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ROLE OF SOME GROWTH SUBSTANCES IN RELIEF HARMFUL OF SALINITY ON RICE CULTIVARS.

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ABSTRACT

Two field experiments were conducted during 2011 and 2012 summer seasons at El-Sirw Agricultural Research Station Farm, Dammietta Governorate, Egypt. The investigation was carried out to study the effects of gibberellic acid, kinetin and urea for increasing the tolerance of rice plants grown under saline conditions. Also, to find out the role of these substance for releifing the harmful of salinity on rice. Data showed that salinity stress in saline soil depressed greatly all the tested growth parameters as well as yield and its components of the three rice cultivars under study. Giza 177 affected more by salinity stress than Sakha101 and Giza 178. The application of growth substances GA_3, Kinetin, urea and their combinations could partially mitigate or relief the harmful effects of salinity stress on growth (plant height (cm), number of tillers/hill, crop growth rate (CGR g/day) and leaf area index (LAI) (cm^2)), yield and its components (number of tillers/hill, number of panicles/hill, panicle length (cm), panicle weight(g), percentage of unfilled grains/panicle, number of filled grains /panicle, weight of1000-grain (g)and grain yield(ton/fed) and some biochemical's traits (chlorophyll content, soluble sugars, proline content , nitrogen %, phosphorus%, potassium% and sodium content) of rice plant. The results revealed that gibberellic acid (GA_3) as combination with urea were the most effective treatment and Giza 178 was the tolerant cultivars and responded more to the growth substances.

Keywords: Gibberellic acid, kinetin, Urea, Salinity, Rice cultivars, Yield and its components

INTRODUCTION

Rice is one of the major field crops in Egypt. The area planted to rice is about 1,500,000 Fedden which is about 15% of Egypt's total cultivated area during the summer season according to Ministry of Agric., Egypt (20l0). The productivity of rice, such as any plant, is environmental conditions especially soil properties, water supply, fertilizers uses efficiency and others.

Salinity is considered a significant factor affecting crop productivity and agricultural sustainability in many regions of the world as it reduces the value and productivity of the affected land and rice.

The average of rice productivity of the salt affected area in Egypt is much lower that of normal soil which negatively affects the national yield average (El-Mowafi, 1994). In saline environments of Egypt, NaCl is usually the most injurious and predominant compound but there are other injurious ones, such as (Zayed *et al*., 2005) found that spraying urea in the concentration of 2% was effective in mitigating salinity harmful, resulted in improving rice salinity tolerance, enhancing rice growth and subsequently rice yield under saline soil.

Plant growth regulators (GA_3 & Kinetin) are widely applied to agricultural crops as a means of crop improvement. There is evidence that plant growth regulators increase stress resistance of plants. The role of these growth promoters in protecting plants from various stresses has been reported for several species (Li *et al*., 1998).

The aim of the present study was to relief the harmful of salinity on some rice cultivars by spraying growth substances would counteract the adverse effect of salinity on growth and yield as well as promote beneficial effects on some metabolic processes of rice plants.

MATERIALS AND METHODS

Two field experiments were conducted during the summer seasons of 2011 and 2012 at El-Sirw Agricultural Research Station Farm, Dammietta Governorate, Egypt. The mechanical and chemical soil analysis is presented in Table 1. The previous crop was clover in both seasons, respectively. Giza 177 salt sensitive variety, Giza 178 salt tolerant variety and Sakha 101 salt moderately-tolerant variety were used in this study. The experiment aimed to study the effects of gibberellins; kinetin, urea and their combinations applied as foliar spray on growth and yield under saline conditions. Gibberellic acid (GA_3), kinetin and urea were used as at the concentrations of 100 mg/l, 20 mg/l and 3 %, respectively. Tween-20 was used with sprayed substances as a wetting agent at 0.02% concentration, and the plants were sprayed twice;35 and 45 days after transplanting .The treatments were1) Water (control). 2) GA_3, 3) Kinetin, 4) GA_3 + kinetin, 5) Urea, 6) Urea + GA_3, 7) Urea + kinetin 8) Urea + GA_3 + kinetin. The experiments were laid out in split-plot design with four replications. The main plots were designated for rice cultivars, while, the sub- plots were devoted to growth substance and urea and their combinations.

Table 1: Soil mechanical and chemical analyses of the experimental site during 2011 and 2012 seasons.

Character	2011	2012
PH(1:2.5 soil water suspension)	8.10	8.00
EC_e (soil past extracted at 25C ds.m^{-1}	7.90	8.33
O.M. % (organic matter)	1.5	1.56
Available N, mg kg^{-1}	28	31
Available P, mg kg^{-1}	10	11
Available K, mg kg^{-1}	195	210
Soluble cations meq.l^{-1} (soil paste)	-	-
Ca^{++}	7.8	6.8
Mg^{++}	5.40	8.4
K^{+}	0.50	0.70
Na^{+}	70.0	69.0
Soluble anions meq.l-1 (soil paste)	-	-
CO3--	-	-
HCO3-	9.64	8.64
CL-	71.5	64.6
SO4--	6.33	5.33
Available micronutrients ppm	-	-
Fe++	5.23	5.95
Zn++	0.90	1.01
Mn++	4.50	4.50
Soil texture	Clay	Clay

Nitrogen and phosphorus at the rate of 165 kg N and 50 kg p_2o_4/ha in the form of urea and calcium super phosphate were applied, respectively, under saline soil. Thirty days old seedlings were transplanted at 15x15 cm spacing with four seedlings /hill. Each plot measured $16m^2$. The rest packages of recommendations under saline soil (Ec_e7.90 and 8.33 ds/m in the two studied seasons) were applied.

Studied characters:

At late booting plant sample from each sub plots was taken, washed and transfer to the laboratory and the following characters were estimated: - plant height, number of tillers/hill and number of panicle/hill ,crop growth rate (CGR g/day) and leaf area index (LAI) (cm^2)

Crop growth rate (CGR g/day) according to the formula of (Charles 1982).

$$CGR = \frac{W_2 - W_1}{T_2 - T_1}$$

- W_1 -Total weight of plant. * W_2- Total weight of plant
- T_1 - the first time T_1 * T_2 - the second Time T_2

Leaf area index 7- (LAI): it was calculated as follows: -

$$LAI = \frac{\text{Leaf area per plant } (cm^2)}{\text{Plant ground area } (cm^2)}$$

according to the formula of (Charles 1982).

Another plant sample in the same stage chemical constituent and elements were determined as follows:-

*Chlorophyll content (SPAD) was estimated at maximum tillering by chlorophyll meter (model SPAD=502) in each plot

*Total soluble sugars were determined by the method described by Sadasivam &Manickam, 1996).

*Proline content was calorimetrically determined by the method described by Troll and Lindsley (1955).

* Nitrogen content was estimated using Microkjeldahl method which modified by Jackson (1967).

*Phosphorus content was determined calorimetrically as the method described by Jackson (1967).

* Potassium and sodium content were measured using Atomic Absorption Spectrophotometer (AAS)

At harvesting time, four hills were identified and average plant height, number of tillers/hill and number of panicle/hill were estimated. Ten panicles were randomly separated and transfer to the laboratory and panicle length (cm), percentage of unfilled grains, number of filled grains /panicle, panicle weight (g)/plant, 1000 grains weight (g) were estimated.

Central five square meters in each sub plots were identified and harvested, threshed and the grain yield was recorded as kg/$5m^2$ and then computed and transferred to ton/Fed.

The average data in both seasons was subjected to the standard analysis of variance, according to the procedure of Gomez and Gomez (1986) using IRRISTAT Computer program. Differences among treatment means were compared using the Revised L S D at 5%.

RESULTS

1. Growth characters:

1.1. Plant height:

Data in Table 2 show that Giza 177 cultivar was affected more and gave the lowest plant (79.76 and 72.91) followed by Sakha 101 cultivar(80.77and 76.82), while Giza 178 cultivar gave the highest value of plant height(83.65 and 78.30) under the same conditions in 2011 and 2012 seasons, respectively.

The application of the growth substance and urea or its combinations significantly increased plant height of all the tested cultivars under salinity conditions as compared with control. Urea plus GA_3 came in the first rank and produce the greatest plant height(98.7and90.7) in both seasons, respectively followed by urea+ kinetin + GA_3,(95.3 and 75.0), while GA_3 alone came in the third rank followed by GA_3+ kinetin which came in the fourth rank and both urea or kinetin alone came in the rank number 5 and 6 respectively. The lowest value of plant height was obtained from control (65.3 and 64.1) in both seasons.

Table2: Plant height (cm) and number of tillers/ hill of some rice cultivars as affected by GA_3, kinetin, urea and their combinations under salinity conditions during 2011 and 2012 seasons.

Characters / Treatment	Plant height		Number of tillers/ hill	
	2011	2012	2011	2012
A .Varieties.				
Giza 177	79.76	72.91	21.81	20.84
Sakha 101	80.77	76.82	22.42	21.71
Giza 178	83.65	78.30	23.44	23.34
F.test	*	*	*	*
LSD at 5%	0.73	0.67	0.46	0.41
B. Growth substances				
Control	65.3	65.3	18.0	17.7
GA_3	84.7	84.7	23.3	22.0
Kinetin	69.3	68.7	20.6	20.0
GA_3+ Kinetin	72.0	71.0	23.3	23.0
Urea	80. 0	79.0	21.7	20.7
Urea+ GA_3	98.7	90.7	26.5	26.0
Urea+ Kinetin	93.3	73.7	22.7	22.3
Urea+kinetin+GA_3	95.3	75.0	24.4	24.0
F.test	*	*	*	*
LSD at 5%	0.93	0.87	0.6	0.4
C. Interaction A x B	*	*	*	*

The interaction between the two factors (rice cultivars and growth substances) had significant effect on plant height in both seasons Giza 178 cultivar produced the highest plant height when treated with urea plus GA_3 or as compared with the other two cultivars (Giza 177 and Sakha 101 cultivars) which gave nearly the same value of plant height under the same treatment (Table 3).

Table 3: The interaction between some rice cultivars and growth substances on plant height and number of tillers/ hill salinity condition during 2011 and 2012 seasons.

Characters	Plant height						Number of tillers/ hill					
	2011			2012			2011			2012		
Treatment	V_1	V_2	V_3	V_1	V_2	V_3	V_1	V_2	V_3	V_1	V_2	V_3
Control	65	63	68	63	63	70	11	11	12	16	12	13
GA_3	82	82	90	78	84	92	16	16	17	13	17	19
Kinetin	70	68	70	65	71	70	14	13	14	15	14	15
GA_3+ Kinetin	81	78	78	80	80	80	15	15	18	15	18	19
Urea	71	69	73	70	73	73	16	15	19	16	19	16
Urea + GA_3	90	101	95	92	101	103	20	19	19	16	19	22
Urea + Kinetin	72	73	76	76	76	73	15	16	17	19	17	17
Urea+GA_3+kinetin	88	93	91	89	96	95	16	16	18	16	18	19
LSD at 5%	1.9			1.7			1.3			1.2		

1.2. Number of tillers/hill:

Data in Table 2 show that Giza 177 cultivar was affected more and gave the lowest value of number of tillers/hill (21.81 and 20.84) followed by Sakha 101 cultivar(22.42and 21.71), while Giza 178 cultivar gave the highest value of tillers number/hill(23.44 and 23.34) in both seasons, respectively.

GA_3, kinetin, urea and their combinations caused an increase in tillers number of different rice cultivars. Urea plus GA_3 came in the first rank and produce the greatest tillers number (26.5and 26.0) followed by urea+ kinetin + GA_3 and GA_3 alone while GA_3+ kinetin came in the third rank followed by urea alone came in the fourth rank and kinetin alone came in the rank number 5, respectively. The lowest value of tillers number was obtained from control treatment (18.0 and 17.7) in 2011and 2012 seasons, respectively.

The interaction between rice cultivars and growth substances had significant effect on number of tillers/hill in both seasons of the present investigation Giza 178 cultivar gave the highest value of tillers number/hill when treated with urea plus GA_3 followed by Sakha 101 cultivar and Giza 177 cultivar (Table3).

1.3. Crop growth rate:

Data in Table 4 showed that Giza 177 cultivar was affected more and gave the lowest crop growth rate (0.83and 0.81) followed by Sakha 101 cultivar (0.98and 0.99), while Giza 178 cultivar gave the highest crop growth rate(1.24and 1.19) under salinity in 2011 and 2012 seasons, respectively.

GA_3, kinetin, urea and their combinations caused an increase in crop growth rate of different rice cultivars. The highest value of crop growth rate of the three rice cultivars in both seasons was obtained from urea + GA_3 treatment (1.17and 1.15), followed by urea alone (1.08and 1.04), while GA_3 alone which came in the third rank (1.07and 1.03) followed by both GA_3+ kinetin and urea GA_3+ kinetin which came in the fourth rank, while kinetin alone came in the fifth rank followed by urea + kinetin (0.96) in both seasons 2011and 2012, respectively. The lowest value of crop growth rate was obtained from control treatment (0.86and 0.85) in 2011and 2012 seasons.

Table4: Crop growth rate (g/hill/day) and Leaf area index (LAI cm) of some rice cultivars as affected by GA_3, kinetin, urea and their combinations under salinity conditions during 2011 and 2012 seasons.

Characters / Treatment	Crop growth rate		Leaf area index	
	2011	2012	2011	2012
A .Varieties.				
Giza 177	0.83	0.81	3,61	3.59
Sakha 101	0.98	0.99	3.78	3.75
Giza 178	1.24	1.19	3.93	3.81
F.test	*	*	*	*
LSD at 5%	0.01	0.01	0.20	0.10
B. Growth substances				
Control	0.86	0.85	3.45	3.44
GA_3	1.07	1.03	3.94	3.86
Kinetin	0.97	0.93	3.75	3.72
GA_3+ Kinetin	1.02	1.00	3.62	3.58
Urea	1.08	1.04	3.75	3.60
Urea+ GA_3	1.17	1.15	4.10	3.99
Urea+ Kinetin	0.96	0.96	3.74	3.71
Urea+kinetin+GA_3	1.02	1.01	3.87	3.86
F.test	*	*	*	*
LSD at 5%	0. 01	0.02	0.26	0.22
C. Interaction A x B	*	*	*	*

Table 5: The interaction between some rice cultivars and growth substances on crop growth rate and leaf area index under salinity condition during 2011 and 2012 seasons.

Characters	Crop growth rate						Leaf area index					
	2011			2012			2011			2012		
Treatment	V_1	V_2	V_3	V_1	V_2	V_3	V_1	V_2	V_3	V_1	V_2	V_3
Control	0.66	0.86	1.07	0.65	0.85	1.05	3.30	3.40	3.65	3.25	3.36	3.70
GA_3	0.90	1.07	1.24	0.87	1.03	1.19	4.00	3.90	3.69	3.96	3.85	4.00
Kinetin	0.75	0.94	1.22	0.70	0.93	1.17	3.70	3.70	3.80	3.66	3.78	3.80
GA_3+ Kinetin	0.82	1.02	1.23	0.80	1.00	1.19	3.40	3.60	3.85	3.35	3.50	3.90
Urea	0.75	0.95	1.18	0.74	0.96	1.18	3.80	3.60	3.85	3.36	3.55	3.90
Urea + GA_3	1.00	1.12	1.39	0.98	1.10	1.33	3.95	4.00	4.20	3.99	4.00	4.30
Urea + Kinetin	0.88	1.06	1.31	0.85	1.02	1.25	3.60	3.70	3.91	3.37	3.60	4.00
Urea+GA_3+kinetin	0.90	0.96	1.20	0.87	0.97	1.16	380	3.90	3.90	3.82	3.76	4.00
LSD at 5%	0.04			0.03			0.55			0.49		

For the interaction between rice cultivars and growth substances, significant effects were found for crop growth rate in both seasons Giza 178 cultivar produced the highest value of crop growth rate when treated with urea plus GA_3 or as compared with the other two cultivars (Giza 177 and Sakha 101 cultivars) which gave nearly the same value of crop growth rate under the same treatment (Table 5).

1.4. Leaf area index:

Data presented in Table 4 show the effect of growth substances i.e. GA_3, kinetin, urea and their combination on leaf area index of rice plant cultivars under salinity conditions.

Giza 177 cultivar was affected more and gave the lowest leaf area index (3.61 and 3.59) followed by Sakha 101 cultivar (3.78and 3.76), while Giza 178 cultivar produced the highest value of leaf area (3.93and 3.81) in both seasons, respectively.

Growth substances (GA3, kinetin, urea and their combinations) caused a slight increase in leaf area index. Urea combined with GA_3 was the most effective in this respect and produced the greatest leaf area index (4.10and 3.99) followed by GA_3, alone (3.94and 3.86), while urea+ GA_{3+} kinetin (3.87and 3.86) came in the third rank, the other growth substance treatments produced the lowest value in this respect. The lowest value of leaf area index was obtained from control treatment (3.45and 3.40) in both seasons, respectively.

Interaction between the rice cultivars and growth substances, affected leaf area index (LAI) in 2011 and 2012seasons Giza 178 cultivar produced the highest value of leaf area (3.91and 4.0) when treated with urea + GA_3 (Table 5).

2. Yield and its components:

2.1 Number of panicles /hill

Data in Table 6 showed that Giza 177 cultivar was affected more and gave the lowest number of panicle/hill (12.3 and 12.1) followed by Sakha 101 cultivar (13.8 and 13.0), while Giza 178 cultivar gave the highest value of number of panicles/hill (14.4and 14.1) in both seasons.

GA_3, kinetin, urea and their combinations caused an increase in number of panicles/hill of different rice cultivars. Urea plus GA_3 produced the greatest number of panicles/hill (16.40 and 16.0) followed by urea alone (15.0 and 14, 5), while urea+ GA_3+ kinetin came in the third rank (15.30and 15.00) followed by GA_3 alone came in the fourth rank and urea + kinetin came in the rank number 5 while kinetin alone and GA_3+ kinetin came in rank number 6 and 7, respectively in both seasons. The lowest value of number of panicles/hill was obtained from control treatment (9.50 and 8.70) in 2011and 2012 seasons.

The interaction between the tested cultivars and studied treatments had a significant effect in panicles/hill. Giza 178 and gave the highest panicles/hill and the testament urea plus GA_3 was the greatest in this respect (Table 7).

Table6: Number of panicle/ hill, panicle length (cm) and panicle weight (gm) of some rice cultivars as affected by GA_3, kinetin, urea and their combinations under salinity conditions during 2011 and 2012 seasons.

Characters	Number of panicle/ hill		Panicle length (cm)		Panicle weight (g)	
Treatments	2011	2012	2011	2012	2011	2012
A .Varieties.						
Giza 177	12.3	12.1	17.58	16.90	1.99	1.96
Sakha 101	13.8	13.0	21.19	20.80	2.15	2.12
Giza 178	14.4	14.1	21.90	21.50	2.71	2.67
F.test	*	*	*	*	NS	NS
LSD at 5%	0.5	0.4	0.87	0.85	0.92	0.88
B .Growth substances						
Control	9.52	8.70	19.20	18.93	2.00	1.95
GA_3	14.82	13.82	20.73	20.30	2.43	2.43
Kinetin	11.22	11.22	19.27	19.03	2.11	2.10
GA_3+ Kinetin	12.82	12.70	19.73	19.70	2.23	2.21
Urea	14.52	14.30	19.80	19.70	2.26	2.24
Urea+ GA_3	16.00	15.92	22.00	21.93	2.56	2.55
Urea+ Kinetin	15.00	14.80	20.70	19.63	2.21	2.20
Urea+kinetin+GA_3	14.70	13.84	20.36	20.03	2.45	2.33
F.test	*	*	*	*	NS	NS
LSD at 5%	0.60	0.40	1.09	1.06	0.7	0.7
C. Interaction A x B	*	*	*	*	NS	NS

2.2. Panicle length (cm):

Data in Table 6 indicated that Giza 178 cultivar gave the highest value of panicles length (21.90 and 21.50) followed by Sakha 101 cultivar (21.19 and 20.80), while Giza 177 cultivar was affected more and gave the lowest value of panicles length (17.58and 16.9) in 2011 and 2012 seasons, respectively.

Application of the growth substance or its combinations significantly increased panicle length of all the tested cultivars under salinity condition compared with control treatment. Urea plus GA_3 came in the first rank and produce the greatest panicle length (22.0 and 21.93) followed by GA_3 alone (20.73 and 20.70), while urea+ kinetin + GA3, came in the third rank (20.63and 20.60) followed by urea alone (20.36 and 20.25) which came in the fourth rank, while GA3+ kinetin and urea +kinetin came in the rank number 5 and 6 respectively. The lowest value of panicle length was obtained from control treatment (19.20 and 18.93) in 2011and 2012 seasons.

The interaction between the tested cultivars and studied treatments had a significant effect in panicle length. Giza 178 and Sakha 101 cultivars gave the highest panicle length, when treated with urea plus GA_3 and supposed Giza 177 cultivars (sensitive to salinity) under the same treatments (Table 7).

Table 7: The interaction between some rice cultivars and growth substances on number of panicle/ hill and Panicle length under salinity condition during 2011 and 2012 seasons.

Characters	Number of panicle/ hill						Panicle length					
	2011			2012			2011			2012		
Treatment	V_1	V_2	V_3	V_1	V_2	V_3	V_1	V_2	V_3	V_1	V_2	V_3
Control	8	9	9	8	9	10	16.5	19.9	21.2	16.3	19.5	21.0
GA_3	13	11	11	13	11	13	17.6	21.7	22.6	17.0	21.6	22.3
Kinetin	11	14	11	10	14	12	16.8	20.4	20.6	16.6	20.0	20.5
GA_3+ Kinetin	12	15	15	12	15	16	17.2	20.7	21.3	17.0	20.9	21.1
Urea	13	16	16	12	16	15	16.4	20.9	22.0	16.5	20.8	22.0
Urea + GA_3	16	16	16	16	16	16	18.6	22.3	22.1	18.0	22.0	22.0
Urea + Kinetin	12	14	14	13	14	15	17.1	20.2	21.6	17.0	20.1	21.5
Urea+GA_3+kinetin	13	15	15	13	15	16	17.1	21.8	22.2	17.0	21.5	21.6
LSD at 5%	1.3			1.2			2.4			2.1		

2.3 Panicle weight (g):

Data in Table 6 showed that Giza 178 cultivar gave the highest value of panicle weight (2.71 and 2.67) followed by Sakha 101 cultivar (2.15and 2.12), while Giza 177 cultivar was affected more and gave the lowest value of panicle weight (1.99 and 1.96) in 2011 and 2012 seasons, respectively.

Growth substances GA_3, kinetin, urea and their combinations increased panicle weight of rice cultivars in the both seasons.Moreover,urea+GA_3 treatment was the most effective in this respect it gave the highest value of panicle weight (2.58 and 2.55) followed by GA_3 alone (2.45 and 2.43), while urea+ kinetin + GA_3 (2.38 and 2.33) came in the third rank followed by urea alone (2.28and 2.24). The lowest value of panicle weight was obtained from control treatment (2.02 and 1.95) in 2011and 2012 seasons.

Interaction between the tested cultivars and the studied treatments had no significant effect in panicle weight.

2.4. Unfilled grains % / panicle:

Data in Table 8 show Giza 177 cultivar was affected more and gave the highest value of unfilled grain percentage per panicle(23.2% 23.8%) followed by Sakha 101 cultivar(17.4and 18.05%), while Giza 178 cultivar gave the lowest value of unfilled grain percentage per panicle (11.5% and 12.25%) in both seasons, respectively.

Growth substances, GA_3, kinetin, urea and their combinations caused decreased in unfilled grains of panicle of different rice cultivars. Urea plus GA_3 came in the first rank and produce the lowest unfilled grains of panicle(15.27and 15.90) followed by GA_3 alone(16.0and 16.70), while urea alone came in the third rank (16.43 and 17.06)followed by urea+ GA_3+ kinetin came in the fourth rank (17.06 and 17.53),while GA_3+ kinetin came in the rank number 5 followed by kinetin alone was less transactions (18.70 and 19.50) in 2011and 2012 seasons ,respectively. The highest value of unfilled grain percentage per panicle was obtained from control treatment (20.13 and 20.90) in 2011and 2012 seasons.

Table8: Unfilled grain%/ panicle and number of filled grain/ panicle of some rice cultivars as affected by GA_3, kinetin, urea and their combinations under salinity conditions during 2011 and 2012 seasons.

Characters / Treatment	Unfilled grain % / panicle		Number of filled grain/ panicle	
	2011	2012	2011	2012
A .Varieties.				
Giza 177	23.20	23.65	94.70	93.96
Sakha 101	17.40	18.05	104.80	103.40
Giza 178	11.50	12.25	111.30	109.60
F.test	*	*	*	*
LSD at 5%	1.45	1.42	5.89	5.44
B. Growth substances				
Control	20.14	20.90	94.63	93.25
GA_3	16.44	16.70	111.80	109. 95
Kinetin	18.71	19.50	95.40	94.65
GA_3+ Kinetin	18.13	18.43	101.70	100.78
Urea	16.02	17.06	102.97	100.85
Urea+ GA_3	15.28	15.90	119.20	118.12
Urea+ Kinetin	17.07	17.80	98.70	97.25
Urea+kinetin+GA_3	17.14	17.53	104.63	103.78
F.test	*	*	*	*
LSD at 5%	1.46	1.44	7.53	6.97
C. Interaction A x B	*	*	*	*

The interaction between tested cultivars and growth substances GA_3, kinetin, urea and their combinations on unfilled grains% /panicle had significant response in this respect Giza 178 cultivar gave the lowest value of unfilled grain percentage per panicle (11.5% and 12.25%) when treated with GA_3 alone in both seasons ,respectively (Table9).

Table 9:The interaction between some rice cultivars and growth substances on unfilled grain % / panicle and number of filled grain/ panicle under salinity condition during 2011 and 2012 seasons.

Characters	Unfilled grain % / panicle						Number of filled grain/ panicle					
	2011			2012			2011			2012		
Treatment	V_1	V_2	V_3	V_1	V_2	V_3	V_1	V_2	V_3	V_1	V_2	V_3
Control	27.8	19.6	13.0	28.3	11.8	12.5	83.60	95.00	105.3	83.00	93.00	104.0
GA_3	21.3	14.7	9.8	22.0	15.5	10.2	102.0	116.3	117.0	100.0	115.0	115.0
Kinetin	22.0	20.8	13.2	22.7	22.1	13.7	85.60	95.30	105.3	85.00	94.00	105.0
GA_3+ Kinetin	25.0	17.4	12.0	25.4	17.9	12.0	92.30	101.3	111.7	91.00	101.0	110.5
Urea	22.9	17.3	11.0	23.9	17.7	11.8	96.60	104.0	108.3	95.70	102.0	105.0
Urea + GA_3	22.5	15.8	11.0	22.8	16.1	15.3	88.30	99.70	108.0	88.00	99.00	105.0
Urea + Kinetin	22.1	15.5	10.4	22.5	16.1	11.4	110.3	122.3	125.0	110.0	121.0	122.0
Urea+GA_3+kinetin	21.9	17.8	11.7	22.4	18.2	12.0	99.00	104.6	110.3	99.00	102.5	110.0
LSD at 5%	6.80			6.50			5.67			5.11		

2.5.Number of filled grains /panicle:

Data in table 8 indicated that Giza 177 cultivar was affected more and gave the lowest filled grains / panicle(94.70 and93.96) followed by Sakha 101 cultivar (104.80 and 103.40), while Giza 178 cultivar gave the highest value of filled grains /panicle (111.30 and 109.60) in 2011and 2012 seasons, respectively.

Growth substances caused an increase in Filled grains /panicle of different rice cultivars. Urea plus GA_3 came in the first rank and produce the greatest Filled grains of panicle (119.20 and 118.17) followed by GA_3 alone (111.80 and 110.0), while urea+ kinetin + GA_3 came in the third rank (104.63 and 103.83) followed by urea alone (102.97 and 100.90) which came in the fourth rank, while GA_3+ kinetin and urea +kinetin came in the rank number 5and 6, respectively in 2011and 2012 seasons. The lowest value of filled grains / panicle was obtained from control treatment (94.63 and 93.30) in both seasons.

The interaction between tested cultivars and growth substances GA_3, kinetin, urea and their combinations had significant response in filled grains / panicle Giza 178 cultivar gave the highest value of filled grains /panicle (125 and 122) in 2011and 2012 seasons, respectively when treated with urea plus GA_3 (Table9).

2.6- Weight of 1000- grain(g) :

Data in Table 10 indicated that Sakha 101 cultivar gave the highest 1000-grain weight (23.86 and 23.60) followed by Giza 178 cultivar (22.50 and 22.26) , while Giza 177 cultivar was affected more and gave the lowest value of 1000-grain weight (17.24 and 17.10) in both seasons, respectively.

Application of the growth substance or its combinations significantly increased 1000-grain weight of all the tested cultivars under salinity condition compared with control. Urea plus GA3 came in the first rank and produce the greatest 1000-grain weight(23.47 and 22.90) followed by GA3 alone(22.20 and 22.17), while urea+ kinetin + GA_3, came in the third rank(22.07 and 21.77)followed by urea alone came in the fourth rank(21.43 and 20.83),while urea + kinetin came in the fifth rank(20.73 and 20.70) followed by kinetin alone and GA_3 + kinetin came in the rank number 6 and 7, respectively in 2011 and 2012 seasons. The lowest value of 1000-grain weight was obtained from control treatment (19.60 and 19.43) in both seasons, respectively.

The interaction between tested cultivars and growth substances GA_3, kinetin, urea and their combinations had significant response in this respect. Sakha 101 cultivar gave the highest 1000-grain weight when received urea plus GA3 followed by Giza 178, while Giza 177 cultivar produce the least (Table11).

Table10: 1000-grain weight (g) and grain yield (ton/fed) of some rice cultivars as affected by GA_3, kinetin, urea and their combinations under salinity conditions during 2011 and 2012 seasons.

Characters / Treatment	1000-grain weight (g)		Grain yield Ton/fed	
	2011	2012	2011	2012
A .Varieties.				
Giza 177	17.24	17.10	3.08	3.05
Sakha 101	23.86	23.60	3.12	3.12
Giza 178	22.50	22.26	3.51	3.41
F.test	*	*	*	*
LSD at 5%	0.37	0.31	0.02	0.02
B. Growth substances				
Control	19.60	19.43	2.92	2.86
GA_3	22.20	22.17	3.46	3.41
Kinetin	20.30	20.27	3.19	3.16
GA_3+ Kinetin	19.77	19.70	3.00	2.95
Urea	20.73	20.70	3.08	3.01
Urea+ GA_3	23.47	22.90	3.62	3.57
Urea+ Kinetin	21.43	20.83	3.38	3.33
Urea+kinetin+GA_3	22.07	21.77	3.28	3.21
F.test	*	*	*	*
LSD at 5%	0.48	0.44	0.023	0.020
C. Interaction A x B	*	*	*	*

Table 11: The interaction between some rice cultivars and growth substances on 1000-grain weight and grain yield under salinity condition during 2011 and 2012 seasons

Characters	1000-grain weight						Grain yield					
	2011			2012			2011			2012		
Treatment	V_1	V_2	V_3	V_1	V_2	V_3	V_1	V_2	V_3	V_1	V_2	V_3
Control	15.5	22.3	21.0	15.3	22.0	21.0	2.87	2.96	3.16	2.85	2.90	3.15
GA_3	17.5	24.2	22.6	17.0	23.5	22.0	3.18	3.15	3.45	3.15	3.20	3.40
Kinetin	17.5	25.2	23.9	18.0	25.0	23.5	3.25	3.22	3.87	3.20	3.25	3.85
GA_3+ Kinetin	15.7	22.5	21.1	16.0	22.0	21.0	2.91	3.01	3.25	2.90	3.00	3.23
Urea	16.5	23.3	22.4	17.0	23.0	22.0	3.05	3.12	3.32	3.00	3.15	3.30
Urea + GA_3	19.7	26.2	24.5	19.0	25.6	24.1	3.32	3.32	3.96	3.30	3.30	3.90
Urea + Kinetin	16.1	23.0	21.7	16.0	23.5	21.5	2.95	3.05	3.28	2.91	3.03	3.25
Urea+GA_3+kinetin	18.5	24.5	23.2	18.2	24.1	23.0	3.11	3.12	3.82	3.09	3.10	3.76
LSD at 5%	0.95			0.91			0.065			0.061		

2.6- Grain yield (ton/fed):

Data in table 10 cleared that Giza 177 cultivar was affected more and gave the lowest value of grain yield (3.08 and 3.05) followed by Sakha 101 cultivar (3.12and 3.12), while Giza 178 cultivar gave the greatest grain yield (3.51 and 3.41) in 2011 and 2012 seasons, respectively.

Rice cultivars under study treated with growth substances namely GA_3, kinetin, urea and their combination caused an increase in grain yield. Urea combined with GA_3 was the most effective in this respect came in the first rank and produce the greatest grain yield (3.69 and 3.66) followed by GA_3 alone (3.53 and 3.50), while urea+ GA_{3+} kinetin (3.45 and 3.42) came in the third rank followed by urea alone(3.35 and 3.25) which came in the fourth rank

as well as urea + kinetin that came in the rank number 5(3.26 and 3.25) and kinetin alone came in the sixth rank followed by GA_3+ kinetin in the rank number 7(19.77and 19.70) in 2011 and 2012 seasons. The lowest value of grain yield was obtained from control treatment (19.60 and 19.43) in both seasons, respectively.

In addition, the interaction treatments between of growth substances under study and the tested rice cultivars had significant effect in grain yield. Giza 178 cultivar produced the highest grain yield when treated with urea plus GA_3 or as compared with the other two cultivars (Giza 177 and Sakha 101 cultivars) which gave nearly the same value of grain yield under the same treatment. (Table11).

3. Biochemical constituents:

3.1. Chlorophyll content (SPAD):

Data in Table12 showed that Giza 177 cultivar was affected more and gave the lowest value of chlorophyll content (36.50 and 36.40) followed by Sakha 101 cultivar (36.80 and 36.70) while Giza 178 cultivar gave the highest value of chlorophyll content (37.20 and 37.10) in the two seasons.

GA_3, kinetin, urea and their combination caused an increase in chlorophyll content of different rice cultivars. Urea plus GA_3 produced the greatest chlorophyll content (37.30 and 37.07) followed by GA_3 alone (37.00 and 36.97) and urea+ GA_3+ kinetin (37.00 and36.87) as well as urea alone (36.87 and 36.80) and urea+ kinetin (36.83 and 36.66) in 2011 and 2012 seasons, respectively. The lowest value of chlorophyll content was obtained from control treatment (36.30 and 36.00) in both seasons.

Table12: Chlorophyll content (SPAD), Soluble sugar content (mg/g) and proline content (mg/g) of some rice cultivars as affected by GA_3, kinetin, urea and their combinations under salinity conditions.

Characters / Treatments	Chlorophyll content		Soluble sugar content		Proline content	
	2011	2012	2011	2012	2011	2012
A .Varieties						
Giza 177	36.50	36.40	0.60	0.57	1.20	1.15
Sakha 101	36.80	36.70	0.72	0.70	1.13	1.12
Giza 178	37.20	37.10	0.83	0.81	0.93	0.92
F.test	*	*	NS	NS	*	*
LSD at 5%	0.04	0.03	0.4	0.3	0.03	0.01
B .Growth substances						
Control	36.30	36.40	0.64	0.61	0.86	0.95
GA_3	37.00	36.97	0.78	0.73	1.08	1.11
Kinetin	36.70	36.57	0.73	0.68	0.98	1.05
GA_3+ Kinetin	36.52	36.53	0.65	0.63	0.88	0.98
Urea	36.85	36.80	0.70	0.67	1.00	1.10
Urea+ GA_3	37.30	37.07	0.82	0.78	1.15	1.24
Urea+ Kinetin	36.81	36.66	0.68	0.67	0.89	1.03
Urea+kinetin+GA_3	37.00	36.87	0.75	0.73	0.92	1.03
F.test	*	*	NS	NS	*	*
LSD at 5%	0.059	0.055	0.48	0.42	0.04	0.02
C. Interaction A x B	*	*	NS	NS	*	*

The interaction between growth substances and studied cultivars had a significant effect in chlorophyll content. Giza 178 cultivar produced the highest value when received urea plus GA_3 followed by Sakha 101 cultivar, while Giza 177 cultivar gave the lowest value of chlorophyll content under the same treatments (Table13).

Table 13: The interaction between some rice cultivars and growth substances on chlorophyll content and proline content under salinity condition during 2011 and 2012 seasons

Characters	Chlorophyll content						Proline content					
	2011			2012			2011			2012		
Treatment	V_1	V_2	V_3	V_1	V_2	V_3	V_1	V_2	V_3	V_1	V_2	V_3
Control	36.0	36.2	36.8	36.1	36.3	36.7	1.10	1.03	0.80	1.04	1.00	0.81
GA_3	36.8	37.0	37.4	36.6	37.1	37.1	1.20	1.20	0.90	1.13	1.17	0.85
Kinetin	36.4	36.7	37.1	36.2	36.6	36.9	1.30	1.20	1.10	1.19	1.15	1.00
GA_3+ Kinetin	36.2	36.5	36.9	36.3	36.6	36.7	1.10	1.05	0.85	1.07	1.03	0.84
Urea	36.6	36.8	37.2	36.5	36.9	37.0	1.15	1.10	0.90	1.09	1.12	0.88
Urea + GA_3	36.6	37.4	37.7	36.4	37.2	37.6	1.40	1.30	1.10	1.36	1.25	1.12
Urea + Kinetin	36.6	36.6	37.3	36.3	36.5	37.2	1.10	1.05	0.85	1.10	1.11	0.89
Urea+GA_3+kinetin	36.7	36.9	37.4	36.6	36.7	37.3	1.25	1.15	0.95	1.20	1.11	0.99
LSD at 5%	0.21			0.19								

3.2-Soluble sugars content (mg/g):

Data in Table 12 showed that Giza 178 cultivar reached to the maximum value of the soluble sugar (0.83 and 0.81) followed by Sakha 101 cultivar (0.72 and 0.70), while Giza 177 cultivar produced the lowest value in this respect (0.60 and 0.57) under the same treatments.

Urea+GA_3 treatment was the most effective treatment in this respect (0.82 and 0.78) followed by GA_3 alone (0.78 and0.73) and urea+ GA_3+ kinetin came in the third rank (0.75 and 0.73) followed by kinetin alone (0.73 and 0.68) which came in the fourth rank and urea alone (0.70 and 0.67) came in the fifth rank, while urea +kinetin and GA_3 + kinetin came in the rank number6 and7, respectively in both seasons2011 and 2012. The lowest value of soluble sugar content was obtained from control treatment (0.64 and 0.61) in both seasons.

In addition, the interaction between growth substances and the tested cultivars had a significant effect in soluble sugars content Giza 178 cultivar produced the highest value when received urea plus GA_3 followed by Sakha 101 cultivar, while Giza 177 cultivar gave the lowest value of soluble sugars content under the same treatments (Table13).

3.4. Proline content (mg/g):

Data in Table 12 cleared that Giza 177 cultivar produced the highest value of proline content (1.20 and 1.15) followed by Sakha 101 cultivar (1.13 and 1.12) , while Giza 178 cultivar gave the lowest value (0.93 and 0.92) under the same treatments.

Growth substances caused an increase in proline content of the tested rice cultivars. Urea plus GA_3 produced the greatest proline content (1.27

and 1.24) followed by GA_3 alone (1.20 and 1.12), while urea alone (1.12 1.10) came in the third rank followed by urea + GA_3+ kinetin (1.05 and 1.03), while urea plus kinetin (1.03 and 1.01) came in the fifth rank but urea + kinetin or GA_3+ kinetin came in the rank 6 and 7, respectively in both seasons. The lowest value of proline content was obtained from control treatment (0.98 and 0.95) in 2011and 2012 seasons.

The interaction between growth substances and the tested cultivars had a significant effect in proline content. Giza 177 cultivar produced the highest value of proline content when treated with urea plus GA_3 or GA_3 alone followed by Sakha 101 cultivar, while Giza 178 cultivar gave the lowest value under the same treatments(Table13).

3.5. Nutrient contents:

3.5.1- Nitrogen%:

Data in Table 14 show that Giza 177 cultivar produced more nitrogen% than both Sakha 101 and Giza 178 rice cultivars(2.57 and 2.30) followed by Sakha 101 (2.32 and 2.29) , while Giza 178 rice cultivars gave the lowest value (2.22 and 2.16) under the same treatments in 2011 and 2012 seasons . The lowest value of nitrogen% was obtained from control treatment (2.19 and 2.15) in two seasons.

The tested cultivars with growth substances i.e. GA_3, kinetin, urea and their combinations showed an increase in nitrogen%. Urea combined with GA_3 was the most effective in this respect (2.64 and 2.48) and came in the first rank followed by urea alone(2.53 and 2.38) which cam in the second rank and urea+ GA_{3+} kinetin in the third rank (2.43 and 2.28) followed by GA_3 alone which came in the fourth rank (2.33 and 2.21),while GA_{3+} kinetin , urea+ kinetin and kinetin alone came in rank number 5,6 and 7, respectively in both seasons.

Table14: Percent of nitrogen and phosphorus of some rice cultivars as affected by GA_3, kinetin, urea and their combinations under salinity conditions.

Characters / Treatment	Nitrogen%		Phosphorus%	
	2011	2012	2011	2012
A .Varieties.				
Giza 177	2.57	2.30	0.321	0.315
Sakha 101	2.32	2.29	0.319	0.310
Giza 178	2.22	2.16	0.278	0.272
F.test	*	*	*	*
LSD at 5%	0.007	0.006	0.002	0.001
B. Growth substances				
Control	2.20	2.16	0.287	0.279
GA_3	2.34	2.21	0.300	0.293
Kinetin	2.22	2.18	0.298	0.290
GA_3+ Kinetin	2.31	2.21	0.306	0.299
Urea	2.54	2.39	0.316	0.308
Urea+ GA_3	2.65	2.49	0.330	0.324
Urea+ Kinetin	2.27	2.20	0.303	0.294
Urea+kinetin+GA_3	2.44	2.29	0.310	0.303
F.test	*	*	*	*
LSD at 5%	0.012	0.011	0.003	0.003
C. Interaction A x B	*	*	*	*

The interaction between growth substances and the tested cultivars had a significant effect in nitrogen%, Giza 177 cultivar gave the highest nitrogen% when treated with urea + GA_3 followed by Sakha 101 cultivar, while Giza 178 rice cultivars gave the lowest value under the same treatments (Table15).

Table 15: The interaction between some rice cultivars and growth substances on chlorophyll content and proline content under salinity condition during 2011 and 2012 seasons

Characters	Nitrogen%						Phosphorus%					
	2011			2012			2011			2012		
Treatment	V_1	V_2	V_3	V_1	V_2	V_3	V_1	V_2	V_3	V_1	V_2	V_3
Control	2.42	2.22	2.08	2.12	2.20	2.03	0.308	0.299	0.287	0.302	0.254	0.249
GA_3	2.55	2.28	2.15	2.24	2.25	2.10	0.311	0.315	0.306	0.303	0.268	0.260
Kinetin	2.28	2.25	2.11	2.16	2.21	2.04	0.317	0.309	0.300	0.311	0.274	0.268
GA_3+ Kinetin	2.42	2.29	2.18	2.21	2.26	2.13	0.321	0.321	0.311	0.316	0.275	0.270
Urea	2.75	2.29	2.26	2.35	2.27	2.21	0.329	0.325	0.316	0.321	0.295	0.288
Urea + GA_3	2.96	2.50	2.45	2.57	2.47	2.39	0.344	0.341	0.333	0.338	0.305	0.300
Urea + Kinetin	2.34	2.31	2.14	2.19	2.29	2.07	0.314	0.324	0.315	0.306	0.271	0.262
Urea+GA_3+kinetin	2.82	2.40	2.37	2.46	2.36	2.31	0.325	0.319	0.310	0.320	0.285	0.279
LSD at 5%	0.04			0.04			0.013			0.010		

3.5.2- Phosphorus%:

Date in table 8 showed that Giza 177 cultivar gave the highest phosphorus percent (0.321 and 0.315) followed by Sakha 101 cultivar (0.319 and 0.310), while Giza 178 cultivar gave the lowest value of phosphorus percent (0.278 and 0.272) in 2011 and 2012 seasons.

Growth substances caused an increase in this respect. The highest value of phosphorus % was obtained from urea plus GA_3 treatment (0.330 and 0.324) followed by urea alone (0.316 and 0.308), while the lowest value was obtained from (0.298 and 0.290) and the other values of P% were in between in 2011 and 2012 seasons. The lowest value of phosphorus percent was obtained from control treatment (0.279 and 0.278) in two seasons

The interaction growth substances and cultivars under study had a significant effect in p% Giza 177 cultivar gave the highest p % when received urea plus GA_3 followed by Sakha 101 cultivar , while Giza 178 cultivar produced the least under the same treatments(Table15).

3.5.3. Potassium (K)%:

Date in Table 16 showed that Giza 177 cultivar gave the highest value of K %(0.637 and 0.591) followed by Sakha 101 cultivar (0.579 and 0.574), while Giza 178 cultivar gave the lowest value of K %(0.568 and 0.561) in 2011 and 2012 seasons

Growth substances i.e. GA_3, kinetin, urea and their combinations increased K% compared with control. In addition, GA_3, kinetin, urea and their combinations caused an increase in this respect. The highest value of K % was obtained from urea plus GA_3 treatment (0.705 and 0.662) followed by urea

alone (0.603 and 0.580), while the lowest value was obtained from urea+ Kinetin (0.565 and0.538). The other values of K% were in between in 2011 and 2012 seasons. The lowest value of K % was obtained from control treatment (0.544 and 0.503) in two seasons.

The interaction between growth substances and cultivars under study had a significant effect in K% Giza 177 cultivar gave the highest K % when received urea plus GA_3 or urea alone followed by Sakha 101 cultivar , while Giza 178 cultivar produced the least under the same treatments(Table17).

Table16: Percent of Potassium (ppm) and sodium content of some rice cultivars as affected by GA_3, kinetin, urea and their combinations under salinity conditions.

Characters / Treatment	Potassium %		Sodium content	
	2011	2012	2011	2012
A .Varieties.				
Giza 177	0.637	0.591	5.70	5.74
Sakha 101	0.579	0.574	5.71	5.65
Giza 178	0.568	0.561	5.99	5.92
F.test	*	*	*	*
LSD at 5%	0.003	0.001	0.01	0.01
B. Growth substances				
Control	0.544	0.502	6.04	6.03
GA_3	0.584	0.557	5.73	5.72
Kinetin	0.566	0.562	5.95	5.94
GA_3+ Kinetin	0.577	0.552	5.79	5.75
Urea	0.603	0.582	5.72	5.69
Urea+ GA_3	0.705	0.664	5.51	5.49
Urea+ Kinetin	0.565	0.540	5.88	5.85
Urea+kinetin+GA_3	0.597	0.459	5.73	5.70
F.test	*	*	*	*
LSD at 5%	0.005	0.003	0.01	0.01
C. Interaction A x B	*	*	*	*

Table 17: The interaction between some rice cultivars and growth substances on Potassium % and Sodium content under salinity condition during 2011 and 2012 seasons

Characters	Potassium %						Sodium content					
	2011			2012			2011			2012		
Treatment	V_1	V_2	V_3	V_1	V_2	V_3	V_1	V_2	V_3	V_1	V_2	V_3
Control	0.567	0.559	0.507	0.530	0.520	0.460	5.88	5.91	6.34	5.95	5.86	6.27
GA_3	0.570	0.560	0.623	0.550	0.545	0.570	5.58	5.84	5.76	5.66	5.79	5.70
Kinetin	0.607	0.567	0.523	0.580	0.540	0.460	5.83	5.76	6.25	5.90	5.70	6.21
GA_3+ Kinetin	0.613	0.570	0.547	0.583	0.541	0.527	5.76	5.57	6.04	5.80	5.51	5.95
Urea	0.667	0.575	0.567	0.637	0.560	0.543	5.67	5.60	5.88	5.71	5.55	5.81
Urea + GA_3	0.747	0.650	0.717	0.683	0.642	0.660	5.73	5.77	6.15	5.77	5.70	6.08
Urea + Kinetin	0.590	0.575	0.530	0.570	0.560	0.483	5.43	5.46	5.63	5.50	5.40	5.57
Urea+GA_3+kinetin	0.637	0.573	0.580	0.617	0.555	0.550	5.62	5.73	5.84	5.66	5.66	5.77
LSD at 5%	0.03			0.02			0.024			0.021		

3.5.4 Sodium content (Na):

Data in Table 16 indicated that Giza 178 cultivar gave the highest value of Na content (5.99 and 5.92) followed by Sakha 101 cultivar (5.74 and 5.70) , while Giza 177 cultivar gave the lowest value Na accumulation in shoots (5,70 and 5.65) in both seasons. The highest value of Na content was obtained from control treatment (6.04 and 6.03) in two seasons.

The application of the growth substance or their combinations significantly decrease effect in Na accumulation in shoots of rice cultivars under salinity condition compared with control. Urea plus GA_3 came in the first rank in this respect (5.51 and 5.49) followed by urea+ kinetin + GA_3 (5.72 and 5.70), while urea alone (5.73 and 5.71) came in the third rank, while the highest value Na accumulation was obtained from Kinetin (5.95 and 5.94). The other values of Na accumulation were in between in 2011 and 2012 seasons.
The interaction growth substances and cultivars under study had a significant effect in Na accumulation (Table17).

GENERAL DISSUSSION

1. Effect of salinity stress on growth:

Data obtained from the two experiments in these hypotheses showed that growth of rice cultivars was greatly inhibited by salinity stress. The high salinity was more effective in increasing the harmful effect in growth or rice cultivars under study.

Moreover, the harmful effect of salinity stress on sensitive cultivar was more than on tolerant or moderately tolerance of rice cultivars.
The inhibitory effect of salinity on growth of rice plant may be due to decrease in water absorption, metabolic processes, merestematic activity and/or cell enlargement (Khadr *et al*., 1994). Moreover, the decrease in growth due to salinity may be attributed to an increase in respiration rate resulting from higher energy requirements**.**

The reduction in plant growth under salinization may be also due to regulation between the endogenous phytohormones present in the plants, Ozdemir *et al.* (2004).

A decrease in either leaf number and leaf area, and/or a decrease in CO_2 uptake in leaves (Fedina and Popova, 1996) mainly because NaCl treatment, decrease stomatal conductance and consequently less CO_2 is available for carboxylation reaction in the photosynthesis apparatus, which lead to reduction of photosynthetic capacity resulting less net assimilation and relative growth rates (Saied *et al*.,2005).

1.1. Role of growth substances in counteracting the harmful effect of salinity stress on growth:

Sakr (1996) found that the growth substance i.e. GA_3 and kinetin partially counteracted the harmful effect of salinity on growth of wheat plant shoots and roots as well as leaf photosynthetic pigments. Such phytohormones has been shown to be beneficial to growth of some crop species grown under saline conditions by increasing nutrients through increased physiological activities and root proliferation

In this connection, Sakr *et al*. (2004) found that the concentration of organic acids and carbohydrate components may play an important role for adaptation of different plant species. The treatment with GA_3 appeared to nullify the accumulation of Na^+ ions and at the same time to increase the organic ion content.

1.2. Role of urea in counteracting the harmful effect of salinity stress on growth:

The current findings showed the enhancing effect of urea on rice growth under salinity stress levels.

Kaya & Higgs (2003) found that increasing the concentration of foliar applied of urea for rice grown under saline stress condition increased plant growth and yield.

2. Yield and its components:

2.1Effect of salinity stress on yield and its components:

Salinity affects all stages of growth and development, as well as yield of rice plant. grain yield is much more depressed by salt than vegetative growth. The reduction in seed yield is largely due to a decrease in seed set in the fruit, which may be attributed to a decrease in the viability of pollen or in the receptivity of the stigmatic surface or both, Sakr et al. (2004).

Salinity induces changes on floral characteristics of rice i.e. panicle length, number of primary and secondary branches of panicles were also affected.The yield components like filled grains/panicle, un-filled grains/panicle, total grains/panicle; total grain weight/panicle and 1000 grain weight were also recorded at maturity Zaibunnisa *et al*. (2002).

2.2. Role of phytohormones on counteraction the harmful effect of salinity stress on yield and its components:

It could be mentioned that application of any plant growth substance helps plants to counteract the harmful effect of moderate and high sodium chloride salinity levels on plant growth and yield. Hypotheses for the mechanisms by which chemical used in this work can alleviate the harmful effect of salinity on plant growth and yield can be grouped into one or more general categories, each having several possible variation (Ozdemir et al., 2004).

Application of plant growth substances led to accumulation of non-toxic solutes as proline**,** soluble sugars**,** potassium in whole plant. Such accumulation provides the turgor necessary for cell division and expansion resulting in increasing length of shoot, leaves area per plant as well as dry weight. that, the merestematic tissues have a high levels of transcript encoding vascular cambium constituent with the abundance of soluble proline (Ozdemir et al.,2004). Proline biosynthesis may be important in stimulating nucleotide biosynthesis needed for rapid proliferation and differentiation of plant cell**.**

Plant growth substances counteracting the deleterious effects of salinity on plant growth and yield by increasing succulence in plant due to the increase in cell number and elongation, tends to dilute the internal ionic concentration Ismail (2003).

2.3. Role of urea in counteracting the harmful effect of salinity stress on yield and its components:

This investigation shows the enhancing effect of urea on rice growth under salinity stress levels.

Fertilization of rice plant through application of urea is important to minimize the hazardous effect of salinity on growth and yield. Marschner (1995) suggested that increased nitrogen fertilization may overcome some of the inhibitory effects of salinity and the foliar urea is one of the N application methods in cereal grain crops grown under salinity stress. Also added that urea could improve the variables affected by high salinity (plant growth, yield, membrane permeability) and can correct N deficiency.

3. Biochemical composition:

3.1 Chlorophyll contents:

3.1.1. Effect of salinity on Chlorophyll contents:

A photosynthetic pigments in the leaves was significantly reduced by increasing salinity levels. This reduction may be related to enhance the activity of chlorophyll degrading enzyme chlorophyllase (Mishra and Sharma 1994) found that increasing saline levels resulted in disruption of the fine structure of chloroplast and instability of chlorophyll or pigment-protein complex, which leads to oxidation of chlorophyll and decreases its concentration.

3.1.2. Role of growth substances on counteracting the harmful effect of salinity stress on Chlorophyll contents:

It is noticed that growth substances kinetin, GA_3 and urea partially counteracted the inhibitory effect of salinity stress on photosynthetic pigment accumulation in green shoot of wheat (Sakr et al., 2004). The reduction effect of high salinity levels may be due to the inhibitory effect of chloride on the activity of Fe-containing enzymes, cytochrome oxidase which in turn may reduce the accumulation of photosynthetic pigments (Sakr ,1996). Growth substances used (GA_3 & kinetin) partially enhanced pigment production and alleviated the inhibitory effect of chloride under salinity stress.

3.2. Sugar contents:

3.3.1. Effect of salinity stress on sugar contents:

The accumulation of non reducing sugars was the result of an enhanced efficiency in the use of co_2 to a reduction in cellular metabolism that could favor the accumulation of respiratory substrate to support the osmotic adjustment required to survive in saline media (Schnapp *et al*., 1990).

3.3. Proline content:

3.3.1. Effect of salinity stress on proline accumulation in rice plant:

Proline has been considered as a carbon and nitrogen source for rapid recovery from stress r (Ozdemir *et al.,* 2004).

Accumulation of proline content was recorded in the roots of rice seedlings treated with different concentrations of NaCl and $CaCl_2$ which suggested osmoprotection to rice seedlings (Khan and Panda, 2002).

3.3.2 - Role of growth substances and urea on proline content:

The application of nitrogen (urea) or growth substances reduced relatively the accumulation of amino acids, a result that indicate that urea

fertilization for rice plant to counteract the damage effect caused by the excess of salt stress. *El-Sayed A. M. K.,*(2006)

3.4. Effect of salinity stress on Na^+, , K^+, , P^+ and N contents:

3.4.1 Effect of salinity stress on Na^+ and K^+ contents:

In a saline environment, plants take up excessive amount of Na^+ and Cl^- as in halophytes, resulting in high Na^+/Ca^{2+} and Na^+/k^+ ratios which may impair the selectivity of the root membrane (Khan and Panda, 2002).

3.4.2. Role of growth substances on Na^+ and K+ contents under salinity stress:

Application of growth substances GA_3 & kinetin help plants that limit of toxic ion as sodium (Na) and chloride (Cl) and protect plant enzymes and cell compartimentation against the deleterious effect of high salinity stress. In addition, compatible solutes protect cell membranes against destabilizing. Moreover, used growth substances increased the succulence of leaves and caused greater increase in leaf thickness, which dilute salinity and increase salt tolerance (Sakr et al., 2004)

3.4.3. Role of urea on Na^+, , K+, P^+ and N contents under salinity stress:

Urea application depressed the uptake of Na by rice plant under salinity condition. In this respect Greenway and Munns (1980) found that competition between Na and K. High K/Na in the phloem could be due to selectivity of K over Na uptake.

3.4.4 Effect of salinity stress on phosphorus, nitrogen and potassium contents:

Saline conditions can influence the different steps of nitrogen metabolism, The reduction in nitrogen under saline conditions may be due to reduction in water absorbed and the decrease in root permeability. (Sakr *et al*., 2004)

Greenway and Munns (1980) attributed the reduction in P concentration and its uptake by plants under saline conditions to a decrease in the translocation of P upward through the stem because of the increase in the osmotic pressure of the root medium, and suggested that high Ca concentration in the saline solution would probably cause P precipitation and consequently reduces P availability to the plants (Sakr et al., 2004).

3.4.5 Role of growth substances on the contents of N, P and K:

Plant growth substances i.e. GA3 and kinetin increased N, P and k contents under salinity stress in rice shoot. This may be due to the enhancing effect of growth substances on: (a) water absorption by plant root. (b) nutrient minerals uptake. (c) enzymatic activity and membrane transport.

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دور بعض مواد نمو في تخفيف أضرار الملوحة على بعض أصناف الأرز

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أجريت تجربتان حقليتان بالمزرعة البحثية لمحطة بحوث السرو الزراعية بدمياط خلال موسمي 2011 و 2012م وذلك بهدف دراسة تأثير الرش ببعض هرمونات النمو واليوريا على سلوك بعض أصناف الأرز النامية تحت ظروف الملوحة (الإجهاد الملحي 7,90و 8,33ديسيسمنز/ م فى كلا الموسمين) وكان التصميم المستخدم هو القطع المنشقة مرة واحدة . حيث احتوت القطع الرئيسية عل ثلاث أصناف هي جيزة 177 وجيزة 178 وسخا 101 واحتوت القطع الشقية على الجبريللين بتركيز 100ملليجرام/اللتر للفدان والكينيتين بتركيز 20 ملليجرام/اللتر للفدان واليوريا بتركيز 3% ومخالطيها ورشت النباتات مرتين فى عمر 35 & 45 يوم من الشتل وكانت المعاملات كما يأتي بدون معاملة (كنترول) ،المعاملة بالجبريللين بتركيز 100ملجم /لتر ،المعاملة بالكينيتين بتركيز 20ملجم/لتر، المعاملة بالجبريللين+ الكينيتين ،المعاملة باليوريا بتركيز 3%،المعاملة باليوريا+الجبريللين، المعاملة باليوريا+ الكينيتين و المعاملة باليوريا +الجبريللين + الكينيتين. وقد تمت دراسة بعض صفات النمو وتم تقدير بعض المحتويات الكيميائية فى المجموع الخضري للنباتات كما تم تقدير المحصول ومكوناته على أساس الزيادة عن الكنترول التي لم ترش بأي من مواد النمو .

وكانت أهم النتائج المتحصل عليها كالأتي:

أولا: صفات النمو:

أوضحت النتائج نقص واضح لصفات النمو المختلفة للأصناف الثلاثة محل الدراسة (ارتفاع النبات ،عدد الفروع/الجورة، معدل نمو المحصول ، دليل المساحة الورقية) وكان تأثير الظروف الملحية للتجربة فى كلا الموسمين واضحاً بدرجة ملحوظة فى الصنف الحساس(جيزة 177)بدرجة أكبر من الصنف المتحمل (جيزة 178).

أشارت النتائج أيضاً إلى التأثير الإيجابي لمعاملة النباتات بأي من المواد المستخدمة (الجبريللين، الكينيتين ، اليوريا أو المخاليط بينهم) حيث حدثت زيادة ملحوظة فى كل صفات النمو المختلفة للثلاثة أصناف الأرز المستخدمة وكان التأثير على الصنف المقاوم ملحوظ بدرجة أكبر من التأثير على الصنف الحساس للملوحة وكانت المعاملة باليوريا + الجبريللين هي الأكثر تأثيراً والأكفأ فى تحسين صفات النمو وخاصة تحت الظروف الملحية للتجربة.

ثانيا: المحصول ومكوناته:

أوضحت النتائج حدوث نقص واضح فى المحصول ومكوناته للثلاثة أصناف المنزرعة وكان الصنف الحساس (جيزة 177) هو الأكثر تأثراً بظروف التجربة الملحية عن الصنفين الآخرين(سخا101،جيزة 178).وأدى استخدام مواد النمو المختلفة (الجبريللين، الكينيتين ، اليوريا أو المخاليط بينهم) إلى حدوث زيادة ملحوظة فى المحصول ومكوناته للثلاثة أصناف . كما أوضحت النتائج أنة أمكن التغلب على الآثار الضارة الناجمة على المحصول ومكوناته للنبات وكانت المعاملة باليوريا + الجبريللين هي الأكثر كفاءة فى التغلب على الآثار الضارة الناجمة على المحصول ومكوناته.

ثالثا: المحتويات البيو كيميائية:

أ دى استخدام مواد النمو المختلفة (الجبريللين أو الكينيتين أو اليوريا أو المخاليط بينهم)إلى حدوث زيادة فى المحتوى من الكلوروفيل فى أوراق النباتات وكانت المعاملة باليوريا + الجبريللين هي الأكثر كفائه فى هذا الشأن وأظهرت النتائج أن معاملة النباتات بأي من مواد النمو وأيضاً معاملات التداخل فيما بينهم أدت إلى زيادة المحتوى من السكريات الذائبة وكذلك المحتوى من البرولين. وكانت المعاملة بالجبريللين منفرداً أو مع اليوريا هي الأكثر كفاءة وتأثير فى هذا الشأن وكان الصنف جيزة 178 هو الأكثر كفاءة فى كل هذه الصفات السابقة .

كما أدت ظروف التجربة الملحية إلى حدوث نقص واضح فى المحتوى من عناصر النتروجين ـ الفوسفور ـ البوتاسيوم فى أنسجة نباتان الأرز بينما المعاملة بأي من مواد النمو المختلفة أدى إلى حدوث زيادة واضحة للمحتوى منهم . كما لوحظت زيادة تراكم الصوديوم فى خلايا النباتات بينما المعاملة بمواد النمو أدت إلى تقليل المحتوى منة وكان الصنف جيزة 178 هو الأكثر كفاءة فى كل هذه الصفات السابقة .

وعلية فإنه بالإمكان زيادة تحمل نبات الأرز بما فيها الأصناف الحساسة إلى مستويات ملوحة6-7 ملليموز وإمكانية تخفيف ضغط الإجهاد الملحي وذلك باستخدام بعض مواد النمو مثل الجبريللين بتركيز 100 ملليجرام/لتر والكينيتين بتركيز 20 ملليجرام/لتر واليوريا بتركيز 3% أو مخاليط هذه المواد والتي كان اليوريا مع الجبريللين رشاً بعد 35 و 45 يوم من الشتل هي المعاملة الأكفأ فى الحصول على أعلى محصول تحت ظروف إجراء التجربة.

قام بتحكيم البحث

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