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USING SOME GROWTH SUBSTANCES TO IMPROVING RICE PLANT FOR SALINITY TOLERANCE CONDITIONS

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ABSTRACT

Two field experiments were conduct during summer season of 2006 and 2007 at Tag El-Ezz Research Station, Dakahlia Governorate, Egypt; to study the effects of gibberellins, cytokinins and urea to increase tolerance of rice plants for high levels of salts. In addition, the best treatment through the interaction between them, as well as the salt level that gives the best productivity of rice yield.

High salinity levels led to decreased total chlorophyll, ascorbic acid and soluble sugars content in rice plant especially in the sensitive rice cultivar, on reverse of proline content. Using growth substances, urea, and their combinations increased total chlorophyll, ascorbic acid and soluble sugars content in rice plant especially in the sensitive rice cultivar, but on reversal that proline content.

INTRODUCTION

Rice is one of the major field crops in Egypt. The productivity of rice, such as any plant, is environmental conditions especially soil properties, water supply, fertilizers uses efficiency and others.

In saline environments NaCl is usually the most injurious and predominant salt but also other including Ca^{+2}, Mg^{+2} and SO_4^{-2} are present. In addition to osmotic effects, the major constraints for plant growth and productivity is ion toxicity associated with excessive uptake of mainly Cl^- or Na^+ nutrient imbalance caused by disturbed uptake or distribution of essential mineral nutrients.

Several authors stated that photosynthetic pigments were decreased with increasing salinity stress as well as disruption of the fine structure of chloroplast. In addition salinity suppressed the specific enzyme, which is responsible for the synthesis of green pigments due to its effect on preserving certain essential ions for chlorophyll synthesis (Sakr, 1996; Panda and Khan, 2003; Mitsuya, *et al.,* 2003 and Saker et al 2004).

Khan and Panda (2002) and Silveira, *et al.,* (2003), pointed that the prominent salt induced proline accumulation in the leaves was associated with the higher salt sensitivity in terms of proteolysis and salt induced senescence as compared to the roots.

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 report for several species (Li *et al*., 1998 and Ozdemir et al 2004).

The role of growth promoters on overcoming the depressing effect of salinity may be due to the enhancing effect of cytokinins which effect plant

water balance through their effect on stomata as well as increase turgor pressure (Mac Robbic,1981) and /or decreasing root resistance to water flow. Application of GA_3 appeared to reverse the effects induced by salinity. GA_3 appears to act partially by increasing the water status of plats and partially by sustaining the determined metabolite levels (Sakr, 1996). Sakr, (1996) noticed that kinetin either partially or completely reversed the inhibitory effect of NaCl on stomata conductance and the chlorophyll contents.

Kaya and Higgs (2003) pointed out that saline environment has generally low nitrogen and furthermore salinity reduces the uptake of No^{-}_{3} in many plant species due mostly to high Cl^{-} content in saline soil. Supplementing soil with N improved the plant growth under salt stress. They also added that nitrogen supplemented into soil in the form of urea can significantly improve the variables affected by high salinity (e.g. plant growth, yield and membrane permeability) and can correct N deficiency.

MATERIALS AND METHODS

Two field experiments were conduct during summer season of 2004 and 2005 at Tag El-Ezz Research Station, Dakahlia Governorate, Egypt. The experiments aimed to study the effects of gibberellins, cytokinins and urea on the increasing the tolerance of rice plants for high levels of salts, and also, the best treatment because of the interaction between them, as well as the salt level that gives the best productivity of rice yield.

The rice plant varieties (Giza 177 & Giza 178 and Sakha 101) were transplanted and grown in two areas different in its salinity level. The first area was (Ec =4.70) while the second was (Ec= 6.25).

Experimental design:

A split-split plot design with four replications was use. The main plots were devote for salinity levels and the sub-plots for varieties and sub-sub split for treatments. Rice plant varieties (Giza 177 & Giza 178 and Sakha 101) were sprayed twice after 35 and 50 days from sowing with either of: water (control), GA_3, Kinetin, GA_3 + kinetin, Urea, Urea + GA_3, Urea + kinetin and Urea + GA_3 + kinetin.

The permanent field was well prepared through a good ploughing and leveling. Calcium super phosphate at the rate of 100 Kg /fed, applied before ploughing. Plot area 1/420 fed. was (3.6x2.8 m) 10.08 m^2 was used and designed as 18 hills and 14 rows; 20 cm apart.

Urea (46 % N), at the rate of 15%, GA (500mg/l) and kinetin (50mg/l).

All the normal cultural practices of growing rice plants were applied as the usual manner followed by the farmers in the distinct.

Biochemical constituents: in rice shoot such as photosynthetic pigments, praline, ascorbic and soluble sugars were determined.

Photosynthetic pigments were determined in the 3rd upper leaves, according to Mackinny (1941).

Proline content was determined in the shoot by the modification of ninhydrine method of Troll and Lindsley (1955). Omitting phosphoric acid to avoid interference with concentrated sugars (Magne & Larther, 1992).

Total soluble carbohydrates were extracted and determined according to (Kayani et al 1990), and (Sadasivam & Manickam, 1996).

Ascorbic acid was extracted and determined according to (Sadasivam & Manikan, 1996) by using the equation Ascorbic acid (mg/100 gm f. wt = 0.5 V_1 ml x V_2 /5 X 100 / weight of sample X100

where V_1 = amount of dye reacted with 10 ml of oxalic acid

V_2 = amount of dye reacted with 10 ml Supernaternt.

RESULTS

Photosynthetic pigments:

Data in table (1) show that high salinity levels (4000 and 6000 mg/l) as well as interaction treatments of high salinity level (6000 mg/l) with any of each growth substances used and urea except for the combination of 6000 mg/l with GA3 + urea decreased chlorophyll (a), chlorophyll (b) especially in the sensitive rice cultivar.

Growth substances used and urea as well as their combinations increased chlorophyll (a), chlorophyll (b) content in rice plant.

The data in table (1) also show that GA_3 & (GA_3 + urea) & (GA_3 + urea+ kinetin) treatments as well as its combinations with salinity levels (2000 and 4000 mg/l) treatments increased chlorophyll (a) of both rice cultivars.

It could be mention that GA_3 + urea treatment was the most effective in counteracting harmful the harmful effect of salinity stress in both sensitive and tolerant cultivars. Growth substances used was more effective in counteracting effect of salinity stress in tolerant cultivar more than the sensitive one.

The different rice cultivars greatly differed in their response to salinity stress. It could be show that sensitive cultivar was more affected by salinity stress which contain less ascorbic acid content in its leaves.

Photosynthetic pigments in the leaves was significantly decreased with increasing salinity levels (tables (1, 2 and 3). This reduction was may be related to enhanced the activity of chlorophyll degrading enzyme chlorophyllasc (Mishra and Sharma, 1994). Prisco and O'leary,(1972) indicated 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 decreased its concentration (Pell and Dann, 1991). Moreover, salinity stress suppressed the specific enzyme, which is responsible for the synthesis of green specific pigments (Strogonov *et al,* 1970) due to its effect on preserving certain essential ions for chlorophyll synthesis (Mishra and Sharma, 1994).

Finally, salinity stress decreased photosynthetic pigment due to its effect on hormonal imbalance where salt stress decreased the biosynthesis of cytokine in salinized plant root and translocated to the shoot (Prisco and O'Leary, 1972) and increased ABA content resulting in promoting chlorophyll breakdown (Hall and McWha, 1981) or inhibiting chlorophyll synthesis (Bengtson *et al*, 1977) in addition, salt stress accelerate leaf senescence through inhibitory chlorophyll synthesis, He and Cramer (1996) and Sakr *et al,* (2004).

Regarding the role of phytohormones on counteracting the harmful effect of salinity stress on photosynthetic pigments:

It is noticed that growth substances kinetin and GA_3 partially counteracted the inhibitory effect of salinity stress on photosynthetic pigment accumulation in green shoot of wheat (Sakr, *et al*. 2004). Growth substances used (GA_3 & kinetin) partially enhanced pigment production and alleviate the inhibitory effect of chloride under salinity stress.

The role of kinetin on overcoming the depressing effect of salinity may be due to enhancing effect of cytokinins content in the leaves, which stimulate chlorophyll synthesis and delayed chlorophyll destruction (Partheir, 1992 and Saker, 1996).

Allen, (1995), Bajguz (2000), Ozdemir *et al* (2004) reported that growth promoters have developed a complex antioxidants system in chloroplasts and hole plants grown under salinity stress. The primary components of this system include carotenoids, ascorbate, glutathion and α-tocopherols and enzymes such as SOD, catalase, glutathione peroxidase which act as antioxidants in the detoxification of AOS produced under salinity stress.

Regarding the role of urea in counteracting the harmfull effect of salinity stress on photosynthetic pigments:

Data in tables (1, 2 and 3) showed that urea nullified the reduction observed in photosynthetic pigments content. This may be due to: (1) N incorporation in enzymes and proteins correlated with chlorophylls biosynthesis, (2) nitrogen is essential for photosynthetic pigments biosynthesis, (3) nitrogen incorporation in endogenous phytohormones which promote chlorphylls biosynthesis, (4) enthancing antioxdants formation which scaving free radicals. That free radical species coused degradation for photosynthetic pigments.

Ascorbic acid:

Data presented in table (4) show that GA_3 & kinetin and urea as well as their combinations increased while high salinity level (area 2) decreased ascorbic acid, content in the leaves of all rice cultivars used.

Each of growth substances used and urea enhanced rice ascorbic acid content under high salinity level (area 2) more than under low salinity level (area 1) in all rice plant cultivars.

The three rice cultivars greatly differed in their response to salinity stress. It could be show that sensitive cultivar was more effective in reducing ascorbic acid. The data show that growth substances and urea could partially contract the harmful effect of salinity on ascorbic acid content.

Ascorbic acid is an important antioxidant, which reacts not only with H_2O_2 but also with O_2, OH and lipid hydroperoxidases. On the other hand, AA has been implicated in several types of biological activities in plants: (1) as an enzyme co-factor, (2) as an antioxidant, and (3) as a donor/ acceptor in electron transport at the plasma membrane or in the chloroplasts, all of which are related to oxidative stress resistance (Conklin, 2001). APX uses AA and oxidizes it to monodehydroascorbate (MDA). MDA may give rise to dehydroascorbate (DHA). AA is water-soluble and also has an additional role in protecting or regenerating! oxidized carotenoids or tocopherols (Imai *et al.,* 1999).

Table (1): Average chlorophyll (a) of rice cultivars Giza 177, Sakha 101 and Giza 178 as affected by different concentrations of urea, GA3 and kinetin under salinity levels.

Treatments	Salt sensitive			Salt semi-tolerant			Salt tolerant		
	Area1	Area2	Mean	Area1	Area2	Mean	Area1	Area2	Mean
Control	1.94	1.65	1.79	2.14	1.82	1.98	2.21	2.03	2.12
Urea	2.32	2.12	2.22	2.33	2.23	2.28	2.42	2.19	2.31
GA_3	2.45	2.18	2.31	2.53	2.38	2.45	2.65	2.64	2.64
Kinetin	1.98	1.69	1.83	2.12	1.92	2.02	2.23	2.05	2.14
GA_3 +kinetin	1.83	2.01	1.92	2.26	2.16	2.21	2.34	2.11	2.22
Urea + kinetin	1.74	1.79	1.76	2.18	2.03	2.10	2.27	2.09	2.18
Urea + GA_3	2.54	2.29	2.41	2.67	2.43	2.55	2.73	2.48	2.60
Urea+kinetin+GA_3	2.34	2.12	2.23	2.41	2.26	2.33	2.54	2.24	2.39
Mean	2.14	1.98	2.06	2.33	2.15	2.24	2.42	2.23	2.32

LSD sal: 0.068 Var: 0.035 Treat: 0.059 Sal x var x treat: 0.21

Table (2): Average chlorophyll (b) of rice cultivars Giza 177, Sakha 101 and Giza 178 as affected by different concentrations of urea, GA3 and kinetin under salinity levels.

Treatments	Salt sensitive			Salt semi-tolerant			Salt tolerant		
	Area1	Area2	Mean	Area1	Area2	Mean	Area1	Area2	Mean
Control	0.98	0.75	0.87	1.03	0.84	0.98	1.110	0.95	1.03
Urea	1.06	1.02	1.04	1.08	1.13	1.11	1.230	1.08	1.16
GA_3	1.15	1.11	1.13	1.48	1.19	1.34	1.280	1.13	1.21
Kinetin	1.00	0.82	0.91	1.04	0.95	0.99	1.080	0.97	1.03
GA_3 +kinetin	1.05	1.03	1.04	1.08	1.03	1.05	1.180	1.03	1.11
Urea + kinetin	1.02	0.93	0.98	1.06	0.99	1.02	1.120	0.99	1.06
Urea + GA_3	1.22	1.14	1.18	1.28	1.23	1.25	1.350	1.19	1.27
Urea+kinetin+GA_3	1.05	1.08	1.07	1.18	1.12	1.15	1.220	1.09	1.16
Mean	1.06	0.99	1.03	1.15	1.06	1.11	1.196	1.06	1.13

LSD sal: 0.038 Var 0.02 Treat: 0.03 Sal x var x treat: 0.09

Table (3): Average carotene of rice cultivars Giza 177, Sakha 101 and Giza 178 as affected by different concentrations of urea, GA3 and kinetin under salinity levels.

Treatments	Salt sensitive			Salt semi-tolerant			Salt tolerant		
	Area1	Area2	Mean	Area1	Area2	Mean	Area1	Area2	Mean
Control	0.73	0.53	0.63	0.81	0.64	0.73	0.85	0.74	0.79
Urea	0.85	0.61	0.88	0.93	0.73	0.83	0.98	0.85	0.92
GA_3	0.97	0.66	0.82	0.98	0.79	0.89	1.03	0.90	0.97
Kinetin	0.75	0.54	0.65	0.83	0.66	0.75	0.88	0.76	0.82
GA_3 +kinetin	0.81	0.58	0.69	0.89	0.71	0.8	0.95	0.81	0.88
Urea + kinetin	0.77	0.56	0.67	0.85	0.68	0.77	0.92	0.79	0.86
Urea + GA_3	1.02	0.69	0.86	1.04	0.83	0.94	1.12	0.94	1.03
Urea+kinetin+GA_3	0.93	0.63	0.78	0.95	0.75	0.85	1.03	0.87	0.95
Mean	0.85	0.60	0.76	0.91	0.72	0.82	0.97	0.83	0.90

LSD sal: 0.02 Var: 0.01 Treat: 0.02 Sal x var x treat: 0.04

Regarding the role of phytohormones on ascorbic acid (AA) contents under salinity stress;

The increase of this antioxidant (ascorbic acid) may be triggered by excess production of reactive oxygen species in the photosynthetic apparatus under stress. Increased α-tocopherol and ascorbic levels may serve as an acclimation strategy of plants to tolerate water deficits.

Exogenous application of GA_3 & kinetin enhanced the antioxidant (α-tocopherol and ascorbic acid) status in plants. Cytokinin can act as a hormone as well as a antioxidant to influence plant metabolism, may be responsible for the enhancement of antioxidant status. GA_3 & kinetin may enhance hydrophobic and hydrophilic antioxidant activity and thus promote growth and leaf water status. It may be concluded that antioxidant status could be manipulated with exogenous application of plant growth regulators.

Soluble sugars:

Data in table (5) show that salinity stress levels increased total soluble sugars of different rice cultivars. It was clearly that the sensitive rice cultivar has significant different to the tolerance cultivars to salinity stress.

Growth substances (GA_3 & kinetin) or urea as well as their combinations increased soluble sugar of the different rice cultivars. Moreover, GA_3 + urea treatment was the most effective in this respect.

It could be suggest that growth substances used or urea as well as their combinations partially nullified the reduction observed in soluble sugars of rice cultivars. Moreover, GA_3 + urea treatment was more effective in this respect.

Table (4): Average ascorbic acid of rice cultivars Giza 177, Sakha 101 and Giza 178 as affected by different concentrations of urea, GA_3 and kinetin under salinity levels.

Treatments	Salt sensitive			Salt semi-tolerant			Salt tolerant		
	Area1	Area2	Mean	Area1	Area2	Mean	Area1	Area2	Mean
Control	4.5	8.4	6.4	4.8	8.6	6.7	4.9	9.1	7.0
Urea	5.0	8.8	6.9	5.1	8.9	7.0	5.4	9.3	7.3
GA_3	5.2	9.0	7.1	5.4	9.0	7.2	5.6	9.6	7.6
Kinetin	4.8	8.5	6.6	6.5	8.6	7.5	5.1	9.0	7.0
GA_3 +kinetin	5.0	8.6	6.8	5.0	8.8	6.9	5.2	9.1	7.1
Urea + kinetin	4.8	8.6	6.7	5.0	8.7	6.8	5.2	9.0	7.1
Urea + GA_3	5.4	9.0	7.2	5.6	9.2	7.4	5.8	9.7	7.7
Urea+kinetin+GA_3	5.1	8.9	7.0	5.2	9.0	7.1	5.5	9.5	7.5
Mean	4.9	8.7	6.8	5.3	8.8	7.1	5.3	9.3	7.3

LSD sal: 0.16 Var: 0.16 Treat: 0.21 Sal x var x treat: 0.68

Table (5): Average soluble sugar of rice cultivars Giza 177, Sakha 101 and Giza 178 as affected by different concentrations of urea, GA_3 and kinetin under salinity levels.

Treatments	Salt sensitive			Salt semi-tolerant			Salt tolerant		
	Area1	Area2	Mean	Area1	Area2	Mean	Area1	Area2	Mean
Control	0.10	0.71	0.40	0.97	0.64	0.80	0.90	0.57	0.73
Urea	0.11	0.84	0.47	0.10	0.78	0.44	0.39	0.70	0.54
GA_3	0.11	0.10	0.10	0.12	0.96	0.54	0.11	0.89	0.50
Kinetin	0.10	0.73	0.41	0.69	0.66	0.67	0.93	0.60	0.76
GA_3 +kinetin	0.11	0.79	0.45	0.10	0.73	0.41	0.98	0.65	0.81
Urea + kinetin	0.10	0.75	0.42	0.10	0.69	0.39	0.96	0.62	0.79
Urea + GA_3	0.14	0.11	0.12	0.13	0.10	0.12	0.12	0.98	0.55
Urea+kinetin+GA_3	0.12	0.91	0.51	0.11	0.86	0.48	0.11	0.79	0.45
Mean	0.11	0.62	0.36	0.29	0.67	0.48	0.56	0.72	0.64

LSD sal: 0.03 Var: 0.06 Treat: 0.07 Sal x var x treat: 0.2

Regarding the effect of salinity stress on sugar contents:

Salinity stress induced a marked decrease in reducing sugars with a concomitant increase in non-reducing sugars and total soluble sugars. The decrease in reducing sugars which was accompanied with an increase in non-

reducing and soluble sugars content of rice revealed an inhibitory effect of salinity to the hydrolytic enzymes.

The accumulation of non reducing sugars was the result of an enhanced efficiency in the use of carbon coupled to a reduction in cellular metabolism, that could farvor the accumulation of respiratory substrate to support the osmotic adjustment required to survive in saline media (Schnapp *et al,* 1990) this accumulation has been attributed to an impaired carbohydrates utilization (Munns and Termaat, 1986), and reduced respiration rate at high salinity level. It is possible that sucrose may play a role in regulating intracellular carbon metabolism and partitioning**.**

It is well known that increasing salinity levels decreased significantly phosphorous content which in terms stimulated carbohydrates transport and increased both sucrose and starch in the root. The increase in sucrose in plants with sodium chloride salinity pointed out a shift in the balance of sucrose-starch metabolism. Under saline conditions, the accumulation of sucrose in plants was usually considered to be the result of inhibition in sucrose oxidation in relation to shoot growth or an osmotic adjustment (Greenway and Munns, 1980).

Regarding the role of urea on sugar contents under salinity stress:

In this respect, Khamraes and Kein (1977) found that application of nitrogen fertilizers increased sugar content of sorghum.

Generally, it is clear under the conditions of the present study that, many metabolic processes were affected by the presence of salinity. Consequently, the chemical composition of the studied cultivars such as mineral concentrations, protein and ammo acid concentrations, and total sugar % were also affected. However, variations existed within the tested rice cultivars in this respect. For instance, the reduction in growth performance and productivity of certain cultivars in comparison to the others could be due to the relatively higher quantities of sugars serving as osmotic agents instead of their normal consumption in the various anabolic processes.

Proline content:

Data in table (6) show that GA_3 and kinetin as well as their combinations with urea caused an increasing effect on praline content of different rice cultivars.

Salinity levels in the two experimental areas had no significant effect in this respect.

The interaction treatments of GA_3 & kinetin or urea with salinity levels stress led to an increasing effect on praline content of the three rice cultivars in the two experimental areas (area 1 and area 2).

GA_3 + urea treatment was more effective counteracting the harmful effect of salinity stress through out the different rice cultivars (sensitive, semi-tolerance and tolerance).

Regarding the effect of salinity stress on proline accumulation in rice plant tissues:

Proline accumulation is one of the most frequently reported modifications induced by water deficit and salt stress in plants, and its often

considered to be involved in stress resistance mechanisms, Lutts *et al,* (1999) and Sakr *et al,* (2004).

Several functions are proposed for the accumulation of proline in tissues submitted to salt stress: (a): osmotic adjustment. (b): C and N reserve for growth after stress relief. (c): Detoxification of excess ammonia. (d): stabilization of proteins and/or membranes. (e): and being a scavenger of free radicals. (f): it improves the stability of some cytoplasmic and mitochondrial enzymes. (g): increased the solvation of protein. (h): Play a protective role in saline media by binding the excess ions absorbed by the plants.(Solomon *et al* 1994).

In addition, proline biosynthesis may be associated with the regulation of cytosolic pH or production of $NADP^+$ for the Stimulation of pentose Phosphate pathway (Lutts *et al,* 1999 and Jain *et al*, 2000).

It is generally accepted that most of the proline accumulated during Osmotic Stress arises from increased synthesis from glutamate (Lutts *et al* 1999 and Jain *et al*, 2000). However, proline accumulation can be also associated with a decrease in its oxidation, low demand for protein synthesis and accumulation in tissue plant owing to restriction in its transport to other plant parts (Viegas & Silveira, 1999 and Jain *et al*, 2000).

Proline and Sugars may not only act a osmotica but also scavenge reactive oxygen species by dint of enhancing the antioxidant response and reducing membrane lipid peroxidation which is an additional feature of membrane stabilization of salt tolerant rice cultivars. So, a positive correlation exists between cytosolute accumulation and antioxidative response in rice cultivars.

Increasing of total soluble carbohydrates (table 3) may be correlated to proline accumulation, in this concern, Larher *et al*, (1993) confirmed the strong correlation between levels of non-structural carbohydrates such as sucrose and induction of proline accumulation. Many authors indicate that the importance of soluble carbohydrates in stimulation of the proline accumulation, through: inhibition of the degradation enzyme of proline (Heineke *et al,* 1992 and Ozdemir, *et al*. 2004),

Table (6): Average proline content of rice cultivars Giza 177, Sakha 101 and Giza 178 as affected by different concentrations of urea, GA_3 and kinetin under salinity levels.

Treatments	Salt sensitive			Salt semi-tolerant			Salt tolerant		
	Area1	Area2	Mean	Area1	Area2	Mean	Area1	Area2	Mean
Control	0.35	1.10	0.72	0.30	1.03	0.66	0.20	0.80	0.50
Urea	0.45	1.20	0.82	0.35	1.20	0.77	0.25	0.90	0.57
GA_3	0.50	1.30	0.90	0.45	1.20	0.82	0.30	1.10	0.70
Kinetin	0.30	1.10	0.70	0.30	1.05	0.67	0.20	0.85	0.52
GA_3 +kinetin	0.35	1.15	0.75	0.35	1.10	0.72	0.35	0.90	0.62
Urea + kinetin	0.30	1.10	0.70	0.30	1.05	0.67	0.20	0.85	0.52
Urea + GA_3	0.60	1.40	1.00	0.55	1.30	0.92	0.40	1.10	0.75
Urea+kinetin+GA_3	0.45	1.25	0.85	0.40	1.15	0.77	0.30	0.95	0.62
Mean	0.41	1.20	0.80	0.37	1.13	0.75	0.25	0.93	0.60

LSD sal: 0.08 Var: 0.03 Treat: 0.04 Sal x var x treat: 0.131

Regarding the role of urea on proline content:

The above-obtained results might suggest that under saline conditions of proteins are converted into free amino acids, which increased as a result of water stress caused by salinity to increase cell soluble content in order to endure lacking of water. In other words, under physiological drought conditions caused by excess salts in the soil or irrigation water the high molecular weight compounds such as free amino acids to increase the soluble content of the cell. In this respect, many investigators respected that salt stress increased the concentration of different amino acids, especially proline in certain plants subjected to salt stress.

The application of nitrogen (urea) 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.

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استخدام بعض المواد لتحسين محتوى نبات الأرز من المواد البيوكيميائية لمقاومة الظروف الملحية

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أجريت تجربة زراعية بمحطة البحوث الزراعية بتاج العز – محافظة الدقهلية – مصر, لدراسة تأثير الجبريلين والكينيتين واليوريا والتفاعل بينهما لزيادة مقاومة نبات الأرز لمستويات الملوحة المرتفعة لزيادة إنتاجية المحصول.

زيادة مستويات الملوحة أدت إلى نقص الكلورفيلات الكلية والأسكوربيك والسكريات الكلية بينما أدت إلى نقص المحتوى من البرولين حيث كانت الإستجابة تبعا لحساسية الصنف للملوحة. المعاملة بالجبريلين والكينيتين واليوريا والتفاعل بينهما أدت إلى زيادة الكلورفيلات الكلية والأسكوربيك والسكريات الكلية.