Effect of Drought Stress Conditions and Nitrogen Fertilizer on Growth of Two Cultivars of Wheat (*Triticum aestivum* L.)

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Abstract: Two field experiments were carried out at the Agricultural Experimental farm of Faculty of Agriculture; Suez Canal University; Ismailia Governorate, Egypt during two winter seasons of 2012/13 and 2013/14. These experiments aimed to study the effect of regimes, rates of nitrogen fertilization (50.75 and 100 kg/fed) and two wheat varieties (Sakha 94 and Sedes 12) and their interaction on plant growth characteristics. This experimental farm is located at Longitude 30 º 58\\ and Latitude 32 º 23\\ at 13 meter above sea level. The texture of experimental site was sandy soil. Split–split plot design with three replications was followed. Exposure wheat plants to drought stress treatment at tillering or heading stages significantly decreased each of total chlorophyll, carotenoid pigments, plant height, dry weight of biomass above ground/ plant, flag leaf area, leaf area index and crop growth rate at the two growing seasons comparing to control treatment without skipping any irrigation. Meanwhile, proline content was decreased by skipping irrigations at tillering and heading stages. Increasing nitrogen fertilizer up to 100 kg N/fed led to increase all traits under studying during two growing seasons. Wheat cultivar Sakha 94 surpassed Sedes 12 in all traits. Flag leaf area, total chlorophyll and proline contents were affected significantly by interaction between the studied factors.

Keywords: wheat, (*Triticum aestivum* L), cultivars, drought stress.

INTRODUCTION

Wheat (*Triticum aestivum*, L) is one of the most important cereal crops in Egypt. Nowadays, wheat production is insufficient to face local consumption as a result of rapidly increase in Egyptian population. Wheat crop is occupied 38.75% almost from all cultivated area during winter season in Egypt. The same trend is found at Ismailia condition. Some of cultivated areas under wheat crop are suffering from a shortage of irrigation water. Therefore, some of wheat areas will be exposed to drought conditions. Agricultural land of Ismailia is characterized by low the fertility therefore it is necessary to use mineral nitrogen to increase productivity.

Nitrogen is considered one of the most essential factors for high wheat grain yield and its quality. Chlorophyll is the pigment responsible for the green color of plants, and plays a unique role in the physiology of green plants. Therefore, chlorophyll has been used as a sensitive indicator of plant physiology. Status of drought stress (both severe drought and moderate drought) accelerated the chlorophyll content index (CCI) reduction after GF-1 stage *i.e.* Feekes 11.1, kernels milky ripe (Ommen *et al.*, 1999; Tas and Tas, 2007; Keyvan, 2010; Saeedipour, 2011; Ping *et al.,* 2012). Bojovici and Stojanovic (2005) mentioned that biosynthesis of carotenoids in plants is a genetic characteristic, but environmental conditions play an essential role. Water stress conditions at heading stage increased leaf proline content compared with control treatment (Khan, 2009; Maralian *et al.*, 2010). Negative effect of skipping irrigation at tillering or heading stages could be explained on the light loss of turgor pressure of plant cell which affects rate of cell expansion and ultimate cell size. Loss of turgor is probably the most sensitive process to water stress and resulted in decrement in growth rate and stem elongation (Bayoumi, 1999; Sharaan *et al.*, 2000; Yakout, *et al.*, 2002; Kotb, 2005; Mehasen *et al.,* 2014). Skipping irrigation has negative effect on dry weight of biomass of wheat plant (Abd El-gawad *et al.*, 1993; Abo- Shetaia and Abd El-gawad, 1995; Yakout *et al.*, 2002; Maralian *et al.,* 2010). Drought stress inhibits cell division and stopping production of new plant tissues and leaf expansion (Yakout *et al.*, 2002; Hassan, 2005; Ping *et al.*, 2012; Mehasen *et al.,* 2014). Drought stress has also negative effect on LAI values and crop growth rate (Abd El-Gawad *et al.*, 1993; Hassan, 2005).

Nitrogen plays an important role in construction of photosynthetic pigments (chlorophyll a + b), as well as carotenoids and increase its concentration into plant cells as increasing nitrogen level (Hassan, 2005; Abdel-Ati and Zaki, 2006; Tatjana Tranavičienė *et al.*, 2007; Bojovic and Markovic, 2009; Talat, 2013; Karimpour *et al.*, 2013). Proline is one of the amino acids group into plant cell. It well known that any amino acid has amino group (NH2) in its structure and thus increasing nitrogen level into the soil leads to increase absorption of nitrogen into plant cell and thus increases concentration of proline acid in plant tissues (Goudarzi and Pakniyat, 2009; Khan *et al.*, 2009).

Nitrogen play an important role in enhancing some physiological process such as protein formation, cell elongation and cell division, building chlorophyll pigment which resulted in formation of new plant organs and increments of some plant growth characteristic such as plant height, dry matter accumulation flag leaf area, leaf area index (LAI), crop growth rate (CGR) (Shrief *et al.,* 1998; Hassan, 2005; Tatjana Tranaviciene *et al.,* 2007; Ahmed *et al.,* 2012; Gheith *et al.,* 2013; Karimpour *et al.,* 2013).

Wheat varieties are differ in their morphological characteristics (Hassan, 2005; Mohamed *et al.*, 2005; Bayoumi, 2006; Gheith *et al.*, 2013; Masoud Karimpour *et al.*, 2013; Mehasen *et al.*, 2014).

MATERIALS AND METHODS

Two field experiments were carried out at the Agricultural Experimental Farm Faculty of Agriculture; Suez Canal University; Ismailia Governorate, Egypt during the two winter seasons of (2012/13 and 2013/14). To study the effect of three irrigation regimes, three rates of nitrogen fertilization and two varieties and their interaction on the plant growth characteristics of wheat. This experimental farm is located at Longitude 30 º 58\\ and Latitude 32 º 23\\ at 13 meter above sea level. The climatic conditions of Ismailia city are presented in Table (1) from these data it could be concluded that averages of air temperature during growing season were ranged from 13.4–19.6C^o at first season and from 14.5–21.4C^o at second season. Ismailia city is characterized by low rain fall during growing season and it was 25 mm /year. The textures of experimental sites were sandy soil as shown from mechanical and chemical properties in Table (2).

Table (1): Monthly climatic data at Ismailia Governorate during two growing periods of wheat cultivation in 2012/2013 and 2013 /2014 seasons.

Date	Solar radiation Dgt [MJ/m2] aver	Precipitation [mm] sum	HC Air temperature [°C] aver	minimum	maximum
2012/2013 season					
December 2012	348.58	1	15.1	6.3	29.2
January 2013	369.51	10.2	13.4	5.4	25.9
February 2013	494.94	2	15.5	7.1	28.2
March 2013	656.73	0	18.5	6	34.7
April 2013	746.74	17.6	19.6	2.5	37.2
2013/2014 season					
December 2013	438.045	0.5	18.8	9	33.4
January 2014	377.37	7	14.8	6.45	25.95
]February 2014	417.36	1.1	14.5	5.95	26.35
March 2014	506.03	4.8	15.3	3.8	28.85
April 2014	777.72	0.6	21.4	11.2	35.6

Source: Central Laboratory for Agricultural Climate

Table (2): Mechanical and chemical analysis of experimental soil site in two growing seasons (2012/13 and 2013/14).

Soil analysis	2012/13	2013/14
Mechanical analysis		
Sand %	16.98	6.91
Silt %	2.32	1.73
Clay %	80.70	91.36
Texture grade	Sandy	Sandy
Chemical analysis		
pH	7.83	7.80
ECs(ds m^{-1})	0.76	0.54
Ca (meq/L)	2.8	3.0
Mg (meq/L)	2.0	1.0
K (meq/L)	0.3	0.2
Na (meq/L)	2.9	1.8
Cl (meq/L)	3.6	1.8
HCo_3 (meq/L)	4.0	3.6
SO_4 (meq/L)	0.4	0.6
CO_3 (meq/L)	0.0	0.0

Factors of study

A-Irrigation regimes: It was three irrigation regimes as following:

1- Normal irrigation regime is considered as a control treatment (without skipping any irrigation treatment).
2- Skipping irrigation treatment during tillering stage.
3- Skipping irrigation treatment during heading stage. Skipping one irrigation.

B- Fertilization treatments were as following
1- 50 Kg N/fed (119.0 kg/ha).
2- 75 Kg N/fed (178.6 kg/ha).
3- 100 Kg N/fed (238.1 kg/ ha).

Nitrogen fertilizer in form of ammonium nitrate (33.5 N) was used. Each fertilizer rate under study was divided into three doses first dose was 20% from total quantity and applied at sowing before first irrigation, second dose was 40% from total quantity and applied after 35 days from first one meanwhile third one was 40% and applied after 29 days from second one.

C- The two varieties were
1- Sedes 12
2- Sakha 94

The two varieties of this study were obtained from Ministry of agriculture-Egypt.

Experimental work:

Experiments were laid out in a split- split plot design with three replications whereas irrigation regimes were laid in the main plots, meanwhile fertilization treatments were applied in subplots and finally varieties were cultivated in sub-sub plots. Sowing date was December 7, 2012 in first season and December 2, 2013 in second season .Sub-subplot area was 3.5 m in length and 3 m in width. Wheat cultivars were sown in sub-sub plot into 15 rows and distance between each two rows was 20 cm. Soil site of experiment was fertilized with phosphorus and potassium fertilizers as recommended and other agronomic practices were applied as followed in Ismailia area. Wheat plants were harvested at April 20, 2013 and April 16, 2014 for first and second season, respectively.

Studied characters:

After conducting experimental treatments of this study five guarded plants were collected randomly to measure some vegetative growth after 116 days characters as follows:

1- Plant height (cm).
2- Dry weight of biomass above ground (g/plant).
3- Flag leaf area (cm^2/plant) by using equation of Owen (1968).
4- Leaf area index (LAI/plant)
5- Crop growth rate (mg/m^2/day).
6- Photosynthetic pigments (Chlorophyll a, b and carotenoids) were estimated from green leaf according to Fadeel method (1962) and using formula of Wettstein, (1957).
7- Free proline content

Free proline was determined according to Bates *et al* (1973).

Statistical analysis:

All measurements of this study were analyzed by using appropriate analysis of variance (ANOVA) for three factorial experiment in split–split plot design with three replications; where irrigation regimes are in the main factor, nitrogen fertilizer rates as the split factor and wheat varieties as the split–split factor. Statistical analysis was done using the COSTAT system for Windows, version 6.311 (cohort software, Berkeley, CA, USA). Duncan's multiple test was used to differentiate between the averages of each factor in this study. In Duncan's multiple test, significance difference between averages was judged by using alphabets at level of 0.05 (Duncan, 1955).

RESULTS AND DISCUSSION

The results will be demonstrated under the following topics

I- Effect of skipping (withholding) irrigation treatments at tillering and heading stages of wheat plant.

Data in Table (3) show that total chlorophyll was decreased by 13.22 and 21.61% with skipping irrigation at tillering stage for two growing seasons, respectively meanwhile these decrements were 18.97 and 19.05% by skipping irrigation at heading stage for the growing seasons, respectively comparing to concentration of total chlorophyll of control treatment (Ping *et al.,* 2012; Ommen *et al.,* 1999; Tas and Tas, 2007; Keyvan, 2010; Saeedipour, 2011). Carotenoid pigment was unaffected significantly in the first growing season but at the second one it was decreased significantly by skipping irrigation at tillering or heading stages comparatively to control treatment .Reduction in carotenoids content as a result of water stress was reported by Bojovici and Stojanovic (2005).

Concentration of proline in green leaves was significantly increased by skipping irrigation at tillering or heading stages. At first season, proline content in green leaves was increased significantly by 33.48 and 65.48%for treatment of skipping irrigation at tillering and heading stages, respectively. The same rend could be observed at second season whereas the percentages of increasing proline content were 30.93 and 57.08% for same stages, respectively. It could be noticed that concentration of proline was significantly increased at heading stage more than at tillering stage. These increases in concentration of proline content were calculated comparing to control treatment. Similar trend which reported by Khan (2009), Goudarzi and Pakniyat (2009), Khan *et al.* (2009) and Maralian *et al.* (2010). They suggested that proline accumulation has beneficial role in osmotic adjustment and protect cell membranes and protein without interfering with macromolecules and behaved as protector of the osmotic pressure.

Data in Table (3) show that exposure wheat plants to drought stress treatment at tillering or heading stages each of plant height, dry weight of biomass above ground/plant, flag leaf area, leaf area index and crop growth rate at two growing seasons significantly decreased compared to control treatment. The existing data in Table (3) show that those traits under investigation were more influenced by skipping irrigation at tillering stage than those of skipping irrigation at heading stage during two growing seasons. The negative effect of skipping irrigation at tillering or heading stages could be explained on the light of loss of turgor pressure of plant cell which affects rate of cell expansion and ultimate cell size. Loss of turgor is probably the most sensitive process to water stress and resulted in decrement in growth rate and stem elongation in addition to stop growing new roots hairs as a result of exposure root plant to water stress by lacking soil moisture (Mehasen *et al.,* 2014). Similar results were also reported by Abd El-gawad *et al.* (1993), Abo-Shetaia and Abd El-Gawad (1995), Bayoumi (1999), Sharaan *et al*. (2000), Yakout *et al.* (2002), Hassan (2005), Kotb (2005), Maralian *et al.* (2010), Ping *et al*. (2012) and Mehasen *et al.* (2014).

II- Effect of nitrogen fertilization levels on photosynthetic pigments and some plant growth characteristics of wheat plant.

Data in Table(4) show that total chlorophyll (a+b) content in green leaves of wheat plants has significantly increased by increasing nitrogen fertilizer rates up to 100 kg N/feddan during the two seasons . In comparison to lowest rate of nitrogen fertilizer (50 kg/fed.), concentration of total chlorophyll pigment was increased by 15.55 and 13.81% as a result of applying 75 kg N/fed at first and second season, respectively. It could be noticed from data in total chlorophyll pigment continued to be increased by increasing nitrogen fertilizer level up to 100 kg/fed. The rate of increase was 29.63 and 22.86% for first and second season, respectively. This increase in chlorophyll content may be due to that nitrogen element is enters in structure of chlorophyll molecule and therefore any increase in nitrogen will be resulted in an increase in chlorophyll content into plant cell. Data in Table (4) show that concentration of carotenoids in wheat green leaves was significantly increased by increasing nitrogen fertilizer level up to 100 kg/feddan and performance of this trait was similar to that of chlorophyll pigments. Similar results were reported by Hassan (2005), Abdel-Ati and Zaki (2006), Tatjana Tranavičienė *et al.* (2007), Bojovic and Markovic (2009), AsqaTalat (2013) and Karimpour *et al.* (2013).

Proline in fresh weight of wheat plant was significantly increased by increasing nitrogen fertilizer at two growing seasons (Table 4). Application of 100 kg N/fed increased proline accumulation by 31.40 and 39.21% in comparison to that of 50 kg N/fed at first and second seasons, respectively. Carotenoids play an important role in photochemical reactions where it's considered as a filter to protect chlorophyll from demolition and dissolution under intense illumination levels (Morsi and Fayed, 1979).

Table (3): Effect of irrigation regimes on some vegetative characteristics of wheat in two growing seasons 2012/2013 and 2013-2014.

	Season 2012-2013	**Season 2013-2014**
	Chlorophyll a+b (mg/g leaf fresh weight)	
control	1.75a	2.73a
Skipping in tillering stage	1.34c	2.14b
Skipping in flowering stage	1.56b	2.21b
	Carotenoids (mg/g leaf fresh weight)	
control	0.404a	0.842a
Skipping in tillering stage	0.305a	0.588b
Skipping in flowering stage	0.316a	0.648b
	Proline (mg/100g fresh weight)	
control	11.59c	13.77c
Skipping in tillering stage	15.47b	18.03b
Skipping in flowering stage	19.18a	21.63a
	Plant height (cm)	
control	96.57a	89.03a
Skipping in tillering stage	84.76c	77.81c
Skipping in flowering stage	92.61b	83.67b
	Total dry weight/plant (g)	
control	3.25a	4.62a
Skipping in tillering stage	2.31b	3.61b
Skipping in flowering stage	2.33b	3.56b
	Flag leaf area (cm^2/ plant)	
control	34.27a	24.90a
Skipping in tillering stage	23.53c	16.75b
Skipping in flowering stage	29.21b	20.92ab
	L.A.I	
control	13.53a	17.12a
Skipping in tillering stage	09.73b	11.51c
Skipping in flowering stage	11.07b	14.22b
	C.G.R(mg/m2/ day)	
control	9a	12a
Skipping in tillering stage	6b	9b
Skipping in flowering stage	6b	9b

Table (4): Effect of N fertilization on some vegetative characteristics of wheat in two growing seasons 2012/2013 and 2013-2014.

	Season 2012-2013	Season 2013-2014
	Chlorophyll a+b (mg/g leaf fresh weight)	
50 kg N/fed	1.73b	2.10b
75 kg N/fed	1.53ab	2.39a
100 kg N/fed	1.39a	2.58a
	Carotenoids (mg/g leaf fresh weight)	
50 kg N/fed	0.318b	0.608b
75 kg N/fed	0.314b	0.637b
100 kg N/fed	0.392a	0.834a
	Proline (mg/100g fresh weight)	
50 kg N/fed	13.60b	15.02b
75 kg N/fed	14.77b	17.50b
100 kg N/fed	17.87a	20.91a
	Plant height (cm)	
50 kg N/fed	84.00c	77.24c
75 kg N/fed	92.79b	83.25b
100 kg N/fed	97.14a	90.01a
	Total dry weight/plant (g)	
50 kg N/fed	2.21b	3.24b
75 kg N/fed	2.79a	3.95a
100 kg N/fed	2.88a	4.59a
	Flag leaf area (cm^2)	
50 kg N/fed	23.09c	17.68c
75 kg N/fed	28.10b	20.72b
100 kg N/fed	35.82a	24.16a
	L.A.I	
50 kg N/fed	9.43b	10.77c
75 kg N/fed	11.89a	13.54b
100 kg N/fed	13.01a	18.54a
	C.G.R(mg/m2/ day)	
50 kg N/fed	5b	9c
75 kg N/fed	7a	1b
100 kg N/fed	8a	12a

Data in Table (4) also, showed that applying highest nitrogen rate *i.e.* 100 kg N/fed increased proline accumulation by 20.99 and 19.49% comparatively to that of 75 kg N/fed at first and second seasons, respectively. Proline is one of the amino acids group into plant cell. It well known that any amino acid has amino group (NH_2) in its structure and thus increasing nitrogen level into the soil leads to increase absorption of nitrogen into plant cell and thus increases concentration of proline acid in plant tissues. These results similar to this of Goudarzi and Pakniyat (2009) and Khan *et al.* (2009).

Data in Table (4) show that plant growth characters under study *i.e.* plant height, dry weight of biomass above ground/plant, flag leaf area, leaf area index and crop growth rate were improved significantly and consequently by increasing nitrogen fertilizer level up to 100 kg/feddan during two growing seasons. These increases in plant growth characteristics may be due to role of nitrogen in enhancing some physiological processes such as cell elongation, cell division and protein formation which turned on increments and improvement of plant growth characteristics and formation of more plant organs. This promoting effect of nitrogen on growth of wheat plant was in harmony with those reported by Sharief *et al.* (1998), Hassan (2005), Tatjana Tranaviciene *et al*. (2007), Ahmed *et al.* (2012), Gheith *et al.* (2013) and Masoud Karimpour *et al.* (2013).

III- Varietal differences:-

Data in Table (5) show that two studied varieties Sakha 94 and Sedes 12 were differed significantly in photosynthetic pigments *i.e.* total chlorophyll and carotenoids of fresh green leaves whereas statistical analysis revealed that wheat variety Sakha 94 surpassed other studied variety Sedes 12 in photosynthetic pigments during two growing seasons. These results are in agreement with the findings of Khan *et al.* (2009), Zhang *et al.* (2009) and Talat *et al.* (2013).

Concerning to proline content in green leaves data in Table (5) show that wheat variety Sakha 94 was higher statistically than that of variety Sedes 12 during two growing seasons. Whereas proline content in green leaves of Sakha 94 were recorded 17.37 and 19.94 mg/100 g green leaves at first and second season, respectively. Meanwhile, proline content in green leaves of variety Sides 12 was 13.46 and 15.68 mg/100 g green leaves at first and second season, respectively. These results are in harmony with results obtained by goudarzi and pakniyat (2009), Khan *et al.* (2009), Talat *et al.* (2013).

Data in Table (5) showed results of statistical analysis of some morphological characters were studied for two cultivars Sakha 94 and Sedes 12. Sakha 94 cultivar was taller than Sedes 12 cultivar by 8.02 and 7.71 % at first and second season, respectively. Concerning to dry weight of biomass above ground plants of cultivar Sakha 94 of dry weight than plants of sedes 12 cultivar by14.69 and 30.21 % at first and second seasons, respectively. Both wheat cultivars were differed significantly in flag leaf area where of Sakha 94 cultivar are characterized by largest flag leaf area than those of cultivar Sedes 12 by 51.45 and 29.30 % at first and second seasons, respectively. Results revealed that Sakha 94 cultivar have great values of leaf area index (LAI) and surpassed significantly that Sedes 12 cultivar at two growing season (Table 5).

Leaf area index values of Sakha cultivar were recorded 13.82 and 16.79 at first and second season, respectively meanwhile LAI values of Sedes plants were 9.07 and 11.77 at first and second season, respectively. Both two wheat cultivars under investigation were differ statistically in crop growth rate trait at two growing seasons. Crop growth rate values of Sakha 94 cultivar was higher than that of sedes 12 cultivar where CGR of Sakha 94 were 7 and 12 mg/m^2/day at first and second season, respectively meanwhile crop growth rate of Sedes 12 plants was 6 and 9 mg/m^2/day at first and second season, respectively. These differences in morphological characters of two studied cultivars may be attributed to genetic differences between them. These results are in agreement with the findings of Hassan (2005), Mohamed *et al.* (2005), Bayoumi (2006), Gheith *et al.* (2013), Masoud Karimpour *et al.* (2013) and Mehasen *et al.* (2014).

Table (5): Effect of varieties on some vegetative characteristics of wheat in two growing seasons 2012/2013 and 2013-2014.

	Season 2012-2013	**Season 2013-2014**
	Chlorophyll a+b (mg/g leaf fresh weight)	
Sakha 94	1.71a	2.55a
Sedes 12	1.39b	2.16b
	Carotenoids (mg/g leaf fresh weight)	
Sakha 94	0.401a	0.826a
Sedes 12	0.281b	0.560b
	Proline (mg/100g fresh weight)	
Sakha 94	17.37a	19.94a
Sedes 12	13.46b	15.68b
	Plant height (cm)	
Sakha 94	94.83a	86.60a
Sedes 12	87.79b	80.40b
	Total dry weight/plant (g)	
Sakha 94	2.81a	4.44a
Sedes 12	2.45b	3.41b
	Flag leaf area (cm^2)	
Sakha 94	34.94a	23.52a
Sedes 12	23.07b	18.19b
	L.A.I	
Sakha 94	13.82a	16.79a
Sedes 12	9.07b	11.77b
	C.G.R(mg/m2/ day)	
Sakha 94	7a	12a
Sedes 12	6b	9b

IV- Effect of interactions among three factors of study:

The statistical analysis revealed that interaction among three factors did not reach to significant level (p=0.05) for all studied traits at two growing seasons excluding chlorophyll and proline content of green leaves and flag leaf area at first season in addition to flag leaf area of second season. The data in table (6-a) are showed that chlorophyll content in green leaves of first season was affected significantly by interaction between cultivars and skipping irrigation regimes (p=0.05). Highest chlorophyll content (1.99 mg/g green leaf weight) was produced from wheat cultivar Sakha 94 of control treatment *i.e.* without skipping irrigation meanwhile lowest chlorophyll content was produced from wheat cultivar Sids 12 (1.23 mg/g green leaf weight) and skipping irrigation at tillering stag.

The interaction between nitrogen fertilization levels and skipping irrigation regimes at first season (Table 6-a) produced highest proline content (23.74 mg/100g leaves fresh weight) from applying 100 kg N/fed and treatment of skipping irrigation at heading stage meanwhile lowest proline content was 11.11 mg/ 100 g leaves fresh weight produced from applying 50 kg N/fed and treatment of without skipping irrigation. At first season, flag leaf area was affected statistically (p=0.05) by interaction between nitrogen fertilizer levels and skipping irrigation regimes.

The largest flag leaves area *i.e.* 25.28 and 27.39 cm^2 were produced from control treatment (without skipping irrigation) and fertilization treatments 75 or 100 kg N/fed. (Table 6-a). The data in Table (6-b) show that flag leaf area was affected significantly by interaction between nitrogen fertilization levels and wheat cultivars at both growing seasons where wheat cultivar Sakha 94 produced largest flag leaf area from applying 100 kg N/fed at two growing seasons. The obtained results are in harmony with finding with Allam (2002), Bayoumi (2006), Gheith (2013) and Mehasen *et al*. (2014).

Table (6-a): Interactions among three factors of study on some vegetative growth characteristics during two seasons.

	Control treatment	**Tillering stage**	**Heading stage**
	Total chlorophyll (mg/g leaf fresh weight) 2012/2013		
Sakha94	2.00	1.45	1.69
Sids12	1.50	1.23	1.44
L.S.D (p=.05) =0.25			
	Proline (mg/100g fresh weight) 2012/2013		
50Kg N	11.11	13.72	15.84
75 Kg N	12.13	14.34	17.84
100 Kg N	11.53	18.35	23.74
L.S.D (p=.05) =1.65			
	Flag leaf area (cm^2)2013/2014		
50Kg N	22.03	14.34	16.67
75 Kg N	25.28	14.45	22.43
100 Kg N	27.39	21.45	23.66
L.S.D (p=.05) =5.71			

Table (6-b): Interactions among three factors of study on some vegetative growth characteristics during two seasons.

	50Kg N	**75 Kg N**	**100 Kg N**
	Flag leaf area (cm^2)2012/2013		
Sakha94	25.16	32.54	47.08
Sids12	20.98	23.66	24.56
L.S.D (p=.05) =13.12			
Flag leaf area(cm^2) 2013/2014			
Sakha94	19.68	22.45	28.42
Sids12	15.68	18.99	19.91
L.S.D (p=.05) =5.71			

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تأثير الإجهاد الرطوبي والتسميد الآزوتي علي نمو صنفين من أصناف قمح الخبز

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يعتبر محصول القمح المحصول الرئيسي في الغذاء بالنسبة لمصر وفي السنوات الأخيرة تواجه مصر مشكلة بين الإنتاج المحلي لهذا المحصول والكمية المستهلكة هذا بالإضافة إلي أن زراعة هذا المحصول تواجه مشكله نقص المياه مثل مناطق التوسع الزراعي لمحافظة الإسماعيلية لذا أقيمت تجربتين في محطة البحوث الزراعية التابعة لكلية الزراعة جامعة قناة السويس بمدينة الاسماعيليه في موسمي الزراعة ٢٠١٢/٢٠١٣ و ٢٠١٣/٢٠١٤. تتميز ارض هذه التجارب بأنها ارض رمليه ومناخ مدينة الإسماعيلية مناخ حار جاف شحيح الأمطار شتاءا. الغرض من إجراء هذه التجارب هو دراسة تأثير كل من نظم الري والتسميد الآزوتي والتفاعل بينهم علي صفات النمو لصنفين من أصناف قمح الخبز. وكانت معاملات الري ثلاث هي : ري عادي – منع الري خلال مرحلة التفريع – منع الري خلال مرحلة طرد السنابل. أما مستويات التسميد الآزوتي فكانت ثلاث هي ٥٠ – ٧٥ – ١٠٠ كجم أزوت/فدان. واختير صنفان من أصناف قمح الخبز هما سخا ٩٤ وسدس ١٢. اتبع تصميم القطع المنشقة مرتين في ثلاث مكررات وتتلخص أهم النتائج فيما يلي:

١- أدت معاملة منع الري سواء كان في طور التفريع أو طرد السنابل إلي نقص معنوي في كل من صبغات التمثيل الضوئي ومحتوي المجموع الخضري من البرولين وكذلك صفات النمو تحت الدراسة مثل ارتفاع النبات و الوزن الجاف للنبات فوق سطح الأرض ومساحة ورقة العلم / للنبات ودليل مساحة الأوراق ومعدل النمو للمحصول.

٢- أدت زيادة مستوي الآزوت المضاف حتى ١٠٠ كجم/للفدان إلي زيادة معنوية في كل الصفات تحت الدراسة.

٣- تفوق الصنف سخا ٩٤ علي الصنف سدس١٢ في كل الصفات تحت الدراسة.

٤- ازداد التفاعل بين عوامل الدراسة إلي مستوي المعنوية (٥%) لكل من تركيز الكلوروفيل الكلي و تركيز البرولين ومساحة ورقة العلم للنبات.