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EFFECT OF FOLIAR APPLICATION WITH INDOL ACETIC ACID AND GIBBERELLIC ACID AND THE INTERACTION BETWEEN THEM ON GROWTH AND SOME PHYSIOLOGICAL CONSTITUENTS OF WHEAT PLANT GROWN UNDER SALINITY CONDITIONS

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ABSTRACT

The present study aimed to investigate the effect of spraying with IAA and GA_3 as well as their interaction on improvement growth, yield and some biochemical and physiological characteristics of wheat (*Triticum durum* serf *Triticum aestivum*). Plants of two cultivars, Mohamed Ben Bachir (MBB) and Hedab (HD), were grown under different concentrations of sea water salinity (10, 30 and 60). The results showed continuous decrease in plant length and yield (as spikes and 100 wheat grain weight), with increasing the concentrations of salinity during the growth period, compared with untreated plants. The concentrations of salinity used, had negative effect on number of leaves and proliferate (first generation) and the leaf area of plant. On contrast, proline content was increased with increasing the concentrations of salinity, this revealed that the plant exhibited resistant to salinity. The spraying with growth regulators used in the present study (IAA and GA_3), showed significant effect on plant, in the extent of reducing the hurt effect of salinity on the growth measurements and some physiological components of plant.

Key words: Salinity, Growth regulators, Wheat

RÉSUMÉ

Le but de ce travail est de connaître l'effet de l'interaction de l'acide indole acétique (IAA) et de l'acide gébrélique (GA_3) sur le développement, la production et certains caractères physiologiques du blé *Triticum durum* Serf. *Triticum aestivum* élevé sous des conditions de salinité (eau de mer diluée à 10%, 30%, 60%) plus le contrôle. **Les résultats obtenus monterent :**

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- Une diminution continue du poids frais, du pois secs, de la hauteur et de production finale de la plante en fonction de l'augmentation des concentrations du sel tout le long du cycle de la plante.
- Un effet négatif sur le nombre et la surface des feuilles, ainsi que sur le nombre de tiges.
- Une augmentation de la teneur en proline en fonction de l'augmentation des concentrations du sel, indiquant une induction de la tolerance vis a vis du stress salin.
- L'application foliaire et simultanée des phytohormones (IAA, GA_3) entraîne une diminution de l'effet négatif du sel sur le développement de la plante.

Mots Cles: Salinité, Regulateurs decroissance–Ble

INTRODUCTION

Cereals cultivation had occupied an important location among the agricultural crops all over the world. Wheat and barely are considered the two main crops from grain crops, specially in the arid zones, that depend on rains in the cultivation. Wheat was used as food from last hundred years ago due to its long association with man's food. Therefore, it was cultivated in large scales in the world to cope the increasing need for food and feed of the people. Therefore, it is necessary for stimulating the interest of scientists, who work in the field of studying wheat plant, to confirm these studies. Many cultivars having higher productivity and resistance for diseases were recently selected by some workers (**Bonner, 1933 and McNeal *et al* 1971**).

The silt to clay loam soils, that contain suitable amounts of calcium and wastes and have neutral pH, are suitable soils for wheat cultivation (**Black, 1965; El-Mohandes, 1999; Aly, 1999 and Shabana and El-Attar, 1994**) .The cultivation of wheat is wide spread in the east of Algeria by using .the systems of arid cultivation and also less information about the scientific methods is known. The newly method, that leads to hold up the wheat plant for growing in salinity medium was not used, particularly that the Algeria possesses large regions and areas for cultivation, but it is saline. Yet, it was necessary for using these large areas to increase the areas of wheat cultivation to obtain high yield under these conditions. Different trials based on experimental studies on the effect of auxin and other ameliorative growth, specially IAA that causes very slight effect were presented, in places of there effect to stimulate the growth occurring (**Mejbaum, 1939**). This author indicated that the externally addition of IAA could stimulate the synthesis of newly protein and RNA in Rhoeo leaves and yeast cells and in sections of green pea stem and outer shell of bean endocarp (**Sacher, 1967**), and in the section of Oat coleoptile elytrum cells (**Shabana and El-Attar, 1994**). Similar effect of both auxin and gibberellin (IAA and GA_3), for enhancing, elongation of cell, formation of partinocarpy fruits and combial activity and building of protein and nucleic acids (RNA and DNA), were reported by (**Harder & Bünsow 1956 and Phinney & West, 1961**).

The addition of IAA and GA_3 individually showed no effect, while the addition of both together to the plant ecology, lead to significant synergistic effect on the elongation of phalangidae (**Masuda *et al* 1967**), who reported that GA_3 depends on IAA in appearance of their effect.

The present study aimed to know the scientific methods that must be applied to make wheat plant becomes more resistant to higher concentrations of salinity by treatments with ameliorative growth. It aimed also to decrease the effect of salinity on yield. The effect of spraying with IAA and GA_3 at the level of 2% on the morphological and physiological characteristics of wheat plant grown under salinity conditions were also studied.

MATERIAL AND METHODS

The present study was done at plastic house, Department of Natural Science, Faculty of Science, route of Ain El-Bey, Mentouri Constantine University, Algeria and Biochemistry Department, National Research Center, Cairo, Egypt.

Wheat seeds were obtained from experimental laboratory field, El-Khroub, Constantine, Algeria. Two cultivars were selected, the first was solid, Mohamed Ben Bachir (MBB) and the second was wet, Hedab (HD). Both cultivars are locally developed, having ability for growing under cold and aridity conditions.

Soil samples from the surface layer were taken and used for chemical and physical analyses. Total percentages of $CaCO_3$ (Calcium carbonate), pH degree for saturated paste soil, and the degree of electrical conductivity of their extraction by ml mol/cm at 25°C were determined according to the method of (**Richards, 1954 and Black, 1965**). The active carbonate and bicarbonate (CO_3 and HCO_3) and Soil thickner were estimated by pipette method (**Kilmer and Alexander, 1949 as described by Materiaux, 1954**).

The experiment was designed to contain four treatments of sea water salinity (0%, 10%, 30%and 60%), two levels of ameliorative growth (IAA and GA_3) and two cultivars of wheat plant (MBB and HD). Each treatment was repeated for 3 times and thus, the experiment included 48 experimental units. Plastic pots were filled with soil and cultivated by seeds of both cultivars under the present study (MBB and HD). The experiment was carried out, and during the vegetative stage, the measurements were recorded after 45 day of cultivation (during vegetative period of plant). During this period, the plants were exposed to irrigation with salinity 4 times according to the concentrations under the present study. To avoid the accumulation of salts, soil was washed with distilled water after each irrigation. Then, the mean of the principle stem length, number of leaves, proliferate and leaf area were recorded. Chemical analyses of vegetative period were done by determination of water potential of leaves, according to the method described by **Brown (1971)**. The chlorophylls (a and b) were estimated by the method of **Bruisma (1961)**.

The growth of plants was followed till the fruiting period, then the plants were removed from the pots and the sum of root was separated from the sum of vegetative and spikes, then the grains were isolated from the spikes and the spikes and 100 wheat grain weight were determined. Wheat grains were dried, they were milled by milling to very fine powder and used for estimating nucleic acids content (RNA and DNA) according to the method of (**Mejbaum, 1939 and Fiszan-Szarfarz,** ***et al*** **1981**).

RESULTS AND DISCUSSIONS

1. Soil analyses

Results in Table (1) show that the experimental soil was calcareous soil (contains 11.0% $CaCO_3$ and has 8.6% pH). (**Aly, 1999**) reported that the soils containing 8% or more of total $CaCO_3$ are identified as calcareous soil. The mechanical analysis of soil indicated that the soil was sand silt soil, it contains 2.4 ml mol of salt/cm which are within the range reported by (**Chapman & Pratt, 1971 and El-Mohandes, 1999**). They reported that soil which has electrical conductivity not exceeding 2ml mol/cm are considered suitable for cultivation.

2. Mean of principle stem length of wheat plant

The present results in Table (2) and Fig. (1) show continuous decrease in the mean length of principle stem for wheat plant cultivars, MBB and HD, with increasing the concentration of sea water. Cultivar MBB exhibited resistance to salinity concentrations used, more than that of HD cultivar, and this explains the increase of the mean value of plant length for MBB cultivar. The spraying with growth amelioratives (IAA and GA_3), showed enhancing effect in reducing the hurt effect of salinity on the mean of plant length of cultivars MBB and HD. Also the spraying with GA_3, showed increase in the mean of plant length more than that of IAA. These results are in agreement with results obtained by (**Harder & Bünsow, 1956; Shimoda** ***et al*** **1967 and Gamal El-Din** ***et al*** **1998**), who stated that the spraying with growth amelioratives significantly reduced the hurt effect of salinity on different growth factors. GA_3 was more effective than IAA.

Table 1. Chemical and physical propreties of soil.

Mechanical analysis			pH		Salinity mMol/cm E.C.	Active Carbonate CO_3	Total Carbonate CO_3	Bicarbonate HCO_3	Carbonate CO_3
Sand %	Silt %	Clay %	Past pH	susp. pH	mmhos/c	%	%	meq/l	
89,5	0,16	10,24	7,80	8,60	2,40	11,00	12,70	0,20	0.00

Table 2. Leafy spraying effect with IAA and GA_3 (2%) on vegetative growth for wheat plants (MBB, HD).

Treatments		Growth measurements							
		HD				MBB			
Salinity Levels %	Growth regulators ppm	Plant height	No. proliferates cm	S.L[1]	N.L.[2]	Plant height	No. proliferates cm	S.L	N.L
Tap	IAA	50	1.9	1.58	4.5	48	1.66	1.83	5.5
water	GA_3	40	1.34	2.05	4.5	45	1.75	1.89	5.0
	IAA	40	1.88	1.75	5.0	40	1.5	1.56	4.5
10%	GA_3	45	1.50	1.79	5.0	45	1.8	7.47	5.5
	IAA	34	1.38	1.49	4.5	39	1.44	2.27	5.0
30%	GA_3	38	1.30	1.75	4.0	42	1.43	5.42	5.0
	IAA	34	1.30	1.77	4.0	34	1.35	1.49	3.5
60%	GA_3	35	1.29	1.48	5.0	33	1.30	1.35	4.5

(1) S.L: Surface of leaf

(2) N.L: Number of leaves

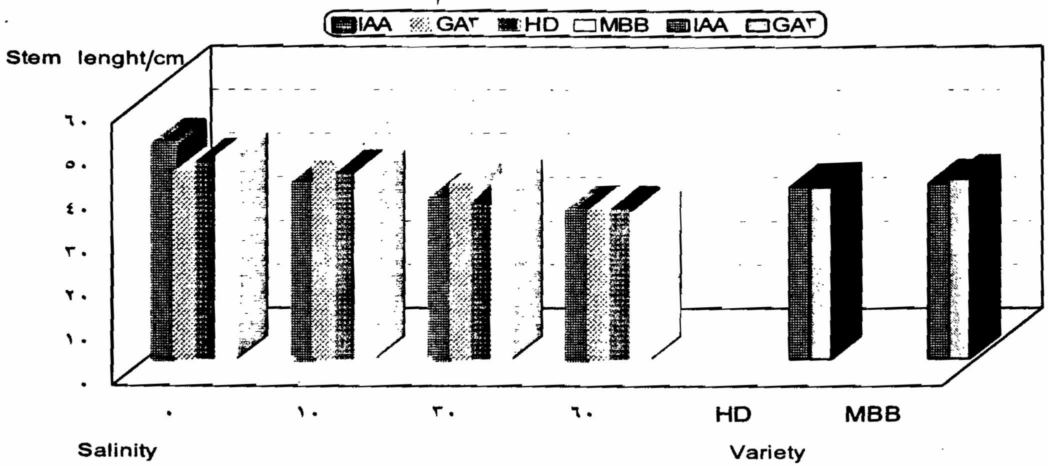

Fig. 1. Effect of spraying with ameliorative growth and interaction between them on the means of stem length/cm of wheat plant of both cultivars (MBB and HD) grown under salinity conditions.

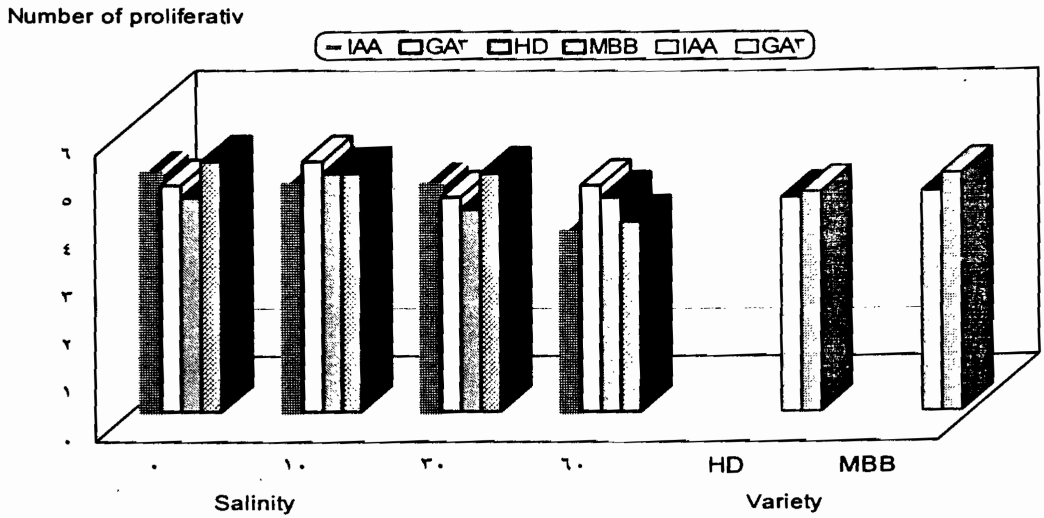

Fig. 2. Effect of spraying with ameliorative growth and interaction between them on the means of number of poliferatives of wheat plant of both cultivars (MBB and HD) grown under salinity conditions.

From these results it can be concluded that salinity has negative effect on the means of plant length, but using of growth amelioratives (IAA and GA_3), the hurt effect of salinity was decreased particularly by using GA_3. This study also showed that the cultivar of plant has an important role, for being affected with salinity, where the results showed that the cultivar MBB surpassed in means of their stems length, than that of HD cultivar, under the concentrations of salinity used. This reveals that MBB cultivar showed more resistance for salinity than HD cultivar.

3. Number of proliferates and leaf area of plant

From results in Table (2) and Fig. (2), it can be observed that the concentrations of salinity used, had a negative effect on the number of leaves and proliferates of plant. The bad effect increased with increasing the concentrations of salinity. This observation agrees with results of the mean of stems length of plant. These results also showed that spraying HD cultivar, with IAA exhibited positive response to resist the concentration of salinity used. The numbers of leaves and proliferates were affected negatively with increasing the concentrations of salinity, while the previous measurements were also affected for MBB cultivar. As for spraying with GA_3, the MBB cultivar showed negative results at the higher concentrations of salinity, specially in stem length, leaf area and number of leaves and proliferates. Similar results were observed with HD cultivar, except for leaves number which was resistant to higher concentration of salinity (**Maliwal, 1997**).

4. Water potential for leaves of wheat plant

Results in Table (3) and Fig. (3) show effect of salinity treatments used on water potential of wheat plant leaves, irrespective of the effect of ameliorative growth (IAA and GA_3). It can be observed that the water potential of plant leaves, was decreased with increasing the salinity concentrations of sea water used in plant irrigation for MBB cultivar. The reverse was true for HD cultivar. The results also show that the cultivar of HD surpassed than cultivar of MBB. As for the effect of interaction between salinity treatments and amelioratives growth on the mean of water potential of wheat plant, irrespective of plant cultivars, it can be observed that using of ameliorative growth, sprayed on leaves of plant, leads to lower water potential of plant leaves with increasing the concentrations of sea water salinity for either of IAA or GA_3. Results also showed that spraying with GA_3 lead to increase water potential for leaves of plants more than that of IAA.

5. Determination of proline in leaves of wheat plant

From the results presented in Table (3) and Fig. (4), it is clear that the amount of proline in leaves of both cultivars was affected by ameliorative growth as well as the cultivars of plant under different concentrations of salinity. As for the effect of interaction between salinity treatments and amelioratives growth on the amount of proline in leaves of both cultivars of wheat plant, results showed that the amount of proline was positively affected with increasing the concentrations of salinity, either for plants treated

Table 3. Effect of foliar application of IAA, GA3 and its interaction on the content of chlorophyll a + b and on total proline in Triticum shoots under different salinity levels.

Growth regulators 200 ppm		HD				MBB			
		Salinity levels (%)				Salinity levels			
		Tap water	10%	30%	60%	Tap water	10%	30%	60%
		Chlorophyll a + b							
IAA	*	0.540	0.222	0.980	0.030	0.290	0.162	0.193	0.002
	**	0.165	0.032	0.002	0.003	0.117	0.036	0.035	0.003
GA_3	*	0.292	0.336	0.166	0.068	0.310	0.199	0.167	0.110
	**	0.068	0.075	0.061	0.037	0.113	0.042	0.030	0.027
		Proline mMol/ mg							
IAA		1.99	0.115	0.088	0.370	0.144	0.353	0.358	0.287
GA_3		0.164	0.224	0.106	0.364	0.113	0.257	0.264	0.258
		Water potential / bars							
IAA		0.065	0.096	0.0111	0.095	0.112	0.090	0.002	0.084
GA_3		0.105	0.112	0.107	0.111	0.114	0.098	0.098	0.075

* Chlorophyll A
** Chlorophyll b

LS.D at 5% for	Chlorophyll A	Chlorophyllb	Proline	Water potential
Salinity (S)	3.82	N.S	N.S	N.S
Growth regulators (R)	7.46	N.S	10.72	N.S
Variety (V)	7.8	N.S	N.S	N.S
(S) * (R)	N.S	N.S	0.2805	.1703
(S) * (V)	2.28	N.S	N.S	.3308
(V) * (R)	8.34	N.S	N.S	.3320

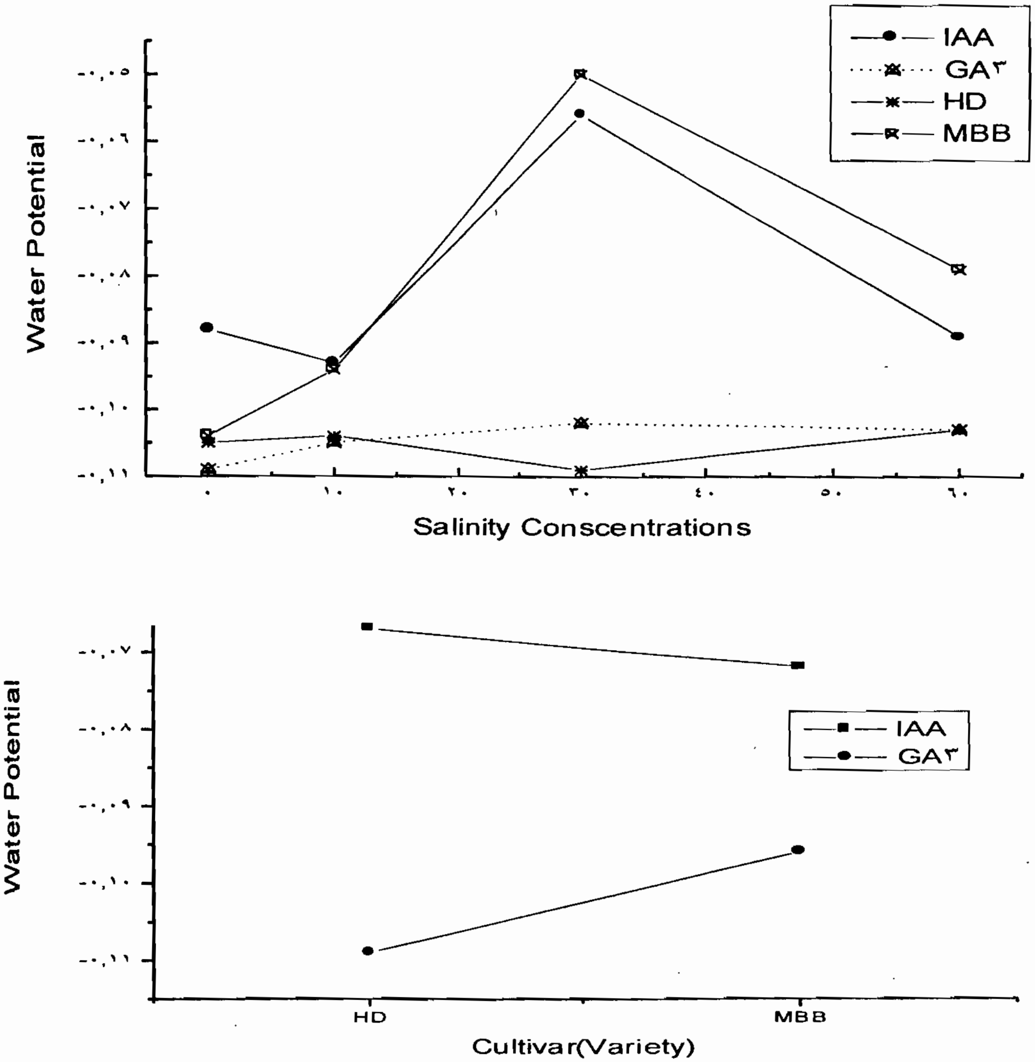

Fig. 3. Effect of spraying with ameliorative growth and interaction between them on the mean water potential of wheat plant of bath cultivars (MBB and HP) grown under salinity conditions.

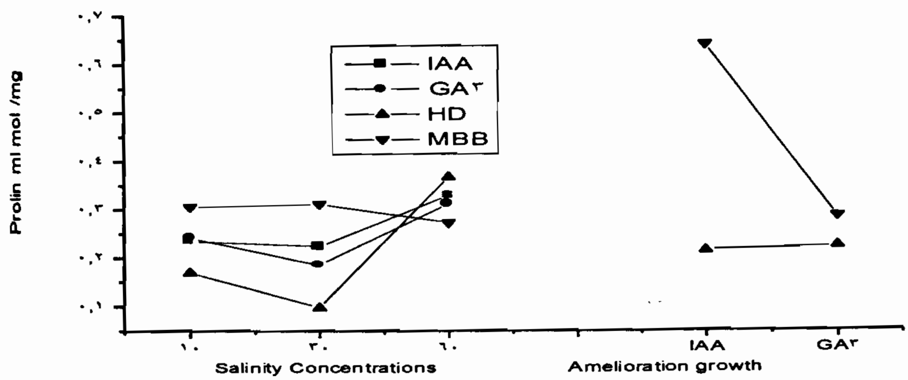

Fig. 4. Effect of spraying with ameliorative growth and interaction between them on the mean proline content in leaves of wheat plant of both cultivars (MBB and HD) grown under salinity conditions.

or not treated with IAA or GA. Similar observation was recorded for the effect of interaction between salinity concentration and cultivars of plant on the amount of proline. Irrespective of the effect of spraying with ameliorative growth, the MBB cultivar exhibited resistance to concentrations of salinity, where the amount of proline in leaves of their plants was increased with increasing the concentrations of salinity. About the effect of interaction between plant cultivar and ameliorative growth on the amount of proline in leaves of wheat plant, it can be observed that HD surpassed MBB in increasing the proline content. Also the spraying with IAA had positive effect in increasing the amount of proline than those sprayed with GA_3 (**Fernandez valiente** ***et al*** **1983).**

6. Plant leaves content of chlorophylls (a, b)

The effect of salinity concentrations and spraying with ameliorative growth (IAA and GA_3) on the amount of chlorophyll (a) in green part of wheat plant, irrespective of plant cultivar are shown in Table (3) and Fig. (5). The amount of chlorophyll (a) was affected negatively by concentrations of salinity used for irrigation with plants sprayed with IAA or GA_3. These results are consistent with results obtained by **(Phinney and West (1961)**, who indicated that the increase of salinity concentrations had negative effect on decreasing the chlorophyll content in plant. As for the effect of interaction between salinity and cultivar on the mean of chlorophyll (a) content, in green part of wheat plant, irrespective of

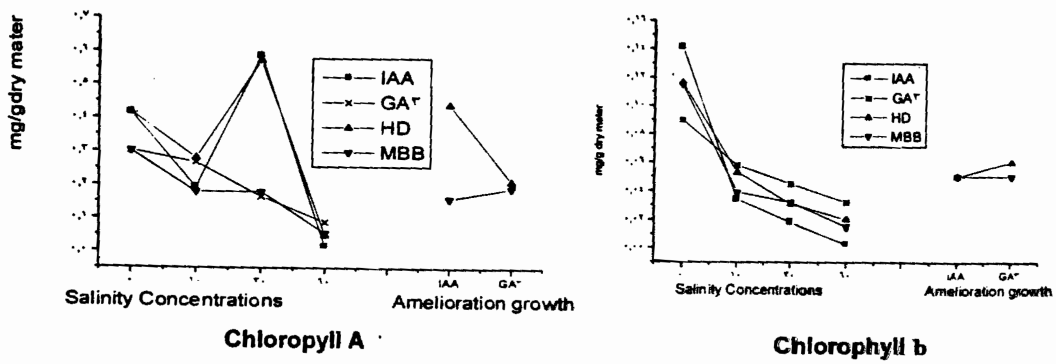

Fig. 5. Effect of spraying with ameliorative growth and interaction between them on the mean chlorophyll a + b content in leaves of wheat plant of both cultivars (MBB and HD) grown under salinity conditions

the effect of amelioratives growth (IAA and GA_3), it is clear that the concentrations of salinity had negative effect on the amount of chlorophyll (a) and this effect was increased at higher concentration of salinity (60%).

The present results showed that the cultivar has an effect in increasing or decreasing in the amount of chlorophyll (a). Results obtained explained this effect, where HD cultivar surpassed than MBB in the amount of chlorophyll (a).

On the other hand, results of chlorophyll (a) were statistically analysed and they were significantly affected with all treatments as well as the interaction between them.

Results in Table (3) and Fig. (6) illustrate the effect of interaction between salinity and cultivar on chlorophyll (b) content in the green part of plant, irrespective the effect of amelioratives growth (IAA and GA3). The concentrations of salinity used affected negatively plant content of chlorophyll (b). Also, the use of amelioratives growth by spraying on green parts of the plant decreased the hurt effect of salinity on plant. These results are similar to those obtained by **(Kandil 2000).**

7. The yield-Spikes weight

The effect of spraying with ameliorative growth and the interaction between them on spikes weight (gm) / pot for plant of wheat cultivars (MBB and HD), that grown under salinity condition are shown in Table (4) and Fig. (6). Irrespective of the effect of ameliorative growth, it is clear that HD cultivar exhibited resistant against concentrations of sea water as revealed in the increase of spikes weight with increasing the concentrations of salinity **(Kandil, 1994).** Similar results were obtained with MBB cultivar, except for higher concentration (60%) of sea water which had negative effect on spikes weight. Moreover, MBB cultivar surpassed in spikes weight / pot under all

Table 4. Effect of foliar application of IAA GA_3. (200ppm) and its interaction on grains yield of Triticum plants grown under different salinity levels.

Salinity (%)	Growth regulators (ppm)	HD		MBB	
		Weight of 100 grains / g	Spikes weight	Weight of 100 grains / g	Spikes weight
Controle	IAA	3.90	4.40	4.20	7.03
	GA3	4.00	5.50	4.40	6.66
10%	IAA	3.500	5.93	4.50	7.20
	GA3	4.10	5.93	4.40	6.33
30%	IAA	3.60	5.60	4.70	6.93
	GA3	3.80	6.00	4.60	7.16
60%	IAA	3.60	5.33	3.30	4.20
	GA3	3.50	4.73	3.30	4.86

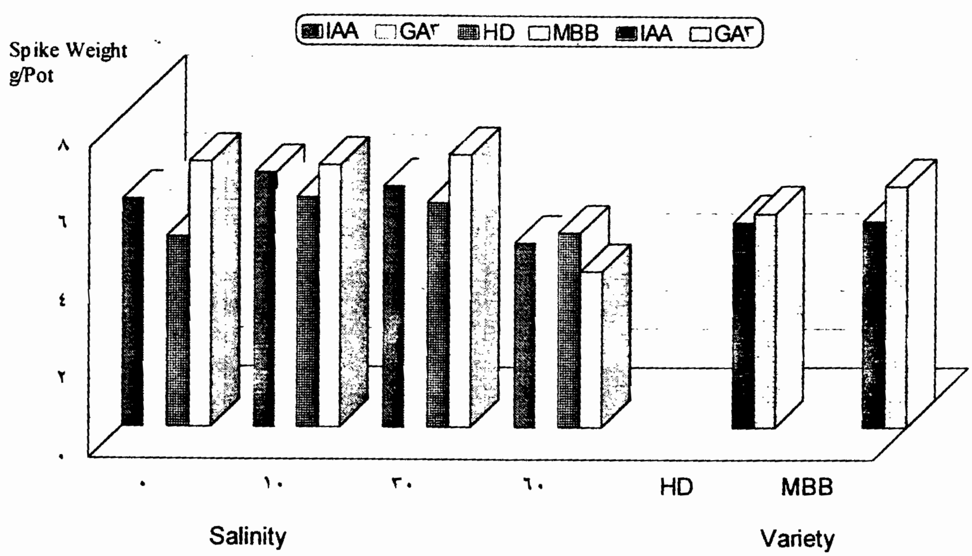

Fig. 6. Effect of spraying with ameliorative growth and interaction between them on the mean of spikes weight of wheat plant of both cultivars (MBB and HD) grown under salinity conditions.

salinity concentrations used, than that of HD cultivar. As for the effect of salinity treatments and ameliorative growth on spikes weight for plant of wheat cultivars, irrespective of the effect of cultivars of wheat plant, it is clear that the spikes weight was increased in treated plant with IAA and GA_3 and salinity concentrations of 10% and 30% of sea water. On contrast, negative effect on spikes weight for both cultivars treated with either of IAA or GA_3, was observed only at higher concentrations of salinity (60%). Results also showed surpass of treated plant with GA_3, in spikes weight, than that of treated plant with IAA (Table 4). About the effect of interaction between amelioratives growth and plant cultivars on spikes weight of both cultivars of wheat plant, the MBB cultivar was surpassed than HD cultivar. in treated plant with ameloratives growth (IAA and GA_3). The present results also showed that plant treated with GA_3 surpassed in spikes weight than that of treated with IAA.

8. Nucleic acid levels in wheat seeds

The effect of interaction between ameliorative growth and salinity concentrations on the amount of nucleic acids (RNA and DNA) in seed of wheat plant are shown in Table (5) and Figs (7) & (8). It can be observed that increasing of salinity concentrations and ameliorative growth caused negative effect on the level of DNA specially at higher concentration (60%), while positive effect was observed on the level of RNA specially at concentrations of 10% and 30%. Results also showed that the amount of RNA was increased in both cultivars (MBB and HD), while DNA amount was decreased in both cultivars under all salinity treatments.

Table 5. Effect of spraying with ameliorative growth (IAA and GA_3) at level of 2% and interaction between them on the level of nucleic acids (RNA, DNA)in seeds of wheat plant (MBB, HD) under different concentration of salinity).

Salinity %	Ameliorative growth and means	MBB cultivar		HD cultivar	
		DNA (9%)	RNA (9%)	DNA (9%)	RNA (9%)
0 %	IAA	0.27	2.46	0.22	2.30
	GA_3	0.28	2.76	0.26	2.5
10 %	IAA	0.22	2.51	0.20	2.46
	GA_3	0.26	2.83	0.22	2.60
30 %	IAA	0.20	2.55	0.18	2.48
	GA_3	0.22	2.91	0.20	2.72
60 %	IAA	0.18	2.20	0.16	2.12
	GA_3	0.22	2.40	0.20	2.28

Means of 2 samples g / 100 g dray weight

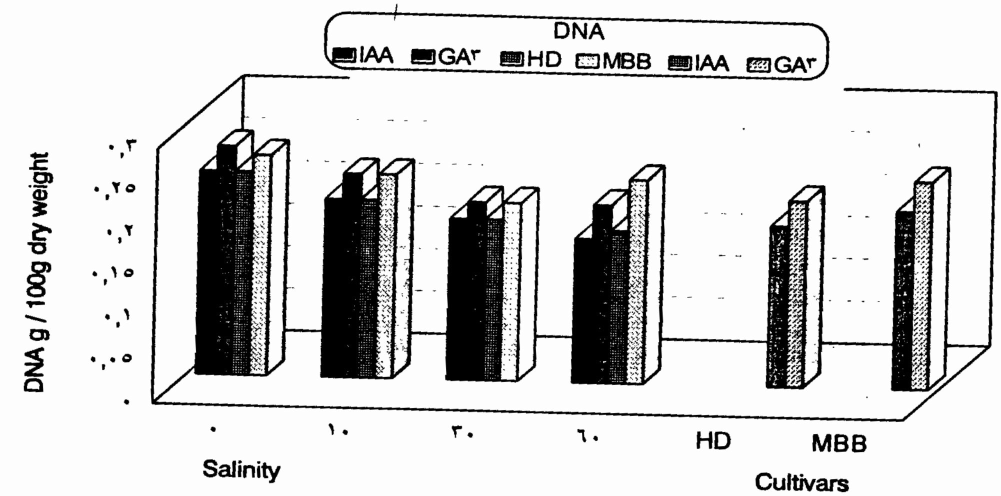

Fig. 7. Effect of spraying with ameliorative growth and interaction between them on the mean seed DNA of wheat plant of both cultivars (MBB and HD) grown under salinity conditions.

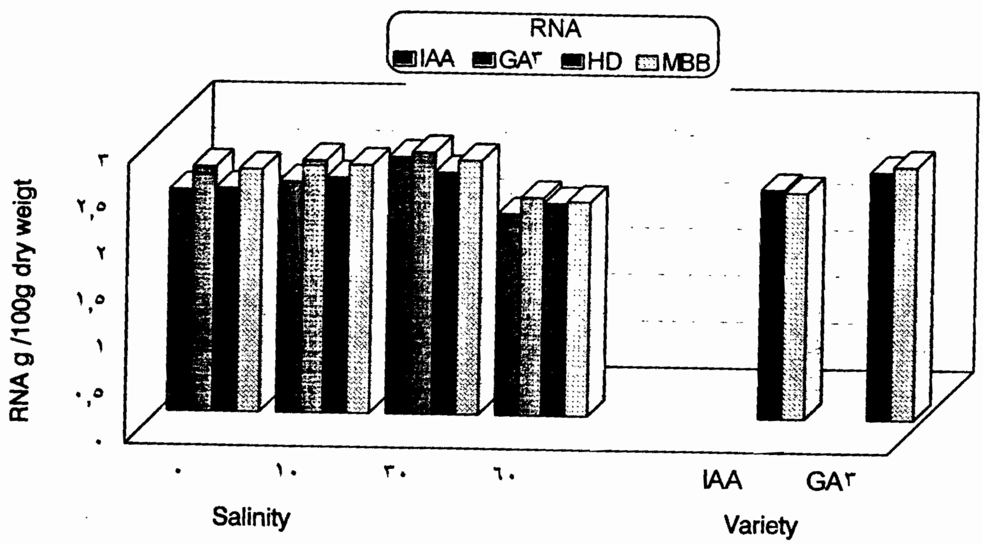

Fig. 8. Effect of spraying with ameliorative growth and interaction between them on the mean seed RNA of wheat plant of both cultivars (MBB and HD) grown under salinity conditions.

These results are in accordance with those reported by (**Shimoda *et al* 1967**). As for the effect of interaction between salinity treatments and plant cultivars (MBB and HD), irrespective of the effect of ameliorative growth, on the amount of nucleic acids, the results showed increase in the amount of RNA at salinity concentrations of 10%, 30% and showed slight decrease at higher concentration (60%). On contrast, the amount of DNA was decreased with all salinity concentrations used in both cultivars under the present study (MBB and HD). The MBB cultivar surpassed than HD cultivar in the levels of total nucleic acids at different salinity concentration, particularly RNA amount. These results are consistent with the results obtained by other workers (**Shabana, and El-Attar, 1994 Sacher, 1967, Shimoda *et al* 1967**). About the effect of the ameliorative growth and plant cultivars on the amount of nucleic acids, irrespective of the effect of salinity concentrations, the results showed that seeds of wheat plant sprayed with GA_3 exhibited increase in nucleic acids content, particularly RNA, than that of spraying with IAA. Also the MBB cultivar surpassed, in the level of total nucleic acid, than that of HD cultivar, when they were sprayed either with GA_3 or IAA. These results are in accordance with those reported by (**Masuda *et al* 1967 Harder & Bünsow, 1956; Phinney & West 1961; Shimoda *et al* 1967 and El-Mohandes, 1999**), who reported that the spraying with auxin and gibberellin lead to stimulate the synthesis of nucleic acid (RNA) and protein in wheat plant. Thus, the MBB cultivar was more resistant against salinity treatments and positively responded to ameliorative growth (GA_3 and IAA), than that of HD cultivar.

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مجلة اتحاد الجامعات العربية للدراسات والبحوث الزراعية ، جامعة عين شمس ، القاهرة ، ١١(١)، ٦٩ -٨٥ ، ٢٠٠٣

تأثير الرش الورقى بكل من حامض الاندول استيك وحامض الجبريليك والتداخل بينهما علي النمو وبعض المكونات الفسيولوجية لنباتات القمح النامية تحت الظروف الملحية

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يهدف البحث الىدراسة تأثير الرش بأندول حمض الخليك (IAA) وحمض الجبريليك (GA_3) والتداخل بينهما ، على تحسين النمو ، والمحصول وبعض الصفات الفيسيولوجية الحيوية لنبات القمح *Triticum durum* Serf. *Triticum aestivum* صنفي هضاب(HD) ومحمد بن بشير (MBB) الناميان تحت تراكيز مختلفة من ملوحة ماء البحر ٠,٠% – ١٠%- ٣٠%- ٦٠%).

وقد أوضحت النتائج

- حدوث نقص مستمر في طول النبات بالإضافة إلى محصول النبات والمتمثل في وزن السنابل وكذا وزن مائة حبة قمح وذلك بارتفاع مستويات الملوحة.
- أثرت مستويات الملوحة المستخدمة سلبا في عدد الاوراق وعدد الاشطاء ومساحة ورقة النبات.
- حدثت زيادة في كمية البرولين مع زيادة مستويات الملوحة مما يدل على أن النبات أبدى مقاومة تجاه الملوحة.
- أحدث الرش بمنظمات النمو المستخدمة ($IAA - GA_3$) على النبات ، تأثيرا واضحا في اختزال الأثر الضار للملوحة على القياسات الخضرية وبعض المكونات الفسيولوجية للنبات.

الكلمات الدالة : الملوحة – منظمات النمو– القمح

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