International Journal of Science and Research (IJSR)
ISSN (Online): 2319-7064
Impact Factor (2012): 3.358

Influence of Uniconazole on Growth Characters, Photosynthetic Pigments, Total Carbohydrates and Total Soluble Sugars of *Hordeum Vulgare L.* Plants Grown under Salinity Stress

Hussein, M.M.[1], M.A. Bakheta[2], Safi-naz S. Zaki[3]

[1,3]Water Relations & Irrigation Department, Agriculture Division, National Research Centre, Dokki, Cairo, Egypt

[2]Botany Department, Agriculture Division, National Research Centre, Dokki, Cairo, Egypt

Abstract: ***Pot experiments were carried out during two successive growth seasons 2011/2012 and 2012/ 2013 under greenhouse conditions of the National Research Centre, Dokki, Cairo, Egypt to investigate the response of Naked barley plants (Hordeum Vulgare L.) grown under salinity stress and spraying with fresh solutions of uniconazole at 150 or 200 ppm concentrations. The results showed that foliar application of uniconazole enhanced the salinity tolerance compared with control in both uniconazole and salinity treatments concerning the number of leaves, weight of leaves and stem dry weight. Plant height, number of green leaves and area of green leaves did not significantly response to salt stress. Stem and leaves dry weights similarly responded, however spikes and top dry weight clearly decreased as the salts concentration increased up to the highest level used. All the used treatments of uniconazole caused improve in the most of studied growth parameters i.e. plant height, number of leaves and fresh weight of stem, leaves, and top height in comparison with those subjected to normal irrigation. The highest values of plant height, and stem, length of spikes and top dry weight were obtained from the application of uniconazole at 150 ppm compared with that obtained from other treatment 200 ppm and salinity. It is clear from the data that application of uniconazole at the two used levels gives higher positive effect on chlorophyll "a" of the plants that irrigated with saline solution at 2500 ppm. In addition, application of uniconazole led to noticeable increases in both total carbohydrates and total soluble-sugars in comparison with those obtained from their respective control.***

Keywords: Barley, Foliar application, Salinity, Uniconazole, Photosynthetic pigments.

1. Introduction

Salinity is considered as sever problem in agriculture as it results in a noticeable reduction in the productivity of crops. Lack of fresh water for irrigation together with the poor drainage of water from the cultivated soils resulted in the accumulation of salts. In Egypt the cultivated regions restricted to the Nile valley depending on fresh water of the River Nile for irrigation does not exceed 4 % of the total land area of Egypt. Most of the newly reclaimed lands depend on underground water of various degrees of salinity for irrigation. In addition progressive accumulation of salts became a serious problem in many cultivated areas of the Delta as a result of high ground water table, especially when accompanied by poor drainage.

Barley is a most of important staple crop in the world and its productivity in saline soils is considerably reduced due to improper nutrition of plants as well as osmotic and drought stress **(Shannon, 1998).** Inhibition of plant growth is considered to be due to toxic effects of NaCl, on the ability of the roots to control entry of ions to the shoots and to slowing down water uptake of plants **(Lambers. 2003). Jamal et al. (2007)** reported that salt stress decreased the germination and also delayed the emergence of seeds in four vegetables species.

Salinity is a major environmental stress that adversely affects plant growth and metabolism. Salts inhibit plant growth by osmotic stress, specific ion toxicity, ion imbalance and oxidative stress **(Tester and Davenport, 2003, Ellouzi et al., 2011 and Hussein et al., 2014).** Many crop plants productivity including barley plant decreased under conditions of high salinity stress. To alleviate this problem, a number of studies were conducted with the aim of removing the inhibitory effect of salt stress on plant growth, using different types of growth regulators **(Hussein et al., 2007; Tuna et al., 2008).** Among these growth retardants such as uniconazole. The application of uniconazole enhances nitrate reductase activity, photosynthetic rate, increase soluble protein content and soluble sugars **(Yang et al., 1994).** It improved the drought tolerance of certain plants as reported by **Imam et al. (1995)** on wheat, **Abou El-Kheir (2000)** on soybean, **Kassab et al. (2006)** on lupine and **May and Muna (2007)** on Datura plants. In addition, Exogenous application of growth retardants such as trialzoles (uniconazole) produced some benefit in alleviating the adverse effects of salt stress and they also improve germination, growth, fruit setting, fresh vegetable and seed yields and yield quality **(Bekheta et al., 2009)**.

The present investigation was conducted to study the effects of salt stress and uniconazole on growth characters, photosynthetic pigments, total carbohydrates and total soluble sugars of *Hordium vulgrae* L plants grown under salinity stress.

2. Materials and Methods

Pot experiments were carried out in opened greenhouse of the National Research Centre, Dokki, Cairo, Egypt during two successive growth seasons (2011/2012 and 2012/ 2013). Naked barley grains (*Hordeum Vulgare L.*) were obtained from the Agricultural Research Center, Ministry of Agriculture. The grains were selected for uniformity by choosing those of equal size and same color. The selected grains were washed with distilled water, sterilized with 1% sodium hypochlorite solution for about 2 min. and washed again with distilled water.

Factorial experiment laid out in a randomized block design with nine replicates. Ten days after sowing, the seedlings were thinned to leave two seedlings per pot. To reduce compaction and improve drainage, the soil was mixed with sand in a 1:1 proportion. Granular ammonium sulphate 20.5% N at a rate of 40 kg N ha^{-1} and single super-phosphate (15% P_2O_5) at a rate of 54 kg P_2O_5 ha^{-1} were added to each pot. The N and P fertilizers were mixed thoroughly into the soil of each pot immediately before sowing. Some characteristics (physical & chemical) of the soil used were carried out according to Jackson (1973).

Table 1: Some characteristics of the soil used in the experiment before mixing it with sand before cultivation

A: Soil Physical Analysis

Course >200µ %	Fine 200-220µ %	Silt 20-22µ %	Clay < 2µ	Soil Texure
7.20	14.25	30.22	48.33	Clay

B: Soil Chemical analysis

pH 1:2.5	EC dSm^{-1}	$CaCO_2$ %	CEC C mole Kg^{-1}	OM %	Soluble cations and anions mg/100g soil							
					Na^+	K^+	Ca^{2+}	Mg^{2+}	CO^{-3}	HCO^{-3}	Cl^{-1}	SO^{-2}
7.15	1.3	2.53	33.5	1.3	1.82	0.23	2.38	1.27	0.0	0.91	1.9	1.89

Available macro-nutrients %			Available micro-nutrients ppm			
N	P	K	Zn	Fe	Mn	Cu
0.47	0.25	0.95	3.1	4.8	7.3	5.2

The growth regulator used was uniconazole, a plant growth retardant manufactured by Sumitomo Chemical Company, Ltd, Japan. Fresh solutions of uniconazole (uni.) at the rate of 150 and 200 ppm were applied twice on barley plants, the 1st one spray after 30 days from sowing while the 2nd spray after two weeks later, in addition to the control group (plants sprayed with distilled water). Irrigation water consisted of three concentrations of salt (tap water as control, 2500 and 5000 ppm) in the form of sodium chloride (NaCl) solution applied 10 days after sowing (DAS). Samples were taken after two weeks from the second application of uniconazole and divided as follows:

Group A: This used to measure shoot height (cm), number of leaves and green leaf area, shoot fresh weight and dry weight after drying in an electrical oven at 60 °C for 72 h, grounded and stored for chemical analysis of total carbohydrates and total soluble sugars.

Group B: include number of fresh plants (9 plants) and selected recently leaves (4th leaf from plant apex) to be used for estimation of photosynthetic pigments.

Photosynthetic Pigments

An accurate weight (0.5 g) of fresh young leaves of barley recently leaves were homogenized in 85% acetone and used for determination of photosynthetic pigments (chl. *a*, chl. *b* and carotenoids) using spectrophotometric method developed by **METZZENER et al. (1965).** The samples were measured at 663, 664 and 452.5 nm, respectively**.**

Determination of Total Carbohydrates

These were determined in fine dry powder of the barley shoots by using the colorimetric method described by **Herbert et al. (1971)**.

Total Soluble Sugars:

The method used for extraction and determination of total soluble -sugars was similar to that described by **Pucher et al. (1957).**

Statistical Analysis

All the collected data were subjected to the proper statistical analysis as described by **Snedecor and Cochran (1982).**

3. Results and Discussion

Growth Measurements

Data presented in Table (2) show reduction in all the studied growth parameters (plant height, number of green leaves, fresh weight of stem, leaves, and area of green leaves) of barley plants grown under the influence of salt stress conditions in comparison with those obtained from the control plants (plants subjected to regular irrigation).

Table 2: Effect of uniconazole spraying and salinity on growth of barley plants (Average of two growth seasons)

Salinity (NaCl) ppm	Uniconazole (UN) ppm	Plant height (cm)	Leaves N°/mean stem	Leaves area /mean stem cm	Fresh weight (g)				Dry weight (g)			
					Stem	Leaves	Spikes	Total	Stem	Leaves	Spikes	Total
Tap water (TW)	0	57.3	4.4	128.7	19.92	20.71	16.45	57.08	0.92	0.71	0.44	2.07
	150	62.7	4.0	143.3	21.00	20.87	17.76	59.63	1.00	0.75	1.07	2.82
	200	47.0	4.3	116.0	20.77	21.17	17.66	59.60	0.77	1.17	1.02	2.96
2500	0	51.0	4.3	122.3	20.00	21.00	16.32	57.32	0.69	0.83	0.32	1.84
	150	44.0	4.3	140.7	19.87	21.11	16.68	57.66	0.66	0.83	0.62	2.11
	200	46.0	4.0	887	19.56	20.80	16.57	56.93	0.65	0.78	0.57	2.00
5000	0	55.0	4.0	105.3	19.45	20.49	16.45	56.39	0.58	0.73	0.44	1.75
	150	58.0	4.1	126.7	19.54	21.15	16.49	57.18	0.60	1.05	0.44	2.09
	200	48.3	4.0	112.7	18.90	20.80	16.75	56.45	0.57	0.76	0.56	1.89
Mean values of salinity	TW	55.7	4.2	129.3	20.56	21.90	17.29	59.45	0.80	0.88	0.84	2.62
	2500	47.0	4.2	117.2	19.81	21.56	16.52	58.58	0.67	0.81	0.50	1.98
	5000	53.8	4.0	114.9	19.30	21.77	16.56	57.63	0.58	0.85	0.48	1.91
Mean values of UN	0	54.4	4.2	118.8	19.79	20.73	16.41	56.93	0.73	0.76	0.40	1.89
	150	54.9	4.1	136.9	20.14	21.04	16.98	58.16	0.75	0.88	0.71	2.34
	200	47.1	4.1	105.8	19.74	20.92	16.99	57.65	0.66	0.90	0.72	2.28
LSD at 5%	S	N.S	N.S	N.S	N.S	N.S	0.87	3.03	N.S	N.S	0.26	0.37
	UN	16.4	N.S	179	0.84	0.91	0.90	3.19	0.25	N.S	0.28	0.47
	S x UN	N.S	N.S	28.5	N.S	N.S	N.S	3.56	N.S	N.S	0.49	0.82

These results are in strongly accordance with **(Pinheiro et al., 2008)** who reported reduction in the accumulation of dry matters of leaves, roots and stems of castor bean seedlings under salt stress. The results of biomass indicated that application of NaCl inhibited the growth of maize plant, which led to a decrease in biomass. This may be related to the effect of salt stress which resulted in the limitation of water absorption and biochemical processes **(Parida and Das, 2005**). In addition, a decline in content of chlorophyll and the rates of net photosynthesis occurs, due to adverse affect on CO_2 assimilation, which leads to a decrease in nutrient uptake and finally growth of plants **(Cha-um and Kirdmanee, 2009 and Hussein et al., 2013).**

Furthermore, other investigations related this depression to the disturbance resulted in enzymes and growth regulations activity **(Bekheta, 2000 and Abd El-Baky et al., 2013)** or mineral absorption and distribution **(Hussein et al., 2008 and Shabaan et al., 2008)** or in oxidation defence **(Abd El-Baky et al., 2013 a&b).** The suppression of plant growth under salt-stress may either be due to osmotic reduction in water availability or to excessive accumulation of ions, known as specific ion effect **(Marschner 1995)**. There are many reports on osmotic stress and ionic toxicity resulted from salt stress in maize plants **(Mansour et al., 2005; Eker et al., 2006).**

In addition, **Grewal (2010)** revealed that plants were harvested after 40 days from sowing and assessed for different parameters. Increasing levels of subsoil NaCl salinity had significant depressing effects on shoot and root biomass, root /shoot ratio, water uptake and water use efficiency (shoot biomass production with a unit amount of applied water. Recently, **Attia et al. (2011)** reported that salt stress restricted whole plant biomass deposition rate by diminishing leaf number and leaf expansion, as well as photosynthetic activity were estimated from whole plant biomass production per unit leaf surface area.

Salinity reduces plant productivity firstly by reducing plant growth during the phase of osmotic stress and subsequently by inducing leaf senescence during the phase of toxicity when excessive salt is accumulated in transpiring leaves. Regarding the effect of uniconazole on growth measurements, the data recorded in table (2) show that spraying barley plants with solutions of uniconazole affected on the growth measurements except the average number and weight of leaves/plant. The highest values of plant height, spikes and top dry weight were obtained from the application of uniconazole at 150 ppm in comparison with that obtained from the control and other treatment (200 ppm). In this concern, **Bekheta (2000)** found that application of uniconazole on *Vicia faba* at different concentrations led to reduction in plant height, fresh and dry weights / plant. In addition, **Berova et al. (2002)** recorded that imbibed wheat seeds (*Triticum aestivum* L., cv. Beloslava) for 24 h in a water solutions containing 0, 25 and 50 mg l^{-1} of paclobutrazol led to a significant reduction in length (44–49%) and fresh weight of shoots (15–23%), but caused increase in root production, leading to an increased root to shoot ratio (21–32%). In addition, **Bekheta and Ramadan (2005)** reported that foliar application of uniconazole on cotton plants caused reduction in the undesirable vegetative growth of cotton plants.

Concerning the interaction effects the data recorded in Table (2) show that application of uniconazole on barley plants grown under salinity stress (2500 or 5000 ppm) caused significantly reduction in the leaf area of green leaves. On the other hand, application of uniconazole at the two used treatments (150 or 200 ppm) had positive effect on dry weights of spikes and stem tops under all the used treatments of salt stress. One of the recent techniques used to counteract or alleviate the injurious effects of salinity stress is using growth retardants **(Rademacher, 2000).** One of these retardants is uniconazole. **Bekheta et al. (2009)** found that application of antigibberellins (prohexadione – Ca) on *Vicia faba* plants grown under salt stress at different concentrations increased the number of lateral branches and number of leaves which led to accumulation of dry matter.

Photosynthetic Pigments

Examination of Data in Table (3) indicated that either total Chlorophyll or Carotenoids increased parallel to the increase in salt concentration up to 5000 ppm. However, the ratio of Chl.a / Chl.b and Chl.a +Chl.b / Carotenoids was higher than in the control plants.

Table 3: Effect of uniconazole and salinity on photosynthetic pigments of barley plants (Average of two growth seasons)

Salinity (NaCl) ppm	Uniconazole (UN) ppm	Chl. a ppm	Chl. b ppm	Carotenoids ppm	Chl. a+ Chl. b ppm	Chl. a: Chl. b	Chl. a+ Chl. b: Carotenoids
Tap water (T.W)	0	3.38	1.82	1.02	5.20	1.86	5.10
	150	2.47	1.45	1.32	3.92	1.70	2.97
	200	2.21	1.85	1.58	4.06	1.19	2.57
2500	0	2.00	1.40	1.67	3.40	1.43	2.04
	150	3.96	2.38	2.26	6.34	1.66	2.81
	200	3.59	2.05	2.18	5.64	1.57	2.59
5000	0	2.43	2.91	2.22	5.34	0.84	2.41
	150	2.15	2.63	2.13	4.78	0.82	2.24
	200	3.35	2.87	2.35	6.22	1.17	2.65
Mean values of salinity	T.W	2.69	1.71	1.31	4.40	1.57	3.36
	2500	3.18	1.94	2.04	5.12	1.64	2.51
	5000	2.64	2.80	2.23	5.44	0.94	2.44
Mean values of UN	0	2.60	2.04	1.64	4.64	1.21	2.83
	150	2.86	2.15	1.90	5.01	1.33	2.64
	200	3.05	2.26	2.04	5.31	1.35	2.60
LSD at 5 %	S	N.S	1.18	NS	1.50	………	……..
	UN	N.S	N.S	NS	1.79	………	………
	S * UN	N.S	N.S	NS	N.S	……….	……..

The changes in the amount of pigments were evaluated as the changes in photosynthesis i.e. changes in the contents of pigments under salt stress are used as parameter for selection of tolerant and sensitive cultivars in crop plants **(Eryilmaz, 2007). Doganlar, et al. (2010)** found that responses of pigments in all tomato cultivars different from each other according to exposure times at 24 h of salt treatment, pigment contents of Dalli Tokat and Argy plants continued to increase, but that of Hazera did not change. Under stress conditions and the time of exposure the pigments were decreased by salt stress but this depending on the studied varieties. Increasing in total Chlorophyll content under salt stress was also observed in wheat plants **(Khan et al. (2009).** On the other hand, **Khosravinejad et al. (2009)** reported significantly decreases in the amounts of Chlorophyll (a", "b" and total Chlorophyll (a + b) but Carotenoids content increased under saline conditions. **Hussein et al. (2014)** demonstrated that Chlorophyll a, b and Carotinoids were determined with salt status.

Data in Table (3) showed that Chlorophyll "a" and total Chlorophyll (a+b) gave its higher value by spraying the plants with uniconazole at 150 ppm. The data also reveal that application of uniconazole at 200 ppm lead to increase in the amounts of Chlorophyll "b" and total Carotenoids in comparison with that obtained from the control plants. **Bekheta (2000)** reported that application of uniconazole on *Vicia faba* plants increased significantly all the photosynthetic pigments and carotenoids. **Kishorekumar et al. (2007)** found that application of triazole compounds triadimefon and hexaconazole at 15 mg l^{-1} and at 10 mg l^{-1} respectively and separately by soil drenching on 80, 110 and 140 days after planting (DAP) on *Solenostemon rotundifolius* plants led to increases in the amounts of photosynthetic pigments (Chlorophyll Pigments).

Concerning the interaction between uniconazole and salinity, it is clear from the obtained data that application of uniconazole gives higher positive effect on Chlorophyll "a" at 150 and 200 ppm of the plants that irrigated with saline solution at 2500 ppm. Uniconazole treatment tended to increase photosynthetic pigments content; this was achieved under saline or non saline conditions as compared with control treatment **(Manal, et al 2010).** These results were in harmony with those obtained by **(Bekheta, 2000; lee, et al. (2004) and Bekheta and Ramadan 2005)** all recorded increases in photosynthetic pigments due to uniconazole application. Such these increments in Chlorophyll contents may be attributed to earlier cytokinins formations which stimulate Chlorophyll synthesis and production **Harvey et al., (1974).** In this respect, **Zhou and Leul (1998)** noticed that foliar sprays of uniconazole retarded the degradation of Chlorophyll and increased respiratory capacity of roots.

Total Carbohydrates and Total Soluble Sugars

The data recorded in table (4) show that irrigation barley plants with saline solutions at 2500 or 5000 ppm caused significantly reduction in the amounts of total carbohydrates and total soluble-sugars of barley plants in comparison with that obtained from the plants that irrigated with tap water. These results are in harmony with **Khosravinejad et al. (2009)** found that irrigation of barley plants with solution of NaCl up to 400 mM increased soluble sugars (42.82%) as compared to the control plants.

Table 4: Influence of uniconazole on total carbohydrates and total soluble-sugars of barley plants grown under salt stress (calculated as mg glucose / g dry wt.).

Salinity (NaCl) ppm	Uniconazole (UN) ppm	Total carbohydrates as mg glucose/g dry wt.	Total soluble sugars as mg glucose/g dry wt.
Tap water (TW)	0	58.9	13.5
	150	65.0	15.1
	200	68.7	17.29
Mean		64.2	15.30
2500	0	52.4	16.3
	150	70.5	18.9
	200	73.5	21.0
Mean		65.47	18.73
5000	0	46.2	18.77
	150	74.6	21.0
	200	75.3	22.98
Mean		65.37	20.92
0		52.50	16.19
150		70.03	18.33
200		72.50	20.42
LSD at 1 %		4.55	3.05

The obtained results show that application of uniconazole at all the used treatments (150 or 200 ppm) caused considerable increases in the contents of total Carbohydrates and total Soluble-sugars of barley plants in comparison with that obtained from the untreated plants**. Zhou and Leul (1998)** noticed that foliar sprays of uniconazole inhibited the degradation of total Chlorophyll and increased respiratory capacity of roots. **Qiu, et al. (2005)** demonstrated that uniconazole significantly increased soluble sugar concentration during water logging. Thus, it suggests that seed's film coating with uniconazole at a suitable concentration can improve rape seedling growth and increase seedling establishment during water logging **Abdul Jaleel et al. (2007)** reported that application of growth retardants triadimefon (TDM) and hexaconazole (HEX) on white yam (*Dioscorea rotundata* Poir.) plants at 15 mg l^{-1} TDM and 10mg l^{-1} HEX by soil drenching on 10, 20 and 30 days after planting (DAP) increased carbohydrates as starch and sugar contents. These increments might be attributed to the inhibition in the activity of enzymes α, β-amylase. In this respect, **Kishorekumar et al. (2007)** recorded that application of triazole compounds triadimefon and hexaconazole at 15 mg l^{-1} and at 10 mg l^{-1}, respectively and separately by soil drenching on 80, 110 and 140 days after planting (DAP) on *Solenostemon rotundifolius* plants caused increases in the amounts of Carbohydrates as starch and decreased sugar content.

Regarding the interaction between uniconazole and salinity on barley plants, the data recorded in table (4) revealed that application of uniconazole led to noticeable increases in both total Carbohydrates and total Soluble sugars in comparison with those obtained from their respective control. These results are in harmony with that obtained by **Bekheta et al. (2009)** reported that application of anti-gibberellins "prohexadione –Ca" on *Vicia faba* seedlings grown under salinity stress increased both total carbohydrates and total-soluble sugars.

The increments of soluble sugars under salt stress means that sugars protect the cells during stress. The hydroxyl groups of sugars may substitute for water to maintain hydrophilic interaction in membranes and proteins. Thus, sugars interact with proteins and membranes through hydrogen-bonding thereby preventing protein denaturation **(Sanchez et al., 1995)**. Accumulation of soluble sugars may be counter the osmotic stress.

In this work the increments in total Carbohydrates and Sugar contents of barley plants treated with uniconazole and grown under salinity stress might be attributed to the positive effect of uniconazole on the photosynthetic processes which led to increases in total Chlorophyll and Carotenoids. Such these compounds might be used to protecting the plants against stress conditions.

References

[1] **Abd El-Baky, H.H., Hussein, M.M. and Ibrahim, E.A. (2013a).** Potential of industrial waste use for Jatropha cultivation in arid land. American J. of Agric. And Biol. Sci., 8(4): 350-356.

[2] **Abd El-Baky, H.H., Hussein, M.M. and El-Baroty, T.S. (2013b).** Induces of antioxidant compounds and salt tolerenate in wheat plant irrigated with sea water as application of microalgae spray. American J. of Agric. And Biol. Sci., 9 (2): 127-137.

[3] **Abdul Jaleel, R., Somasundaram, P., Manivannan, R. Panneerselvamleel, C.; A. Kishorekumar, B. Sankar, M. Gomathinayagam and R. Gopi (2007).** Alterations in carbohydrate metabolism and enhancement in tuber production in white yam (*Dioscorea rotundata* Poir.) under triadimefon and hexaconazole applications. Plant Growth Regul. 53: (1) 7-16.

[4] **Abou El-kheir, M.S.A. (2000).** Response of soybean plants growth under water stress conditions to uniconazole application. Egypt J. Appl. Sci., 15(3): 112-125.

[5] **Attia H.; C. Ouhibi ; A. Ellili; N. Msilini; N. Karray and M. Lachaa (2011):** of salinity effects on basil leaf surface area, photosynthetic activity and growth. Acta Physiol. Planta, 33: 823–833.

[6] **Bekheta, M.A. (2000).** Physiological studies on the effect of uniconazole on growth and productivity of Vicia faba plants grown under different levels of salinity. Thesis Ph.D degree,Cairo university, Faculty of Science, Botany department.

[7] **Bekheta, M.A.A. and Amany A. Ramadan (2005)**. Influences of uniconazole and coumarin on some morphological, physiological aspects and fiber quality of cotton plants. J. Agric., Sci., Mansoura Univ., 30, (7) 3683—369.

[8] **Bekheta, M.A.; M. Abdelhamid and A. El-Morsi (2009).** Physiological response of Vicia faba L. to prohexadione calcium under saline conditions. Plant Daninha, Vicosa-MG v 27 (4)769-779.

[9] **Berova, M.; Z. Zlatev and N. Stoeva (2002).** Effect of pacloputrazole on wheat seedlings under low temperature stress. Blug. J. Plant Physiol. 28(1–2), 75–84.

[10] **Cha-um, S. and Kirdmanee, C. (2009)**. Effect of salt stress on proline accumulation, photosynthetic ability and growth characters in two maize cultivars. Pak. J.

Bot. 41: 87-98. . .

[11] **Doganlar, B.Z.; K. Demir; H. Basak and I. Gul (2010).** Effects of salt stress on pigment and total soluble protein contents of three different tomato cultivars. African Journal of Agricultural Research Vol. 5(15): 2056-2065.

[12] **Eker, S., Cömertpay, G., Konu_kan, Ö., Ülger, A.C., Öztürk, L. and Çakmak, I. (2006).** Effect of salinity on dry matter production and ion accumulation in hybrid maize varieties. Turk. J. Agric. For. 30: 365-373.

[13] **Ellouzi, H., Hamed, K.B., Cela, J., Munne-Bosch, S. and Abdelly, C. (2011).** Early effects of salt stress on the physiological and oxidative status of Cakile maritima (halophyte) and Arabidopsis thaliana (glycophyte). Physiol. Plant, 142:128–143

[14] **Eryilmaz, F. (2007).** The relationships between salt stress and anthocyanin content in higher plants. Biotechnol. Biotechnol., Eq. 20(1): 47-52.

[15] **Grewal, H.S. (2010).** Water uptake, water use efficiency, plant growth and ionic balance of wheat, barley, canola, and chickpea plants on a sodic vertosol with variable subsoil NaCl salinity. Agri. Water Manage., 97: 148-156.

[16] **Harvey, B.M.R.; Lu, B.C. and R.A. Fletcher (1974).** Benzyladenine accelerates chloroplast differentiation and stimulates photosynthetic enzyme activity in cucumber cotyledons. Can. J. Bot., 52: 2581–2586**.**

[17] **Herbert, D.P.; Phlipps, P. and Strangl, R. (1971).** Determination of carbohydrates. Methods on microbiol. 58: 209-344.

[18] **Hussein, M.M., Balbaa, L.K. and Gaballah, M.S. (2007)**. Salicylic Acid and Salinity effects on growth of Maize Plants. Research Journal of Agriculture and Biological Sciences 3, 321-328.

[19] **Hussein, M.M., Mehana, H.M., Zaki, S.S. and Abd El-Hadi, N.F. (2014).** Influence of salt stress and foliar fertilizers growth, chlorophyll and carotenoids of jojoba plants. Middle East J. of Agric. Res., 3(2): 221-226.

[20] **Hussein, M.M., Shabaan, M.M. and El-Saady, A.M. (2008).** Response of cowpea plants grown under salinity stress to KP-foliar application. American J. of Plant Physiology, 3(2):81-88.

[21] **Imam, R.M., S.A. Kanil, M.S.A. Abo El-Kheir and S. Abd El-Halium (1995).** Growth parameters, metabolic changes and productivity of wheat plants as affected by uniconazole treatments under water stress conditions. Egypt. J. Appl. Sci., 10(4): 12-27.

[22] **Jackson, M.L. (1973).** "Soil chemical analysis", Prentice-Hall, Inc. Englewood Cliffs. N.J.

[23] **Jamal, S.N., Iqbal, M.Z. and Athar, M. (2007).** Phytotoxic effect of aluminium and chromium on the germination and early growth of wheat (*Triticum aestivum*) varities Anmol and Kiran. Int. J. Environ. Sci. Tech., 3(4): 411-416.

[24] **Kassab, O.M., H.A. El-Zeiny and M.S.A. Abo-El-Kheir (2006).** Response of two lupine varieties to water stress and uniconazole application. Egypt J. of Appl. Sci., 21(1): 100-107.

[25] **Khosravinejad, F; R.Heydari and T. Farboodnia (2009).** Effect of salinity on organic solutes contents in barley. Pakistan J. of Biological Scie. 12(2):158-162.

[26] **Kishorekumar**, A.; **C. Abdul Jaleel**; **P. Manivannan**; **B. Sankar** and **R. Sridharan (2007).**Comparative effects of different triazole compounds on growth, photosynthetic pigments and carbohydrate metabolism of *Solenostemon rotundifolius*. 60: (2) P 207–212.

[27] **Khan, M.A.; M.U. Shiraz; M. A. Khan; S.M. Mujtaba; E. I. S. Mumtaz; A. Shereen; R.U. Ansariand and M. Y. Ashraf (2009**). Role of proline K/NA ratio and chlorophyll content in salt tolerance of wheat (*Tritcum astivum* L.). Pak. J. Bot., 41(2): 633-638**.**

[28] **Lambers, H. (2003).** Introduction, dry land salinity: a key environ. issue in Southern Australia. Plant Soil 257: 5-7.

[29] **Lee, G.; R.N. Carrow and R.R. Duncan (2004).** Photosynthetic responses to salinity stress of halophytic seashore paspalum ecotypes. Plant Sci., 166: 1417-1425.

[30] **Manal, F.M.; A.T. Thalooth and R.K.M. Khalifa (2010).** Effect of foliar spraying with uniconazole and micronutrients on yield and nutrients uptake of wheat plants grown under saline condition. J. Amer. Sci. 6: 398-404.

[31] **Mansour, M.M.F.; Salama, K.H.A.; Ali, F.Z.M. and Hadid, A.F.A. (2005).** Cell and plant responses to NaCl in *Zea mays* L. cultivars differing in salt tolerance. Gen. Appl. Plant Physiol. 31: 29-41.

[32] **Marschner, H. (1995).** Mineral nutrition of higher plants. Academic Press, London.

[33] **May, M. Al-Rumaih and Muna M. Al-Rumaih, (2007).** Physiological response of two species of Datura to uniconazole and salt stress. Journal of Food Agriculture & Environmental, 5(3&4): 450-453.

[34] **Metzzener, H.; Rava, H. and Sender, H. (1965):** Untersuchungen zur synchronisier barkeit einzelner pigment. Mangol von chlorella. Planta, 65: 186-190.

[35] **Parida, A.K. and Das, A.B. (2005).** Salt tolerance and salinity effects on plants: A Rev. Ecotoxicol. Environ. Safety, 60: 324-349.

[36] **Pinheiro H.; S. J.; L. Endres; F. V. Camara C.; F.F. Oliveira JF, de Carvalho LWT, dos Santos JM, dos S. Filho (2008).** Leaf gas exchange, chloroplastic pigments and dry matter accumulation in castor bean (*Ricinus communis* L) seedlings subjected to salt stress conditions. Ind. Crop Prod., 27: 385-392**.**

[37] **Pucher, W. G.; Leavensworth, C. S. and H. B. Vickery (1957)**. in S. P. Colowi and N. C. Kaplan (eds.), Methods in Enzymology Academic Press, New York, NY, Vol. 3, pp. 38–40.

[38] **Qiu, J.; Wang, R.; Yan, J. and Hu, J. (2005).** Seed film coating with uniconazole improves rape seedling growth in relation to physiological changes under water logging stress. Plant Growth Regulation, Volume 479 (1): 75-81.

[39] **Rademacher, W. (2000)**. Growth retardants effects on Gibberellin Biosynthesis and Other Metabolic Pathways. Annual Review of Plant Physiology and Plant Molecular Biology, 51: 501-531.

[40] **Sanchez, M.; G. Revilla and I. Zarra (1995).** Changes in peroxidase activity associated with cell walls during pine hypocotyl growth. Ann. Bot., 75: 415-419.

[41] **Shannon, M.C. (1998).** Adaptation of the plants to salinity. Adv. Agron., 60: 75-199.

[42] **Shabaan, M.M., Hussein, M.M. and El-Saady, A.M. (2008).** Nutrition of statns or shoots of barley

genotypes as affected by salinity of irrigation water. American J. of Plant Physiology, 3(2): 89-95.
[43] **Snedecor, G.W. and W.C. Cochran (1982):** Statistical Methods,Oxford and IBH publishing G. 7th ed. Iowa State univ. Press.Iowa USA.
[44] **Tester, M. and Davenport, R.J. (2003).** Na+ transport and Na^+ tolerance in higher plants. Annals of Botany, 91: 503-27.
[45] **Tuna, A.L.; Kaya, C.; Dikilitas, M. and Higgs, D. (2008).** The combined effects of gibberellic acid and salinity on some antioxidant enzyme activities, plant growth parameters and nutritional status in maize plants. Environmental and Experimental Botany 62, 1-9.
[46] **Yang, D.J.; J.X. Yang and Y.W. Hu, (1994**). Effect of S-3307 on some physiological characteristics of rape seedlings. Plant Physiology Commun., 30: 182-185.
[47] **Zhou, W. and Leul, M. (1998).** Uniconazole-induced alleviation of freezing injury in relation to changes in hormonal balance, enzyme activities and lipid peroxidation in winter rape. Plant Growth Regulation 26(1): 41-47.