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Growth and Photosynthetic Pigments Responces of Durum Wheat Varieties to Irrigation by Diluted Sea Water

Hussein, M. M.[1], N.F. Abd El Hady[2]

Water Relations & Irrigation Dept., Agric. Div., NRC, Cairo, Egypt

Abstract: ***A pot experiment was conducted in the greenhouse of the National Research Centre at Dokki, Cairo Egypt in 2006 and 2007 during winter season to evaluate the effect of different salt stress degrees on the growth, photosynthetic pigments and yield characters. The differences between varieties in all estimated growth criteria (Plant height, number and area of green leaves/mean stem, number of tillers, number of spikes and length of spike) were significant. Plant height and number of green leaves were higher in Sohag3, number of tillers and spikes were higher in BaniSweef3 and area of leaves/mean stem and length of spike were higher in Sohag2 plants. The lowest values of all these characters were in BaniSweef1. BaniSweef3 exceeded BaniSweef1 in growth characters, however, the differences between both Sohag cultivars were not significant in the above mentioned criteria. Salt stress had remarkable negative effects on growth parameters of durum wheat plants. The depression in growth attributes increased as the salt level increased in water of irrigation. The differences in chl.b, carotenoids and total chlorophyll were not significant. Among the three varieties ,Banisweif 3 variety was superior in chl.a :chl.b and ch.a + chl.b:total carotenoids ratios. This indicated that there is a positive relationship between salt stress and the concentration of both parameters. Similar response s were detected by chla; chl.band chl.a+chl.b : total carotenoids ratios. However, the concentration of chl.b as well as total carotenoids did not significantly affected by salinity. Both concentration of salt stress led to a decrease in total carotenoides concentration in Banisweif 3 and Sohage3. The reverse was true with babisweif1 and Sohag2.***

Keywords: Durum wheat - Varieties - Seawater - Salinity –Growth, Dry matter-Photosynthetic pigments

1. Introduction

Durum wheat (*Triticum durum L)* is one of the most important nutritional cereal crops in Egypt. Nowadays this important increased from their uses includes macaroni production and the excess used in bread production. The nutritional value of durum wheat has much better content of amino acids and vitamins; also it is resistant under hot regions. Nowadays, Sohag1, and 3 and Banisweaf1, 2 and 3 varieties are available for production of semolina with relatively high quality for local macaroni production. On the other hand, varieties of high yielding capacity and quality still until now are scarce in which the possibility of expanding the cultivated area (**El-Hosary, et al., 2000**).

One of the major problems limited the increase in area and productivity of bread and durum wheat in the arid regions is the scarcity of water and use of saline water. Salinity adversely affected growth, yield and yield traits (**Gawish, et al., 1999; Hun, et al., 2001; Gupta, et al., 2001 and Hussein, et al., 2012, 2013and 2014**. **Steppuhn, et al., 2001)** exposed durum wheat, dry bean, field bean and canola to near zero, moderate and severe salinity (electrical conductivities of 1.2 as nutrients only, 11.2 and 24.9 ds m-l, respectively. They found that durum wheat emerged and survived moderate and severe salinity better than any of the alternative crops. Under severe salinity yield of all crops reduced drastically but this effect was more pronounced in beans. (**Hussein, M.M. et al.,2009 confirmed these results**.)

Varietals differences in morphological characters, yield structure and yield component of durum wheat were detected by: (**Stheno, et al., 2001; Delchev, et al., 2000; Gatteric, et al., 2000; Raiu, et al., 2000 and Mohammed, et al., 2001)** The high yield varieties and drought resistant or / and tolerate salt stress, nowadays, are considered as a vital goal to increase and improve the productivity of crops in the new areas. Recently intensive researches are conducted to evaluate the genetical differences between varieties in salinity tolerance. Therefore, this work aimed to study the effect of irrigation by diluted seawater on growth and photosynthetic pigments of some durum wheat varieties.

2. Material and Methods

A pot experiment was conducted in the greenhouse of the National Research Center at Dokki, Cairo, Egypt during 2006/2007 winter season to evaluate the effect of different salt stress degrees on the growth, photosynthetic pigments and yield characters. The treatments were as follows:
1 - Varieties: BaniSweef 1, BaniSweef 2, Sohag 2 and Sohag 3
2 - The salt concentration in water of irrigation (by diluting Mediterranean seawater with fresh water): Tap water (250 ppm), 2000 and 4000 ppm.

The experiment included 3 levels of salinity in combination with three varieties i.e. 12 treatments in 6 replicates. Metallic ten pots 35 cm. in diameter and 50 cm. in depth were used. Every pot contained 30 Kg. of air dried clay loam soil. The inner surface of the pots was coated with three layers of bitumen to prevent direct contact between the soil and metal. In this system, 2 kg of gravel (Particles about 2-3 cm in diameter), so the movement of water from the base upward.

Grains of different varieties of durum wheat (*Triticum durum L*) cvs Sohag2, Sohag3, BaniSweef1 and BaniSweef3 were sown in December,20,2002 plants were thinned twice, the 1st days after sowing and the 2nd two weeks later to leave three plants / pot . Calcium super phosphate (15.5 % P205) and potassium sulfate (48.5 % k20) in the rate of 3.0 and 1.50 g/pot were added before sowing. Ammonium sulfate (20.5 % N) in the rate of 6.86 g / pot was added in two equal portions, the 1st after two weeks and the 2nd two weeks later. Irrigation with diluted seawater in different concentrations was started 30 days after sowing (Firstly, irrigation by salt water and secondly, was by fresh water, alternatively). Photosynthetic pigments in leaves of different durum wheat plants was determined according to the method of (**VanWittestien, et al., 1957).**

Data collected were subjected to the proper statistical analysis with the methods described by **(Snedecor and Cochran, 1990).**

3. Results and Discussion

3.1 Varietals differences

3.1.1 Growth

Data recorded in Table (1) showed that the differences between varieties in all estimated growth criteria (Plant height, number and area of green leaves/mean stem, number of tillers, number of spikes and length of spike) of spike were significant. Plant height and number of green leaves were higher in Sohag 3, number of tillers and spikes were higher in BaniSweef 3 and area of leaves / mean stem and length of spike were higher in Sohag2 plants. The lowest values of all these characters were in BaniSweef1. BaniSweef3 exceeded BaniSweef1 in growth characters, however, the differences between both Sohag cultivars were not significant in the above mentioned criteria. Data in Table (1) also showed that the differences between durum wheat varieties in dry weight of stem, leaves, straw, spikes and grains were significant. Sohag2 surpassed the other varieties in stem, spikes, grains and whole plant but Sohag3 was superior in leaves and straw weight. the lowest values of these parameters were by Banisweaf 1. Many authors reported the differences between varieties in growth characters of durum wheat varieties: (**Aydin, et al., 2000; Erchidi, et al., (2000); Halitligil, et al., 2000 and Hafsi, et al., 2000).**

Terziev (2000) concluded that the highest variety of, wheat, triticale and barley, in yield had the highest number of grains and grains weight/spike. In Egypt, **El-Hosary, et al., (2000)** with durum and bread wheat varieties, indicated that in the 1st season, Banisweaf2, Banisweaf3, Sohag2 and Sohah3 gave the highest number of spikes/m3 . But Gemmeza3 gave the lowest value. Sohag3 gave the highest number of kernels/spike while no significant differences between Sohag2, Banisweaf 3, Banisweaf1, Sohag 1 and Sohag3 cultivars. The lowest value recorded by Banisweaf3 cv. Whereas, in the 2nd season, Sohag3, Banisweaf1 and Sohag1 had the best average of 1000 grains weight. Moreover, **Houshmand, et al., (2005**) reported that field salinity significantly reduced means of all traits averaged on eight genotypes. In vitro salt tolerance Dippereb and Prion-1 produced the highest dry weight and K: Na ratio under salt stress conditions (150 mMNaCl).

Recently, the varietals differences of durum wheat were observed by many authors among of them: (**Platan, et al., 2009;Akram, et al., 2009; Bassu, et al., 2009 and Mobarak, et al., 2009).**

3.1.2 Photosynthetic Pigments

Chlorophyll a concentration in Banissweif 3 and Sohag 3 exceeded those in Banisweif 1 and Sohage 2. Nevertheless, Data in Table (2) clearly showed that the differences in chl.b, carotenoids and total chlorophyll were not significant. Furthermore, Banisweif3 variety was superior in chl.a :chl.b and chl.a+chl.b : total carotenoids ratios among the three other varieties.

Several researches detected that photosynthetic pigments and florescence have shown that there are varietals differences in durum wheat (**Dib, et al., 1994;Sarke, et al., 1999 and Sayer, et al., 2008).** Moreover,(**Hussein, et al., 2011**) reported the varietal differences in photosynthetic pigments of barley varieties.

3.2 Salinity

3.2.1 Growth

Data presented in Table (3) indicated that salt stress had remarkable negative effects on growth parameters of durum wheat plants. The depression in growth attributes to increase as the salt level increased in water of irrigation. (**Grieve and Poss, 2000)**reported that salinity significantly reduced wheat biomass production, yield components and final grain yield. (**Khatkar, et al., 2000)** revealed that no of green leaves, leaf area, relative growth rate and net assimilation rate were affected adversely in KRL 1-4 and HD2009 varieties. (**Gawish, et al., 1999)** noticed that increasing salinity reduced plant growth and hazard effects were generally more pronounced in roots of Giza 164 and Sakha 69 bread wheat varieties. (**Hu, et al., 2001)** suggested that the limitation of leaf growth by salinity may be due to the effect of salinity on leaf expansion, but not due to the effect on the synthesis of dry matter.

Irrigation with diluted seawater exhibited significant effects on the dry matter of stem, straw, spikes and whole plants, however, the differences in leaves and grains dry weight not enough to reach the level of significance. It is clearly shown that the first dose of salinity did not exert any significant effect while using of 4000 ppm solution adversely affected the all above mentioned criteria.

It could be concluded from the afro mentioned data that durum wheat tolerates the low and moderate salt stress. Salt stress effected on wheat plant growth through its effect on one and/or more ways: Absorption and movement of water through different tissues and organs (**Hu, et al., 2001;Akram, et al., 2009 and Ribaut and Pilet, 1994**), photosynthesis (**Behbout,et al., 1986; Aldesouky and Gaber, 1993 and Ashraf, et al., 2002**); protein synthesis and enzymes activity (**Anurahda and Rao, 2001; Salama,**

et al., 2000 and Abd-El-Baky, et al., 2003), hormonal disturbance (**Ribaut andPilet, 1991; Scott, 1994; and Hussein, et al., 2002**); mineral absorption and distribution and mineral toxicity(**Zekri and Persons, 1992; Romero, 1997;Lingle, et al., 2000 and Lutts, et al 2004**.**Katerji, et al., (2003**) concluded that salinity affected the pre-dawn leaf water potential, stomatal conductance, evapotranspiration, leaf area and yield. The following criteria were used for crop salt tolerance classification: soil salinity, evapotranspiration deficit, water stress day index. **Katerji, et al., (2009)** noticed that salinity affected the durum wheat by reducing the grain and straw yields when the soil salinity (EC_e) was higher than 5.8 dS m^{-1}. This reduction was due to the fact that there were fewer grains per ear. As for barley, the grain yield was not reduced if EC_e ranged from 0.9 to 9.8 dS m^{-1}, but the straw yield was affected. The results obtained for durum and barley are consistent with the observations reported in the literature.

3.2.2 Photosynthetic Pigments

Data presented in Table (4) revealed the concentration of chl.a and total chlorophyll. This indicated that there is a positive relationship between salt stress and the concentration of both parameters. Similar responses were detected by chla; chl.b and chl.a+chl.b : and total carotenoids ratios. However, the concentration of chl.b as well as total carotenoids did not significantly affected by salinity. **Ehsanzadeh, et al., (2009)** found that salinity reduced leaf content of chlorophyll a (chl-a) at 120 mM but had not significant effect on chlorophyll b (chl.b) content. Salt stress decreased plant leaf area by nearly 63%. Plant top dry weight declined by 52 % with increasing salinity to 120 mM level.**Hussein, et al., (2011)** on barley plants; and **Hussein, et al.,** (**2012**) on Egyptian clover showed the depression in photosynthetic pigments.

3.3 Varietals differences x Salinity

3.3.1 Growth

The effect of salinity on the different barley varieties were illustrated in Table (5).Data showed that the depression effect of salt stress on plant growth, number of tillers and number of spikes were more pronounced in Banisweaf 1 variety than the other varieties however, this finding was in leaves area/ mean stem by Sohag 2 and for length of spikes by Sohag 2 and Sohag3. The lowest depression effect on plant height, and number of leaves / mean stem by Sohag 3 and the length of spikes by Baniseaf 3 and Baniseaf 1. Salinity did not exert any effect on number of tillers and spikes / plant. The differences as interaction of variety and salt stress in the growth criteria were not great enough to reach the significant level. Data also showed that the depression in dry weight of different plant parts in Banisweaf1 and 3 exceeded those in Sohag2 and 3 varieties. This means that Sohag2 and 3 were more tolerant to salinity than Baniseaf1 and 3 varieties. **Hussein, et al.,2011**) found that varieties of wheat showed different responses to the salt stress levels.

Gawish et al., (1999) in Egypt with three types of salinity concluded that Giza 124 cultivar was relatively salt-tolerance and Sakha 69 cultivar was relatively salt sensitive.

Gupta et al., (2001) reported that water stress reduced LWP in both varieties but LOP was significantly higher in C-306. **Badr and El-Shafie (2002)** found that growth rate/plant as appreciably greater at 100 mM in Sakha 8 than at Giza 162, although the difference between the two cultivars in root dry weight was not significant. The application of higher levels (100 and 150 mm) NaCL impiared plant growth and the reduction was more pronounced on above growth parts than in the roots particularly in salt sensitive cultivar. The wheat root system relatively more tolerant than the shoots, this may contribute to the survival of wheat plants under saline condition. The salt tolerant variety Cham-1, created by ICARDA, showed a higher grain yield than the less salt tolerant landrace Haurani, but the main parameters for the pasta quality declined considerably. Salinity had a slight positive effect on the grain quality of the Cham-1 variety, whereas the Haurani variety showed no salinity effect on grain quality. A decrease in ash content corresponded with an increase in water use efficiency. The relationship between ash content and water use efficiency may be useful for selecting varieties with high water efficiency under saline conditions **(Katerji, et al., 2005a**). Seven varieties of durum wheat (*Triticum turgidum*), provided by ICARDA, were tested in a greenhouse experiment for their salt tolerance. Afterwards two varieties, differing in salt tolerance, were irrigated with waters of three different salinity levels in a lysimeter experiment to analyze their salt tolerance. The characteristics of the salt tolerant variety compared to the salt sensitive variety are: - a shorter growing season and earlier senescence; - a higher pre-dawn leaf water potential;- a stronger osmotic adjustment;- a better maintenance of the number of productive stems per plant. Salt tolerance of durum wheat corresponds with drought tolerance because the tolerance is caused by earlier senescence and stronger osmotic adjustment, both reducing the transpiration of the plant (**Katerji, et al., 2005b**).

(Panahi1, et al., 2006) mentioned that wheat was chosen as a test case to investigate the current availability of salt-resistant germplasm in the world collection. A three-year field study was conducted in Yazd, to compare the yields of 9 durum wheat cultivars under saline conditions. These cultivars are all imported to the country. The results indicate that there is significant variation among the yields of the 9 cultivars studied. Cultivar #6 had the highest yield in both years with 2.26 and 3.16 ton/ha for the first and second year, respectively. Although the cultivar 36 didn't have the highest 1000-kernel weight but had the highest yield in the three seasons. Based on the results of this study, cultivars36 is recommended for cultivation under present saline conditions. Based on the results of this study, also cultivars #6 is recommended for cultivation under present saline conditions.

(T**ekalign, et al., 2007)** studied the response to salinity of four varieties each of durum wheat (DZ-04-118, DZ-320, DZ-918, and Tob-2) and tef (DZ-01-354, DZ-010787, DZ-01-1445 and DZ-Cr-370) at germination and late vegetative stages was studied using four salinity levels (0, 2, 4 and 8 dSm^{-1}NaCl. They found that among the durum wheat varieties, DZ-04-118 was the most sensitive and DZ-01-320 the most tolerant at high levels of NaCl. At the germination stage, tef variety DZ-01-1445 was the most sensitive while DZ-Cr-37 was the most tolerant. It is recommended that further studies should involve screening from large genetic populations of both crops in order to identify more salt tolerant lines that may be used in breeding activities.

To screen wheat and barley genotypes for salinity resistance, 10 bread wheat, 123 durum wheat and 11 barley genotypes were planted under saline conditions (**Thalji and Shalaldeh, 1997).** Salinity ranged (20.6219 and 4.5-5.5 dS/m) for both soil and water, respectively. The results showed that wheat genotypes Jumaizah, Bin-bashair, and Snap and barley genotypes Acsad-176, lLine-105 and Rum showed higher biological yield performance. Genotypes; Jumaizah, Bin-bashair, Snap, Cham3 and Cham6 and barley genotypes: Line3, Line2 and Line5 showed high seed yield performance. However, wheat genotypesBehowth1 exhibited the highest straw yield performance compared to the other wheat genotypes. Germination percentage had a strong positive correlation with seed yield (0.75) and straw yield (0.41). Negative association between heading and physiological maturity periods with seed yield (-0.29) for each was obtained.

Husain, et al., (2003) revealed that at early emergence, the effects of salinity on biomass were less on the low Na^+ than on the high Na^+ genotypes at 75 mMNaCI, but there was no difference between groups at 150 mM NaCl. At maturity, salinity had a similar effect on biomass of both genotypes, at both 75 and 150mMNaCl. Grain yield at 150 mM NaCI was equally reduced in both genotypes, being only 12% of controls. However, at 75 mM NaCI there was a significant yield difference between genotypes; yield of the high Na^+ genotype was only 70% of controls, whereas yield of the low Na^+ genotype was 88% of controls. The greater yield of the low Na^+ genotype was due to enhanced grain number and grain weight in the tiller ears.
Zair, et al., (2003) stated that when watered with a solution containing more than 20 g l^{-1}NaCl, the seeds of cultivar Te derived from R_{0-10} regenerated plants exhibited the best elongation of roots and coleoptiles. **Munns, et al.,** (**2006)** mentioned that physiological mechanisms that under lietraits for salt tolerance could be used to identify new genetic sources of salt tolerance. Important mechanisms of tolerance involve Na^+ exclusion from the transpiration stream, sequestration of Na^+ and Cl^- in the vacuoles of root and leaf cells,a nd other processes that promote fast growth despite the osmotic stress of the salt outside the roots. **James, et al., (2006)** noticed that lines containing *Nax1* differed from those containing *Nax2* by unloading Na^+ from the xylem as it entered the shoot so that Na^+ was retained in the base of the leaf, leading to a high sheath to blade ratio of Na^+ concentration. Gradients in tissue concentrations of Na^+ along the leaf suggested that Na^+ was continually removed from the xylem. The *Nax2* line did not retain Na^+ in the base of the leaf, suggesting that it functioned only in the root. The *Nax2* gene therefore has a similar function to *Kna1* in bread wheat (*Triticum aestivum*). **Zhao, et al., (2007**) found that the differences between VAO-7 and VAO-24 for most parameters measured were significant after 2 weeks of stress introduction at 200 and 250 m*M* NaCl. Salt stress at the lowest level (50 m*M*) reduced total leaf area by35% and plant dry matter by 52%. Significant reduction in photosynthetic rate was observed even at the low salinity levels. There were no significant difference between 100 and 150 m*M*NaCl treatments. Photosynthetic rate decreased by 81% for VAO-7 and by 91% forVAO-24 at 250 m*M* NaCl concentration at 25 DASA. Concurrently, stomatal conductance was also reduced with the increase in salt concentrations. It was observed that stomatal conductance for VAO-24 was reduced by 67% compared with the control at 100m*M*NaCl stress. However, neither photosynthetic rate nor stomatal conductance was reduced significantly at the 150 m*M* level as compared with 100 m*M* treatment.

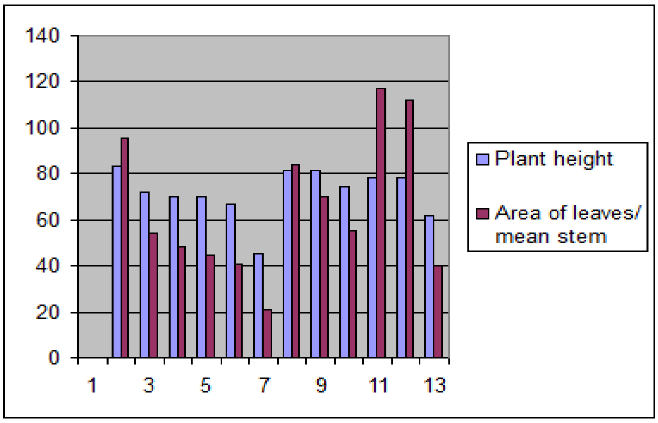

Figure 1: The effect of different concentrations of salinity on plant height and area of leaves / mean stem.

Photosynthetic Pigment

Data dealing with the interactive effects of salt stress and varieties of durum local varieties of durum wheat were reported in Table (6).Both concentration of salt stress led to a decrease in total carotenoides concentration in Banisweif3 and Sohage3. The reverse was true with babisweif1 and Sohag2. **Hussain, et al., (2003**) showed that the low Na^+ genotypes much longer chlorophyll retention than the high Na^+ genotypes, the start of leaf senescence being prolonged by a week or more in the low Na^+ genotypes. The difference was greatest at 75 mM NaCI. **Zair, et al.,(2003)** revealed that a chlorophyll fluorescence test showed a clear improvement in salt tolerance of R_{0-10} plants at four to five-leaf stage, compared to R_{0-0} plants. It is concluded that plant regeneration from callus initiated on high NaCl levels may be a valid method of selection for salt tolerance. **Zhao, et al., (2007)** found that under salinity stress, leaf photosynthetic rate was reduced significantly of durum wheat.

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Table 1: Growth of different durum wheat varieties. (after 120 days after sowing)

varieties	Plant height cm.	No of leaves/ mean stem	No of tillers/ plant	Area of leaves/ mean stem	No of spikes /plant	Length of spike cm
Ban. 3	75.0	3.43	3.57	65.9	4.23	13.67
Ban. 1	60.5	2.97	1.67	35.5	2.23	13.87
Soh. 3	79.0	3.77	2.67	69.8	3.57	14.2
Soh. 2	72.7	3.67	2.97	90.0	3.67	14.67
L.S.D. 0.05	7.02	0.46	0.27	20.3	1.02	N.S

Ban. : Banisweaf Soh. : Sohag

Table 2: Effect of irrigation by diluted seawater on growth of durum wheat plants (after120 days after sowing)

Salt conc. ppm	Plant height cm	No of leaves/ mean stem	No of tillers/ plant	Area of leaves/ mean stem	No of spikes /plant	Length of spike cm.
T.W.	78.1	3.83	3.05	85.40	3.75	15.83
2000	74.5	3.58	2.85	69.30	3.60	14.48
4000	62.8	2.90	2.25	41.20	2.93	11.93
L.S.D. 0.05:	4.69	0.64	0.70	17.90	0.50	1.45

T.W. : Tap water

Table 3: Effect of irrigation by diluted seawater on growth of different durum wheat plants. (after 120 days from sowing)

	Salt conc.	Plant	No. of	No. of	Area of	No. of	Length of
Ban. 3	T.W.	83.3	.4.0	3.3	95.3	4.o	15.0
	2000	71.7	3.3	3.7	54.0	4.7	15.3
	4000	70.0	3.0	3.7	48.3	4.0	10.7
Ban. 1	T.W.	69.7	3.3	2.3	44.7	3.0	15.3
	2000	66.7	3.0	1.7	41.0	2.0	14.3
	4000	45.0	2.3	1.0	20.7	1.7	12.0
Soh. 3	T.W.	81.3	4.0	3.3	84.3	3.7	16.3
	2000	81.3	4.0	2.7	69.7	3.7	14.0
	4000	74.3	3.3	2.0	55.3	3.3	12.3
Soh. 2	T.W.	78.0	4.0	3.3	117.3	4.3	16.7
	2000	78.3	4.0	3.3	112.3	4.0	14.3
	4000	61.7	3.0	2.3	40.3	2.7	12.7
L.S.D. at 5%		9.37	N.S	N.S	N.S	N.S	N.S

Ban. = Banisweaf T.W = Tap water
Soh. = Sohag M. stem = Mean stem

Table 4: Effect of irrigation by diluted seawater on photosynthetic pigments of durum wheat plants. (after 120 days from sowing.

Salt conc. ppm	Chl.a	Chl.b	Carotenoids	Chl.a+Chl.b	Chl.a; Chl.b	Chl.a+Chl.b ::Carotenoids
T.W.	5.55	3.85	5.69	9.40	1.44	1.65
2000	6.13	3.87	5.43	10.00	1.58	1.84
4000	7.07	4.00	5.42	11.07	1.77	2.04
L.S.D. 0.05:	1.49	N.S	N.S	1.23	……	……

Ban. : Banisweaf Soh. : Sohag

Table 5: Effect of irrigation by diluted seawater on photosynthetic pigments in plants of durum wheatvarieties. (after 120 .(days from sowing

varieties	Chl.a	Chl.b	Carotenoids	Chl.a+Chl.b	Chl.a; Chl.b	Chl.a+Chl.b ::Carotenoids
Ban. 3	7.10	3.25	4.03	10.35	2.19	2.57
Ban. 1	5.84	3.98	5.61	9.82	1.48	1.75
Soh. 3	6.44	3.23	5.90	9.67	1.99	1.64
Soh. 2	5.60	4.10	5.18	9.70	1.37	1.87
L.S.D. 0.05	1.38	N.S	N.S	N.S	…….	…..

Ban. : Banisweaf Soh. : Sohag

Table 6: Effect of irrigation by diluted seawater on photosynthetic pigments of different durum wheat plants. (after 120 days from sowing)

varieties	Salt conc.	Chl.a	Chl.b	Carotenoids	Chl.a+Chl.b	Chl.a; Chl.b	Chl.a+Chl.b ::Carotenoids
Ban. 3	T.W.	6.88	203	6.38	8.91	3.39	1.40
	2000	6.68	342	5.72	10.10	1.95	1.77
	4000	7.75	430	4.00	12.05	1.80	3.01
Ban. 1	T.W.	5.69	359	4.94	9.28	1.59	1.88
	2000	6.07	383	5.31	9.90	1.59	1.86
	4000	5.78	452	6.57	10.30	1.28	1.57
Soh. 3	T.W.	4.98	373	6.48	8.71	1.34	1.37
	2000	5.65	368	5.78	9.33	1.54	1.61
	4000	8.69	228	5.45	10.97	2.01	2.01
Soh. 2	T.W.	4,.63	284	4.95	7.47	1.63	1.51
	2000	6.10	456	4.92	10.66	1.34	2.17
	4000	6.07	491	5.68	10.98	1.24	1.93
L.S.D. at 5%		N.S	N.S	0.73	N.S	…..	………

Ban. : Banisweaf Soh. : Sohag