^{-1}	6 dSm^{-1}	10 dSm^{-1}	2 dSm^{-1}	6 dSm^{-1}	10 dSm^{-1}
Varieties			2015			
Giza177	28.2	24.27	23.53	9.44	3.47	1.09
Giza178	21.13	18.49	17.41	10.63	6.67	4.84
Giza179	25.23	23.96	23.79	10.90	6.48	4.32
EHR1	23.23	21.75	19.91	12.10	7.10	5.94
LSD at0.05		0.28			0.23	
			2016			
Giza177	28.52	24.67	23.81	9.63	3.67	1.24
Giza178	21.45	18.85	17.8	10.77	6.82	4.93
Giza179	25.59	24.27	24.08	11.06	6.63	4.42
EHR1	23.52	22.06	20.54	12.15	7.33	6.09
LSD at0.05		0.48			0.28	

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بعض مضادات الأكسدة والصفات الفسيومورفولوجيه ومحصول الحبوب لبعض أصناف الأرز المتأثرة بمستويات مختلفة من الملوحه

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أقيمت تجربتان حقليتان بمحطه بحوث السرو خلال موسمي ٢٠١٥ و٢٠١٦ وذلك بهدف دراسة تأثيرمستويات ملوحة مختلفة (٢و٦و١٠) على محتوى بعض العناصر الغذائية للنبات وبعض الصفات الفسيولوجية وايضامحصول الحبوب ومكوناته لبعض اصناف الأرز (جيزة ١٧٧وجيزه ١٧٨ وجيزة ١٧٩ وهجين مصري واحد) استخدم تصميم القطاعات الكامله العشوائية لكل معامله على حده وتم دراسه محتوى بعض العناصر الغذائية والصفات الفسيولوجية عند الطرد وكذلك محصول الحبوب ومكوناته عند الحصاد وكانت النتائج المتحصل عليها كالتالي : أدت زيادة مستويات الملوحة الىنقص محتوى البوتاسيوم في النبات وزياده الصوديوم ونسبه الصوديوم / للبوتاسيوم وخفض المادة الجافه للنبات والمحتوى المائي للورقة ونقص في صبغات البناء الضوئي وزياده نسبه الكلوروفيل (أالىب) وايضا مضادات الأكسدة (البروكسيديز،الكتاليز وايضا البرولين) ايضا ادت زياده مستويات الملوحةالىتقليلدلي لمساحه الاوراق ومحتوى الكلوروفيل(SPAD value) طول النبات،وزن السنبلة،طول السنبلة،عددالحبوب الممتلئة/ السنبلة،وزن الالف حبه ومحصول الحبوب. تفوق الصنف الهجين واحد مصري على باقي الاصناف الاخرى في معظم الصفات المدروسة وجيزة ١٧٩في المرتبة الثانية ثم جيزة ١٧٨ اما جيزة ١٧٧ اعطى اقلالقيمفي معظم الصفات المدروسة. ابدى الهجين تحت مستويين الملوحة ٦و١٠ديسمنز/سم تفوق علي باقي الاصناف الاخرى في كلاالموسمين.من خلال دراسهالصفات الفسيومورفولوجية والمحصول تحت مستويات مختلفة من الملوحة كان ترتيب الأصناف المختبرة من حيث تحملها للملوحة كالتالي هجين مصري واحد جيزه١٧٩ جيزة ١٧٨ وأتى جيزة ١٧٧ في المرتبة الأخيرة لكونه اكثر الاصناف حساسيه للملوحة. ولذلك توصى الدراسة بزراعه صنف الارز هجين مصري واحد تحت مستويات الملوحة المرتفعة.