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DIFFERENTIAL RESPONSE OF SOME WHEAT AND TRITICALE GENOTYPES TO SEEDING RATE AND WATER SUPPLY CONDITIONS 1. GROWTH CHARACTERS

F. M. Ismail , H. Mahfouz and S.K. Ghabour
Agronomy Dept., Fac. of Agric., El-Fayoum, Cairo Univ.

ABSTRACT

Differential response of two Egyptian wheat (cvs Sakha 69 and Sids 4), and two triticale (cvs Hare 212 and Beagle "S") to three seeding rates i.e., 40, 80 and 120 kg./fed., and four irrigation intervals viz. 20,30,40 and 50 days, was investigated during 1999/2000 and 2000/2001 growing seasons in alluvial clay soil at Dar-Ramad , Fayoum Governorate. Plant height, leaf area/plant, leaf area index, as well as the biological yield of triticale significantly surpassed those of wheat cultivars. Number of days to 50% heading was less in wheat than triticale cultivars. Moreover, flag leaf area showed higher values in wheat cultivars as compared to triticale ones. Increasing seeding rate from 40 to 80 or 120 kg/fed., significantly decreased days to 50% heading and number of tillers/plant. However, the increase in plant density (i.e., seeding rate), resulted in higher biological yield. Means of the studied growth characters were significantly increased as irrigation interval decreased to 20 days. Prolonged irrigation interval up to 50 days generally decreased means of the studied characters, except earliness, which increased with greater irrigation interval. Results of the interactions between the studied variables indicated that wheat and triticale varieties should be sown using a seeding rate of 80 or 120 kg. grains/fed., and irrigated at intervals of 20 days, to realize high potentiality of biological yield . Plant height and leaf area index showed positive and significant correlations with biological yield for each studied variety .

Key words: ***Wheat – Triticale – Irrigation – Seeding rate – Growth characters – Genotypic variation.***

INTRODUCTION

Wheat is the major cereal crop around the world, while triticale is considered a promising cereal food crop under certain conditions. In Egypt, wheat production does not meet the consumption of the over - increasing population. Partial self-sufficiency from wheat (75%), requires additional cultivated area. Since water represents a vital input for horizontal expansion. It is of utmost importance to determine the optimum requirements of irrigation for growing cereal crops. The influence of timing and duration of soil water deficits on morphological development of small cereal grains has been investigated by Begg and Turner (1976) and Lawor *et al* (1981). They found that water stress during vegetative growth reduced tiller size and number. Stark and Longley (1976) illustrated the importance of adequate early season soil water availability in developing uniform tillering patterns

and high yield potential for spring wheat. Duwayri (1984) reported decreases in flag leaf area and leaf area index of wheat plants under water stress conditions. On the other hand, El-Far and Allam (1995), showed that well- irrigated wheat plants at all growth stages showed highly significant increases in plant height and spike length as compared to water stress. Different wheat cultivars behaved differently under different irrigation regimes with respect to yield and yield attributes (El-Far and Teama 1999).

Number of productive tillers in wheat and in triticale is one of the most important components determining to a great extent the obtained yield. Therefore, it seems important to find out the appropriate rate of seeds which can insure the optimum number of tillers.

The effect of different seeding rates on plant growth characters in cereal plants was studied by many investigators (Eissa 1990, Salem *et al* 1990, El-Bana and Basha 1994, Abdalla and Bassiouny 1994 and El-Karamity 1998). They reported increments in plant height, number of spikes/unit area, grain and straw yields with increasing seeding rate. The study carried out by Mahdy and Teama (2000) showed that wheat varieties, i.e. Sakha 69 and Sids 8 responded positively to high seeding rate (78 and 115 kg /fed.). Heakal and Zohary (1996) found that an 80 kg/fed seeding rate gave the greatest mean value for number of spikes/m^2. Therefore, the present study is meant to evaluate the response of some wheat and triticale genotypes under water stress and various plant densities (seeding rate).

MATERIALS AND METHODS

Two successive field experiments were performed during 1999/2000 and 2000/2001 growing seasons, at Dar-Ramad Agriculture Experimental Farm, El-Fayoum Governorate. Each experiment included fourty eight treatments which were the combination of :

a- Four divergent genotypes, two local wheat varieties, i.e. Sakha 69 and Sids 4 designated as V_1 and V_2 and two hexaploid triticale varieties, i.e. Hare 212 and Beagle "S" designated as V_3 and V_4, respectively.

b- Three levels of seeding rate (40, 80, and 120 kg/fed.).

c- Irrigation intervals (20, 30, 40 and 50 days) .

The treatments were arranged in a split- split plot design with four replications. Irrigation intervals were randomly distributed in the main plots, genotypes of both wheat and triticale were assigned at random to the sub-plots, whereas the seeding rates were allocated to the sub-sub plots. The plot of 3 m x 3.5 m dimensions occupied an area of 10.5 m^2. There were 13 rows per plot each, 3.5 m long and 25 cm apart. Agricultural practices other than irrigation and seeding rate, applied in Fayoum region were used for growing

wheat cultivars, while those recommended agricultural practices by the Agric. Res. Cent. were used for growing triticale genotypes.

Grains were hand drilled and planting was performed on the November 11 and 12 for the two seasons, respectively.

Results of soil analysis of the experimental site in the two seasons are summarized in Table (1).

A sample of ten plants were taken at random from the inner rows of each plot at heading stage to measure the following characters:

(1)Plant height in (cm), (2) Days from planting to 50% heading,

(3) Leaf area = leaf length x maximum leaf breadth x 0.75 (According to procedure of Watson 1947).

(4) Leaf area index (LAI) = leaf area plant^{-1} cm^2 / land area plant^{-1} cm^2

(5) Number of tillers/plant, (6) Flag leaf area cm^2 and (7) Biological yield at harvest.

Data were subjected to statistical analysis of the split-split plot design. Combined analysis of varaince over years was performed on the data of the two growing seasons and estimation of simple correlation between the studied traits according to Gomez and Gomez (1984). and the treatment means were compared using the least significant differences (LSD) method .

Table 1. Chemical and physical properties of soil samples taken from experimental site in two seasons 99/2000 and 2000/2001.

Soil properties	99/2000	2000/2001	Soil properties	99/2000	2000/2001
pH soil paste	7.35	7.21	DTPA-extractable micronutrients ppm		
EC (ds/m)	1.60	1.83	Fe	9.11	10.21
Organic matter	2.50	2.12	Mn	7.21	6.11
$CaCO_3$ %	6.24	6.94	Zn	0.67	0.61
Mechanical analysis			Available nutrients (ppm)		
Course Sand %	6.21	7.12	N	0.09	0.08
Fine Sand %	27.12	26.12	K	7.00	6.32
Silt %	25.12	25.11	$NaHCO_3P$	7.54	8.32
Clay %	41.55	41.65			
Soil texture	Clay	Clay			

RESULTS AND DISCUSSION

Genotypic variability

Data in Table (2) and Fig. (1) show the differences among the tested wheat and triticale varieties in plant height, number of days to 50% heading, leaf area/plant, leaf area index, flag leaf area, number of tillers per plant and biological yield (ton/feddan).

In respect of plant height. triticale varieties (V_3 and V_4) attained similar values which surpassed significantly those of wheat varieties (V_1 and V_2). The results obtained for the other growth characters indicate that most of the afore-mentioned characters showed higher significant values for triticale as compared to wheat varieties. However, flag leaf area in triticale plants followed reverse trend where lower values for the character were recorded. Moreover, the wheat variety Sakha 69, significantly exceeded Sids 4, and showed higher values in the studied growth characters with the exception of days to 50% heading which was earlier for Sids 4. Number of tillers per plant showed marked and significant reduction as compared to other varieties from both wheat and triticale.

The biological yield (grain and straw) of triticale varieties (ton/fed.) surpassed yield of wheat varieties. This increment was significant in the two seasons and their combined analysis. Sakha 69 wheat (V_1) recorded greater biological yield as compared to Sids 4 (V_2). This result could be partly attributed to the higher values obtained for plant height and number of tillers per plant, while the greater values recorded in leaf area could result in more photosynthetic product in triticale varieties. These results are in harmony with those obtained by Aggrawal and Sinha (1987).

Effect of seeding rate

Data in Table (2) and Fig. (1) revealed the effect of seeding rate on plant growth characters and the biological yield for both wheat and triticale plants in two seasons and their combined analysis. Seeding rate had significant impact in both seasons on earliness and number of tillers per plant, while other studied characters were not affected. Lower values were attained by increasing seeding rates from 40 up to 120 kg/fed., indicating better earliness, and less number of tillers/plant. The decrease in number of tillers per plant resulting from increasing seeding rate is mainly due to the increase in number of plants per unit area, which in turn gives rise for higher competition between plants and restrict the tillering process. In respect to no. of tillers per plant, results agreed with those obtained by El-Karamity (1998).

Table 2. Growth attributes of wheat and triticale to varieties in response to seeding rates and irrigation intervals in two successive seasons and their combined.

Variable levels		Plant height cm			Days to 50% heading			Leaf area cm^2 / plant			Leaf area index			Flag leaf area cm^2			No. of tillers / plant			Biological yield t/fed.		
		1999/2000	2000/2001	Combined	1999/2000	2000/2001	Combined	1999/2000	2000/2001	Combined	1999/2000	2000/2001	Combined	1999/2000	2000/2001	Combined	1999/2000	2000/2001	Combined	1999/2000	2000/2001	Combined
Varieties																						
Wheat	Sakha 69	103.4	109.0	106.2	87.6	85.8	86.7	259.1	210.7	234.9	12.4	10.3	11.4	33.4	41.1	37.2	6.8	6.4	6.7	11.7	13.5	12.6
	Sids 4	95.5	94.9	95.2	61.7	60.9	61.3	182.4	158.0	170.2	4.2	2.9	3.5	37.2	25.0	31.1	1.6	1.7	1.6	9.4	8.7	9.0
Triticale	Hare 212	133.6	134.6	134.1	92.6	91.5	92.1	315.5	342.7	329.1	13.6	15.6	14.6	24.1	24.2	24.1	6.4	7.2	6.8	16.2	17.1	16.7
	Beagle S	134.7	135.1	134.9	92.1	90.8	91.4	371.9	312.3	342.1	15.5	12.9	14.2	27.4	23.2	25.3	5.9	6.0	6.0	15.0	17.0	16.0
LSD 5%		3.6	3.3	2.4	0.6	0.6	0.4	59.0	43.9	35.8	2.5	1.8	1.5	3.1	3.5	2.3	0.8	0.7	0.5	0.6	0.5	0.4
Seeding rates																						
40 kg / fed.		116.1	119.0	117.5	84.1	83.0	83.6	271.1	268.6	269.8	9.6	9.4	9.5	30.3	30.5	30.4	5.9	6.5	6.2	11.3	11.9	11.6
80 kg / fed.		116.2	119.3	117.8	83.6	82.4	83.0	291.9	253.4	272.7	11.8	10.7	11.2	31.1	27.9	29.5	5.2	5.4	5.3	12.8	14.6	13.7
120 kg / fed.		118.2	116.9	117.5	82.7	81.4	82.1	283.7	245.8	264.8	12.9	11.2	12.0	30.2	26.8	28.4	4.4	4.2	4.3	15.1	15.7	15.4
LSD 5%		n.s.	n.s.	n.s.	0.4	0.3	0.2	n.s.	n.s.	n.s.	1.5	n.s.	1.1	n.s.	n.s.	n.s.	0.3	0.4	0.2	0.6	0.4	0.3
Irrigation intervals																						
20 days		129.5	121.0	125.3	86.9	83.3	85.1	459.0	245.1	352.1	20.6	11.0	15.8	42.9	31.1	37.0	4.8	5.6	5.2	18.1	18.2	18.2
30 days		121.7	120.8	121.2	80.5	79.9	80.2	263.8	239.5	251.6	9.4	9.3	9.4	29.8	24.8	27.3	4.8	6.9	5.3	11.9	12.1	12.0
40 days		111.8	116.1	113.9	83.3	83.1	83.2	234.1	288.1	261.1	9.0	11.4	10.2	25.4	29.4	27.4	5.8	5.1	5.5	11.7	13.1	12.4
50 days		104.4	115.7	110.0	83.3	82.6	82.9	172.0	250.9	211.4	6.7	9.9	8.3	23.9	28.2	26.1	5.4	4.8	5.1	10.5	12.8	11.7
LSD 5%		2.9	4.5	2.4	0.9	1.0	0.6	99.8	n.s.	51.3	4.4	n.s.	2.2	6.7	3.5	3.1	n.s.	n.s.	n.s.	0.9	0.8	0.5

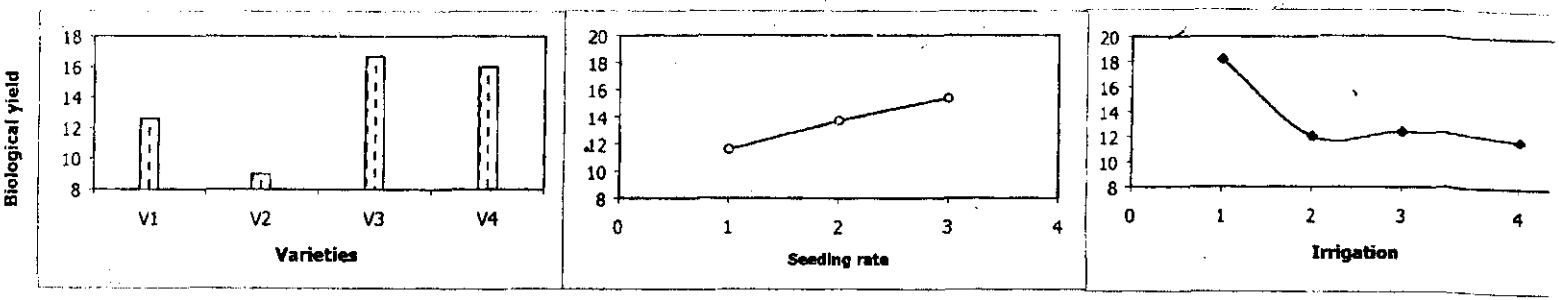

Fig . 1. Mean value of biological yield ton / fed. of wheat and triticale plants as affected by main effect of varieties , seeding rates Irrigation intervals (combined of two seasons)

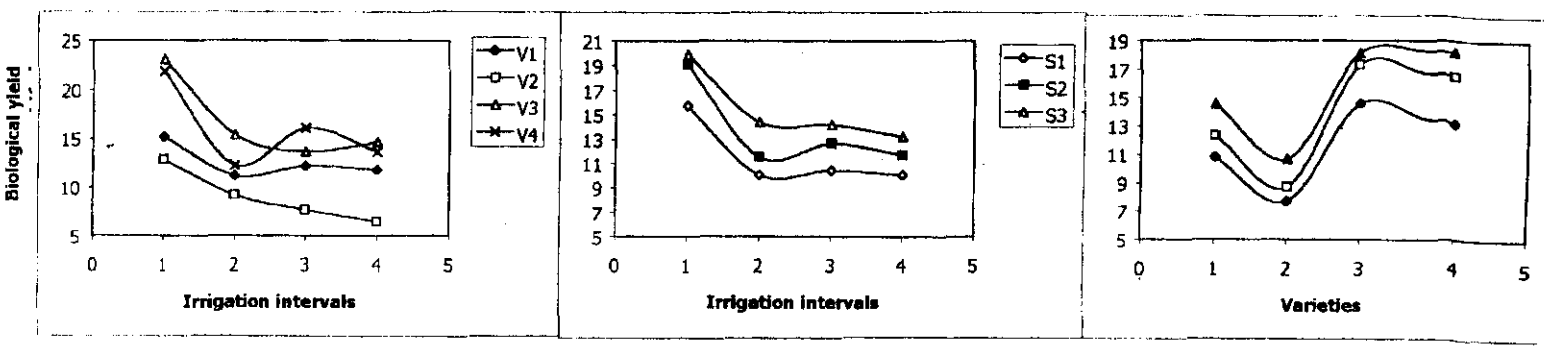

Fig . 2. Mean value of biological yield t/fed. of wheat and triticale plants as affected by first order interaction btween the studied varie (combined of two seasons)

Seeding rate of 120 kg/fed recorded the highest biological yield followed by that obtained from 80 kg/fed., in both seasons. The increase in biological yield due to dense sowing is mainly attributed to the increase in number of plants per unit area which showed more pronounced effect than the effect of the decrease in no. of tillers per plant attained with higher seeding rate. These results are in agreement with those obtained by Bassal (1997), El-Karamity (1998) and El-Banna (2000).

Effect of irrigation intervals

Wheat and triticale plants irrigated every 20 days showed stimulative effect on the studied growth characters while prolonged irrigation period up to 50 days interval, had significant negative impact on the growth characters. The induction of water stress through increased period of wheat and triticale plants, which reduced the values of growth characters can be ascribed to the lack of water absorbed causing an inhibition of photosynthetic efficiency. The adequate water supply by irrigation interval of 20 days (I_1) significantly increased plant height and the number of days to 50% heading. This means that plants receiving adequate water, showed better growth and decreased earliness. It is worth to mention that number of tillers/plant was not significantly affected different water regimes applied as it could be considered as highly heritable character. The stimulative effect of 20 day irrigation interval on growth characters resulted in an increment in biological yield (Fig 1) amounting to 55% compared to that obtained from irrigation interval of 50 days.

Results in Table (2) showed that increasing irrigation interval significantly decreased plant height . Such decrease may be attributed to the need of water during vegetative period. The lack of water caused an inhibition in the activity of meristimatic tissues responsible for elongation (Hussein *et al* 1978 and Abd El- Gawad *et al* 1993).

Effect of the interactions

The interaction effect between the tested wheat and triticale varieties and seeding rates on growth attributes i.e., plant height, leaf area/plant, leaf area index, number of tillers/plant and biological yield (Table 3 and Fig. 2) were statistically significant mostly during the two seasons. This result indicates that the effect of seeding rates on most studied growth characters differed among tested varieties.

Date in Table (4) and Fig. (2) indicate that plant height, days to 50% heading, flag leaf area and biological yield of wheat and triticale varieties responded significantly to the irrigation treatments. The taller plants from wheat varieties was obtained by Sakha 69 (V_1) irrigated at 20 days interval.

Table 3. Response of growth attributes of wheat and triticale to the interaction between varieties and seeding rates in two successive seasons and their combined

Interactions	Plant height cm			Days to 50% heading			Leaf area cm^2 / plant			Leaf area index			Flag leaf area cm^2			No. of tillers / plant			Biological yield t/fed.		
	1999/ 2000	2000/ 2001	Comb - ined	1999/ 2000	2000/ 2001	Comb - ined	1999/ 2000	2000/ 2001	Comb - ined	1999/ 2000	2000/ 2001	Comb - ined	1999/ 2000	2000/ 2001	Comb - ined	1999/ 2000	2000/ 2001	Comb - ined	1999/ 2000	2000/ 2001	Comb - ined
Varieties x Seeding rates																					
V1 x S1	100.5	104.3	102.4	88.1	86.3	87.2	284.6	191.5	213.0	9.9	8.0	9.0	34.2	38.9	36.5	7.6	8.1	7.8	10.4	11.2	10.8
V1 x S2	105.0	113.2	109.1	87.8	86.1	86.9	235.9	182.5	209.2	11.6	8.9	10.3	35.3	42.6	38.9	7.0	6.6	6.8	11.3	13.4	12.3
V1 x S3	104.8	109.4	107.1	86.9	85.1	86.0	306.8	258.2	282.5	15.8	14.0	14.9	30.8	41.8	36.3	5.9	4.8	5.3	13.4	15.8	14.6
V2 x S1	94.0	102.4	98.2	62.3	61.8	62.0	142.5	193.2	167.8	2.6	2.9	2.8	39.1	31.2	35.1	1.8	1.9	1.9	8.1	7.3	7.7
V2 x S2	92.4	88.8	90.6	61.8	60.9	61.4	221.4	129.1	175.3	4.9	2.3	3.6	38.2	21.7	29.9	1.6	1.5	1.5	8.8	8.7	8.7
V2 x S3	100.2	93.3	96.8	60.9	60.2	60.5	183.5	151.7	167.6	5.0	3.4	4.2	34.2	22.1	28.1	1.3	1.6	1.5	11.3	10.1	10.7
V3 x S1	133.8	133.8	133.8	93.1	92.4	92.8	314.1	345.9	330.0	12.2	14.5	13.4	24.4	27.8	26.1	7.3	8.4	7.9	14.5	14.6	14.6
V3 x S2	134.9	138.3	136.6	93.1	91.6	92.3	330.1	379.4	354.8	14.1	17.7	15.9	20.9	23.8	22.3	6.5	7.5	7.0	16.2	18.5	17.3
V3 x S3	132.2	131.8	132.0	91.7	90.5	91.1	302.4	302.6	302.5	14.4	14.7	14.5	27.0	21.1	24.0	5.3	5.7	5.5	18.0	18.2	18.1
V4 x S1	135.9	135.4	135.7	93.1	91.6	92.3	393.2	343.6	368.4	13.7	12.3	13.0	23.6	24.1	23.9	6.9	7.5	7.2	12.0	14.3	13.2
V4 x S2	132.5	136.8	134.7	91.9	90.8	91.4	380.2	322.6	351.4	16.3	13.8	15.1	30.0	23.4	26.7	5.8	5.8	5.8	15.1	17.9	16.5
V4 x S3	135.8	133.0	134.4	91.4	89.8	90.6	342.2	270.8	306.5	16.4	12.7	14.6	28.7	22.0	25.4	5.2	4.7	4.9	17.8	18.6	18.2
LSD 5%	4.4	5.5	3.9	n.s.	n.s.	n.s.	n.s.	70.4	49.1	n.s.	3.0	2.1	n.s.	n.s.	n.s.	0.5	0.7	0.5	1.1	0.9	0.7

Table 4. Response of growth attributes of wheat and triticale to the interactions between varieties and irrigation intervals in two successive seasons and their combined.

Interactions	Plant height cm			Days to 50% heading			Leaf area cm^2 / plant			Leaf area index			Flag leaf area cm^2			No. of tillers / plant			Biological yield t/fed.		
	1999/ 2000	2000/ 2001	Comb - ined	1999/ 2000	2000/ 2001	Comb - ined	1999/ 2000	2000/ 2001	Comb - ined	1999/ 2000	2000/ 2001	Comb - ined	1999/ 2000	2000/ 2001	Comb - ined	1999/ 2000	2000/ 2001	Comb - ined	1999/ 2000	2000/ 2001	Comb - ined
Varieties x Irrigation intervals																					
V1 x I1	106.0	115.2	110.6	92.8	85.8	89.3	370.9	189.9	280.4	19.2	9.9	14.96	37.3	44.9	41.1	6.1	6.4	6.3	14.8	15.3	15.1
V1 x I2	106.2	112.6	109.4	76.8	76.4	76.6	306.0	191.8	248.9	12.2	9.1	10.7	30.7	39.6	35.1	7.1	7.2	7.2	10.2	12.2	11.2
V1 x I3	98.3	102.3	100.3	89.2	90.9	90.1	186.3	213.2	199.7	9.5	10.6	10.0	32.3	37.7	35.0	7.2	6.7	6.9	11.0	13.3	12.2
V1 x I4	103.1	105.8	104.4	91.6	90.2	90.9	173.1	248.0	210.6	8.9	11.5	10.2	33.4	42.2	37.8	6.9	5.6	6.2	10.7	13.0	11.8
V2 x I1	107.6	96.6	102.1	63.9	62.0	62.9	396.3	170.5	283.4	10.9	4.0	7.4	63.2	35.1	49.2	2.0	1.3	1.7	13.7	11.9	12.8
V2 x I2	100.7	95.6	98.1	61.4	61.2	61.3	157.6	159.3	158.4	3.2	2.6	2.9	39.0	18.3	28.7	1.4	2.0	1.7	10.3	8.2	9.2
V2 x I3	89.0	88.1	88.6	61.0	60.2	60.6	97.4	134.2	115.8	1.5	2.4	1.9	26.0	20.4	23.2	1.4	1.3	1.4	7.7	7.6	7.7
V2 x I4	84.9	99.2	92.1	60.3	60.3	60.3	78.5	168.1	123.3	1.1	2.6	1.8	20.4	26.0	23.2	1.4	2.0	1.7	5.8	7.2	6.5
V3 x I1	149.6	133.7	141.6	96.1	94.1	95.1	461.8	305.0	383.4	23.5	15.8	19.6	29.6	23.8	26.7	5.3	7.9	6.6	23.0	23.0	23.0
V3 x I2	135.7	135.7	135.7	92.3	91.2	91.8	292.5	305.9	299.2	11.5	15.7	13.6	24.9	23.6	24.2	6.0	7.9	6.9	14.9	15.9	15.4
V3 x I3	129.9	137.3	133.6	91.7	90.9	91.3	298.7	451.6	375.1	11.0	18.2	14.6	20.5	29.7	25.1	7.2	7.0	7.1	12.9	14.4	13.7
V3 x I4	119.4	131.9	125.7	90.3	89.8	90.1	209.1	308.1	258.6	8.4	12.9	10.6	21.2	19.8	20.5	7.0	6.0	6.5	14.2	15.1	14.7
V4 x I1	155.0	138.4	146.7	94.9	91.4	93.2	607.2	315.2	461.2	28.8	14.4	21.6	41.6	20.6	31.1	5.6	6.6	6.1	20.9	22.7	21.8
V4 x I2	144.1	139.3	141.7	91.3	90.9	91.1	298.9	301.2	300.0	10.8	10.0	10.4	24.4	17.5	21.0	4.7	6.3	5.5	12.4	12.0	12.2
V4 x I3	129.8	136.7	133.2	91.4	90.6	91.0	354.3	353.6	353.9	13.8	14.6	14.2	22.9	29.8	26.3	7.4	5.6	6.6	15.2	17.0	16.1
V4 x I4	110.0	125.9	117.9	90.9	90.1	90.5	227.1	279.4	253.3	8.6	12.7	10.6	20.8	24.8	22.9	6.1	5.6	5.8	11.3	16.1	13.7
LSD 5%	7.2	6.7	4.8	1.1	1.1	0.8	n.s.	n.s.	71.7	n.s.	n.s.	3.0	6.5	7.1	4.6	n.s.	n.s.	n.s.	1.3	1.1	0.8

Moreover, wheat variety Sids 4 (V_2) which was significantly shorter than Sakha 69 showed maximum plant height at irrigation treatment of 20 days interval. The former trend was observed in triticale varieties. This result could be ascribed to the higher meristemic activity of tissues responsible for elongation, in the presence of needed water. Consequently, the studied varieties subjected to water deficiency showed gradually and sometimes significant decreases in plant height.

The biological yield obtained from each variety was significantly affected by irrigation treatment. The maximum yield was attained in each variety irrigated at 20 days interval. These findings were in the same trend with those obtained by Abd El-Gawad *el al* (1993) and Sawires (2000).

Data in Table (5) and Fig. (2) show that the interaction between irrigation intervals and seeding rates had a significant impact on plant height, days to 50% heading and biological yield. The later character was confirmed only in one season. The other studied growth characters were not affected by this interaction. The application of seeding rate at the level of 80 or 120 kg /fed. and applying irrigation at 20 days interval showed favorable effect on plant height and biological yield of wheat and triticale plants.

The second order interaction effects on growth characters (Table 6 and Fig. 3) was statistically significant in most of the studied characters. Sowing Sakha 69 and Sids 4 wheat cultivars as well as triticale varieties by using 80 or 120 kg/fed and irrigation at 20 days exerted favourable effects on plant height, leaf area / plant and biological yield. A reverse trend was observed for flag leaf character while leaf area index was significantly affected only in one season.

The simple correlation coefficients between the biologecal yield and the studied growth characters of wheat and triticale varieties are shown in Table (7) . It is quite evident that the values of correlation coefficients between the biological yield and both plant height and leaf area index were highly significant . This trend was clear in wheat and triticale varieties. It seems therefore that plant height and leaf area index are important characters to biologecal yield than the other studied characters .

Table 5. Response of growth attributes of wheat and triticale to the interactions between irrigation intervals and seeding rates in two successive seasons and their combined

Interactions	Plant height cm			Days to 50% heading			Leaf area cm^2 / plant			Leaf area index			Flag leaf area cm^2			No. of tillers / plant			Biological yield t/fed.		
	1999/2000	2000/2001	Combined	1999/2000	2000/2001	Combined	1999/2000	2000/2001	Combined	1999/2000	2000/2001	Combined	1999/2000	2000/2001	Combined	1999/2000	2000/2001	Combined	1999/2000	2000/2001	Combined
Seeding rates x Irrigation intervals																					
S1 x I1	128.9	118.6	123.8	87.4	84.5	86.0	426.5	243.7	335.1	16.2	9.3	12.8	41.	33.0	37.4	5.4	6.7	6.0	16.0	15.3	15.7
S1 x I2	120.5	121.1	120.8	81.3	80.8	81.0	256.4	266.1	261.2	8.4	8.8	8.6	29.0	25.6	27.2	5.7	7.0	6.4	10.3	9.9	10.1
S1 x I3	111.9	118.3	115.1	84.2	83.5	83.8	243.5	287.1	265.3	8.2	10.4	9.3	26.8	31.1	28.9	6.5	6.3	6.4	9.5	11.3	10.4
S1 x I4	102.9	118.0	110.5	83.6	83.3	83.5	158.0	277.3	217.7	5.6	9.1	7.4	23.7	32.4	28.0	6.1	5.9	6.0	9.1	11.0	10.1
S2 x I1	129.8	120.5	125.2	87.1	83.3	85.2	508.1	258.2	383.2	22.6	12.0	17.3	44.7	32.6	38.7	4.8	5.7	5.2	18.0	20.0	19.0
S2 x I2	123.1	121.3	122.2	80.7	80.2	80.4	253.0	230.3	241.7	8.8	9.2	9.0	29.4	22.0	25.7	4.7	5.7	5.2	11.1	11.9	11.5
S2 x I3	110.0	117.2	113.6	83.4	83.3	83.4	223.1	281.8	252.4	8.4	11.4	9.9	24.0	31.4	27.7	5.8	5.1	5.4	11.7	13.6	12.6
S2 x I4	101.9	118.3	110.1	83.4	82.6	83.0	183.3	243.3	213.3	7.1	10.2	8.6	26.2	25.5	25.8	5.7	5.0	5.3	10.5	12.9	11.7
S3 x I1	129.8	123.8	126.8	86.3	82.2	84.2	442.5	233.5	338.0	22.9	11.8	17.4	42.3	27.6	35.0	4.1	4.3	4.2	20.2	19.4	19.8
S3 x I2	121.4	120.0	120.8	79.4	78.9	79.2	281.9	222.2	252.0	10.9	10.0	10.5	30.9	26.8	28.8	7.1	4.8	4.5	14.4	14.4	14.4
S3 x I3	113.3	112.8	113.1	82.4	82.6	82.5	235.9	295.5	265.7	10.3	12.5	11.4	25.5	25.8	25.6	5.3	4.1	4.7	13.9	14.4	14.2
S3 x I4	108.3	110.8	109.5	82.8	81.9	82.4	174.6	232.1	203.3	7.5	10.4	8.9	22.0	26.7	25.4	4.3	3.4	3.9	11.9	14.5	13.2
LSD 5%	n.s.	5.5	n.s.	n.s.	0.6	n.s.	n.s.	n.s.	n.s.	n.s.	n.s.	n.s.	n.s.	n.s.	n.s.	n.s.	n.s.	n.s.	n.s.	0.9	0.7

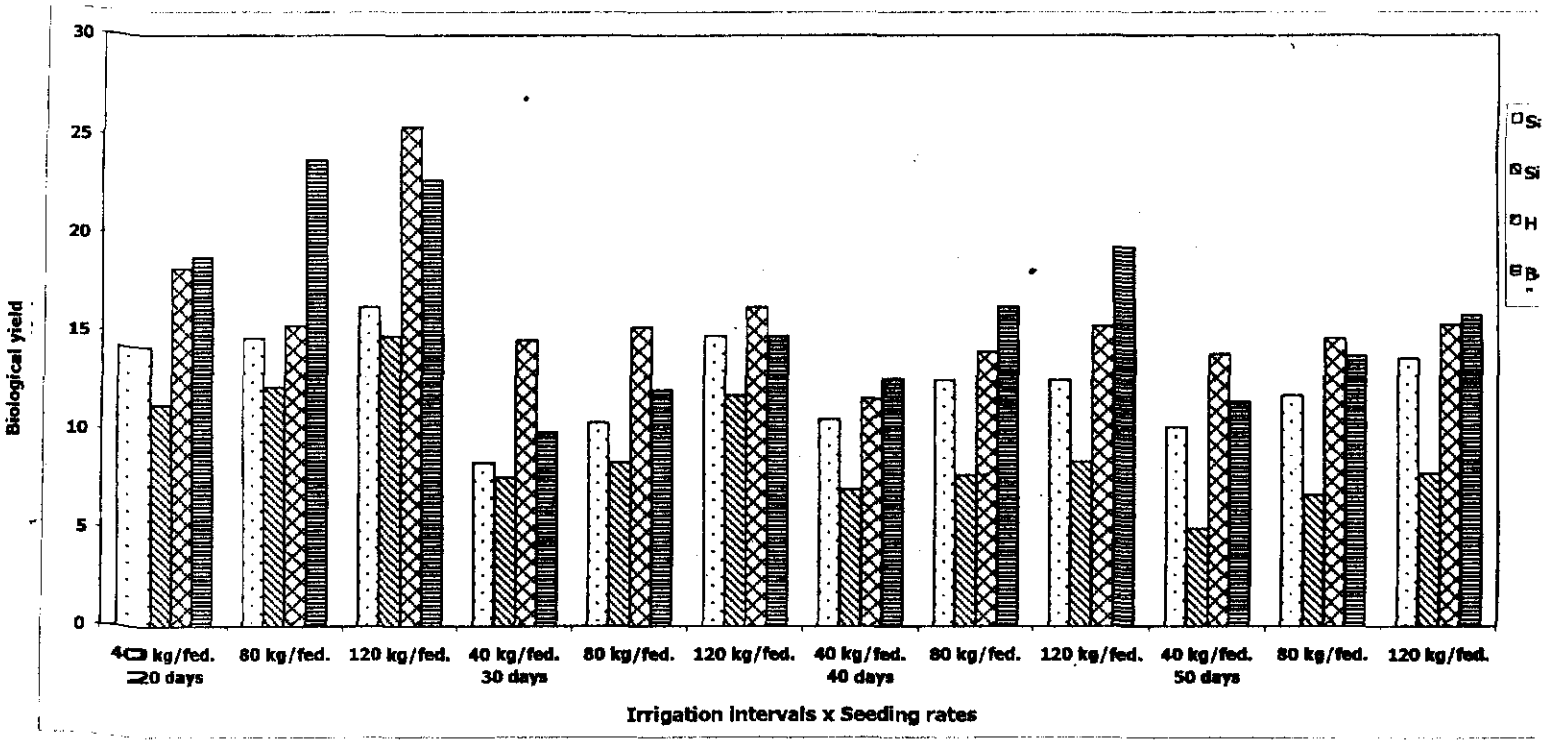

Fig . 3. Mean value of biological yield t/fed. of wheat and trticale as affected by second order interaction between the studied variabl varieties , seeding rate and irrigation intervals (combined of two seasons)

Table 6. Response of growth attributes of wheat and triticale to the interactions between varieties, seeding rates and irrigation intervals in two successive seasons and their combined

Interactions	Plant height cm			Days to 50% heading			Leaf area cm^2 / plant			Leaf area index			Flag leaf area cm^2			No. of tillers / plant			Biological yield t/fed.		
	1999/2000	2000/2001	Combined	1999/2000	2000/2001	Combined	1999/2000	2000/2001	Combined	1999/2000	2000/2001	Combined	1999/2000	2000/2001	Combined	1999/2000	2000/2001	Combined	1999/2000	2000/2001	Combined
Varieties x Seeding rates x Irrigation intervals																					
V1 x S1 x I1	107.0	109.0	108.0	92.0	87.0	89.5	267.0	171.9	219.5	12.1	7.8	10.0	35.0	42.6	38.8	6.7	8.0	7.3	13.8	14.7	14.2
V1 x S1 x I2	99.0	102.7	100.8	78.3	76.7	77.5	350.6	188.5	269.6	12.0	7.2	9.6	29.4	42.0	40.7	8.0	9.0	8.5	8.1	8.6	8.3
V1 x S1 x I3	94.3	100.7	97.5	89.7	91.0	90.3	157.5	224.4	191.0	7.5	10.5	9.0	28.9	26.2	27.5	7.7	7.7	7.7	10.3	10.7	10.5
V1 x S1 x I4	101.7	105.0	103.3	92.3	90.7	91.5	163.1	181.3	172.2	8.0	6.6	7.3	33.4	44.7	39.0	8.0	7.7	7.8	9.5	10.7	10.1
V1 x S2 x I1	105.0	113.3	109.2	92.3	85.7	89.0	368.2	146.6	257.4	19.6	7.2	13.4	46.9	48.7	47.8	6.0	6.3	6.2	14.7	14.7	14.7
V1 x S2 x I2	113.0	116.0	114.5	77.3	77.0	77.2	220.4	130.6	175.5	8.8	6.6	7.7	30.2	33.8	32.0	7.0	7.0	7.0	9.3	11.4	10.4
V1 x S2 x I3	102.7	110.7	106.7	89.3	91.3	90.3	172.5	171.3	171.9	8.8	8.3	8.5	34.1	48.9	41.5	7.3	7.0	7.2	10.6	14.5	12.5
V1 x S2 x I4	99.3	112.7	106.0	92.0	90.3	91.2	182.5	281.3	231.9	9.4	13.5	11.5	29.9	39.1	34.5	7.7	6.0	6.8	10.5	13.0	11.7
V1 x S3 x I1	106.0	123.3	114.7	94.0	84.7	89.3	477.5	251.1	364.3	25.8	14.8	20.3	30.1	43.3	36.7	5.7	5.0	5.3	16.0	16.6	16.3
V1 x S3 x I2	106.7	119.0	112.8	74.7	75.7	75.2	347.1	256.3	301.7	15.9	13.5	14.7	22.4	43.0	32.7	6.3	5.7	6.0	13.1	16.6	14.8
V1 x S3 x I3	98.0	95.7	96.8	88.7	90.3	89.5	228.8	244.0	236.4	12.1	13.1	12.6	33.8	38.0	35.9	6.7	5.3	6.0	12.3	14.8	12.5
V1 x S3 x I4	108.3	99.7	104.0	90.3	89.7	90.0	173.8	281.3	227.6	9.3	14.4	11.8	36.8	42.8	39.8	5.0	3.0	4.0	12.1	15.2	13.7
V2 x S1 x I1	106.0	101.0	103.5	64.7	63.0	63.8	288.6	225.6	257.1	7.0	4.1	5.6	62.4	42.1	52.3	2.0	1.7	1.8	13.0	9.6	11.3
V2 x S1 x I2	105.0	109.3	107.2	62.0	62.3	62.2	98.8	169.0	133.9	1.5	2.0	1.7	37.1	19.5	28.3	2.0	2.0	2.0	8.4	6.8	7.6
V2 x S1 x I3	85.0	98.7	91.8	61.7	60.7	61.2	107.5	128.0	117.8	1.3	2.0	1.6	30.0	24.8	27.4	1.7	2.0	1.8	6.7	7.2	6.9
V2 x S1 x I4	80.0	100.7	90.3	60.7	61.0	60.8	75.0	250.0	162.5	0.8	3.4	2.1	27.0	38.1	32.6	1.7	2.0	1.8	4.2	5.7	5.0
V2 x S2 x I1	110.7	87.7	99.2	64.0	62.3	63.2	542.1	103.4	322.8	13.6	2.2	7.9	62.0	29.8	45.9	2.3	1.0	1.7	12.6	11.8	12.2
V2 x S2 x I2	93.0	86.0	89.5	61.7	61.3	61.5	163.3	188.8	176.0	3.1	3.1	3.1	44.4	18.0	31.2	1.3	2.0	1.7	8.6	8.1	8.3
V2 x S2 x I3	86.0	82.7	84.3	61.3	60.0	60.7	93.4	110.6	102.0	1.6	1.9	1.8	27.3	18.5	22.9	1.3	1.0	1.2	7.9	7.5	7.7
V2 x S2 x I4	80.0	99.0	89.5	60.3	60.0	60.2	86.9	113.8	100.3	1.2	1.9	1.5	19.0	20.5	19.8	1.3	2.0	1.7	5.8	7.5	6.7
V2 x S3 x I1	106.0	101.0	103.5	63.0	60.7	61.8	358.1	182.4	270.3	12.2	5.6	8.9	65.3	33.5	49.4	1.7	1.3	1.5	15.4	14.2	14.8
V2 x S3 x I2	104.0	91.3	97.7	60.7	60.0	60.3	210.6	120.0	165.3	4.9	2.5	3.7	35.5	17.5	26.5	1.0	2.0	1.5	13.8	9.7	11.7
V2 x S3 x I3	96.0	83.0	89.5	60.0	60.0	60.0	91.3	63.8	127.5	1.7	3.1	2.4	20.7	18.0	19.4	1.3	1.0	1.2	8.6	8.1	8.3
V2 x S3 x I4	94.7	98.0	96.3	60.0	60.0	60.0	73.8	140.6	107.2	1.2	2.5	1.8	15.0	19.3	17.2	1.3	2.0	1.7	7.2	8.3	7.8

Table 6. Continued

Interactions	Plant height cm			Days to 50% heading			Leaf area cm^2 / plant			Leaf area index			Flag leaf area cm^2			No. of tillers / plant			Biological yield t/fed.		
	1999/ 2000	2000/ 2001	Comb- ined	1999/ 2000	2000/ 2001	Comb- ined	1999/ 2000	2000/ 2001	Comb- ined	1999/ 2000	2000/ 2001	Comb- ined	1999/ 2000	2000/ 2001	Comb- ined	1999/ 2000	2000/ 2001	Comb- ined	1999/ 2000	2000/ 2001	Comb- ined
Varieties x Seeding rates x Irrigation intervals																					
V3 x S1 x I1	147.0	125.0	136.0	97.3	95.3	96.3	538.5	307.8	423.1	22.8	14.9	18.9	32.5	27.5	30.0	6.3	9.0	6.7	18.8	17.7	18.3
V3 x S1 x I2	130.0	141.3	135.7	92.3	92.3	92.3	180.0	341.3	260.6	6.8	16.9	11.8	23.0	25.8	24.4	7.0	10.0	8.5	14.6	14.6	14.6
V3 x S1 x I3	135.0	136.3	135.7	93.0	91.3	92.2	249.0	388.0	341.0	10.1	13.2	11.6	20.3	30.8	25.6	8.0	8.0	8.0	11.2	12.0	11.6
V3 x S1 x I4	123.3	132.7	128.0	89.7	90.7	90.2	243.8	346.8	295.3	9.2	13.1	11.1	21.7	27.0	24.4	8.0	6.7	7.3	13.5	14.2	13.9
V3 x S2 x I1	152.3	138.3	145.3	97.0	94.0	95.5	471.0	348.4	409.7	24.5	18.4	21.4	24.2	23.3	23.8	5.3	8.7	7.0	23.2	27.4	25.3
V3 x S2 x I2	141.0	138.3	139.7	93.0	91.3	92.2	365.3	290.6	328.0	14.0	15.0	14.5	22.4	22.5	22.4	5.7	7.3	6.5	14.6	16.0	15.3
V3 x S2 x I3	126.3	138.0	132.2	91.7	91.3	91.5	320.1	473.8	397.0	11.4	20.0	15.7	13.0	32.0	22.5	7.3	8.0	7.7	13.0	15.1	14.0
V3 x S2 x I4	120.0	138.7	129.3	90.7	89.7	90.2	163.9	405.0	284.5	6.7	17.6	12.1	24.0	17.2	20.6	7.7	6.0	6.8	14.0	15.4	14.7
V3 x S3 x I1	149.3	138.7	143.5	94.0	93.0	93.5	376.0	259.0	317.5	23.1	14.1	18.6	32.2	20.4	26.3	4.3	6.0	5.2	27.0	23.9	25.4
V3 x S3 x I2	136.0	127.3	131.7	91.7	90.0	90.8	332.3	285.8	309.0	13.6	15.3	14.5	29.4	22.4	25.9	5.3	6.3	5.8	15.4	17.2	16.3
V3 x S3 x I3	128.3	137.7	133.0	90.3	90.0	90.2	281.9	493.0	387.5	11.6	21.3	16.5	28.3	26.3	27.3	6.3	5.0	5.7	14.5	16.2	15.3
V3 x S3 x I4	115.0	124.3	119.7	90.7	89.0	89.8	219.5	172.5	196.0	9.3	7.9	8.6	18.0	15.2	16.6	5.3	5.3	5.3	15.2	15.6	15.4
V4 x S1 x I1	155.7	139.3	147.5	95.7	92.7	94.2	611.9	269.4	440.6	22.9	10.4	16.7	37.5	19.6	28.6	6.7	8.0	7.3	18.6	19.1	18.8
V4 x S1 x I2	148.0	131.0	139.5	92.7	91.7	92.2	396.1	365.5	380.8	13.5	9.3	11.4	16.4	14.6	15.5	5.7	7.3	6.5	10.3	9.5	9.9
V4 x S1 x I3	133.3	137.7	135.5	92.3	91.0	91.7	415.0	408.2	411.6	13.8	16.0	14.9	28.0	42.4	35.2	8.7	7.3	8.0	10.0	15.2	12.6
V4 x S1 x I4	106.7	133.7	120.2	91.7	91.0	91.3	150.0	331.3	240.7	4.6	13.3	9.0	12.5	19.8	16.2	6.7	7.3	7.0	9.3	13.4	11.4
V4 x S2 x I1	151.3	142.7	147.0	95.0	91.3	93.2	651.3	434.5	542.9	32.9	20.3	26.6	45.7	28.7	37.2	5.3	6.7	6.0	21.5	26.1	23.8
V4 x S2 x I2	145.3	144.7	145.0	90.7	91.0	90.8	263.2	311.3	287.2	9.4	11.9	10.7	20.6	13.8	17.2	4.7	6.3	5.5	11.8	12.3	12.0
V4 x S2 x I3	125.0	137.3	131.2	91.3	90.7	91.0	306.3	371.5	338.9	11.7	15.4	13.5	21.7	26.0	23.9	7.0	4.3	5.7	15.3	17.4	16.3
V4 x S2 x I4	108.3	122.7	115.5	90.7	90.3	90.5	300.0	173.1	236.6	11.3	7.7	9.5	31.9	25.1	28.5	6.0	6.0	6.0	11.7	15.9	13.8
V4 x S3 x I1	158.0	133.3	145.7	94.0	90.3	92.2	558.3	241.7	400.0	30.6	12.7	21.6	41.5	13.4	27.4	4.7	5.0	4.8	22.6	22.9	22.8
V4 x S3 x I2	139.0	142.3	140.7	90.7	90.0	90.3	237.5	226.7	232.1	9.3	8.8	9.0	36.2	24.2	30.2	3.7	5.3	4.5	15.3	14.4	14.8
V4 x S3 x I3	131.0	135.0	133.0	90.7	90.0	90.3	341.5	281.0	311.3	15.7	12.5	14.1	19.1	20.9	20.0	6.7	5.0	5.8	20.3	18.4	19.4
V4 x S3 x I4	115.0	121.3	118.2	90.3	89.0	89.7	231.3	333.8	282.5	10.0	16.9	13.5	18.1	29.6	23.9	5.7	3.3	4.5	13.0	18.9	15.9
LSD 5%	n.s.	11.1	7.0	1.7	n.s.	n.s.	139.7	140.9	98.3	n.s.	6.0	4.2	14.2	12.9	9.5	n.s.	1.5	0.9	2.2	1.7	1.4

Table 7. Simple correlation coefficients between biological yield and the studied growth characters of wheat (V1 and V2) and triticale (V3 and V4) varieties (combined of two seasons)

Characters	Varieties	Plant height	Days to 50% heading	Leaf area / plant	Leaf area index	Flag leaf area	No. of tillers / plant
Biological yield	V1	0.382 **	0.188	0.215	0.394 **	0.279 *	-0.512 **
	V2	0.448 **	0.435 **	0.506 **	0.683 **	0.590 **	-0.082
	V3	0.402 **	0.420 **	0.131	0.412 **	0.098	-0.216
	V4	0.329 **	0.131	0.317 **	0.536 **	0.313 **	-0.202
Plant height	V1		-0.315 **	0.040	0.088	0.202	-0.120
	V2		0.439 **	0.537 **	0.509 **	0.477 **	0.337 **
	V3		0.456 **	0.498 **	0.573 **	0.249 *	-0.173
	V4		0.459 **	0.499 **	0.488 **	0.294 *	-0.072
Days to 50% heading	V1			0.020	0.138	0.051	-0.107
	V2			0.534 **	0.527 **	0.699 **	0.198
	V3			0.342 **	0.435 **	0.237 *	0.025
	V4			0.566 **	0.512 **	0.345 **	0.266 *
Leaf area / plant	V1				0.953 **	-0.019	-0.178
	V2				0.946 **	0.676 **	0.163
	V3				0.917 **	0.489 **	-0.217
	V4				0.929 **	0.502 **	0.066
Leaf area index	V1					-0.018	-0.294 *
	V2					0.733 **	0.114
	V3					0.463 **	-0.245 *
	V4					0.571 **	-0.090
Flag leaf area	V1						-0.112
	V2						0.213
	V3						-0.008
	V4						-0.130

* and ** : denote significant at 0.05 and 0.01 probability levels , respectively .

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اختلافات استجابة بعض أصناف القمح والتريتيكال لمعدل التقاوى والإمداد المائى
١- صفات النمو

فاروق محمد إسماعيل حمدى محفوظ سامى خليل غبور

قسم المحاصيل – كلية الزراعة بالفيوم – جامعة القاهرة

أقيمت تجربتان حقليتان خلال موسمى ١٩٩٩ / ٢٠٠٠ ، ٢٠٠٠ / ٢٠٠١ بأرض رسوبية طميية بمزرعة كلية الزراعة – منطقة دار الرماد – محافظة الفيوم – واشتملت كل تجربة على التوافيق بين أربعة أصناف من القمح والتريتيكال (سخا ٦٩، وسدس ٤ للقمح ، و Hare 212 ، و " S" Beagle للتريتيكال) – وثلاثة معدلات تقاوى (٤٠ ، ٨٠ ، ١٢٠ كجم/فدان) وأربعة نظم رى تختلف فى طول الفترات بين الرية والأخرى وهى ٢٠ ، ٣٠ ، ٤٠ ، ٥٠ يوم.

تفوقت أصناف التريتيكال على أصناف القمح تفوقا معنويا فى ثلاثة من صفات النمو: ارتفاع النبات ومساحة الأوراق على النبات ودليل مساحة الورقة ، فى حين تفوقت أصناف القمح على أصناف التريتيكال فى صفة التبكير والمعبر عنها بطرد ٥٠ % من السنابل . أدت زيادة معدل التقاوى المستخدمة فى زراعة كل من نباتات القمح والتريتيكال الى تحسين واضح فى صفة التبكير وزيادة معنوية فى المحصول البيولوجى ، بينما أدت الى نقص عدد الأفرع للنبات معنويا. كما أظهرت صفات النمو وكذلك المحصول البيولوجى للنبات قيما مرتفعة ومعنوية عند رى النباتات على فترات زمنية متقاربة (كل ٢٠ يوم) مقارنة بالقيم المتحصل عليها عند الرى كل ٥٠ يوم . أستنتج من نتائج التفاعلات بين العوامل تحت الدراسة (أصناف – معدلات تقاوى – فترات رى) أن زراعة الأصناف المختبرة بمعدلات تقاوى ٨٠ أو ١٢٠ كجم / فدان و الرى على فترات زمنية كل ٢٠ يوم له تأثير إيجابى على صفات نمو النباتات والتى أعطت بدورها محصولا بيولوجيا متميزا . وأظهرت دراسة العلاقة الإرتباطية لكل صنف على حده أن هناك ارتباطا معنويا وموجبا بين صفة المحصول البيولوجى وكل من صفتى ارتفاع النبات ودليل مساحة الورقة لجميع الأصناف المدروسة .

المجلة المصرية لتربية النبات ٦ (١): ٢٢١-٢٣٧ (٢٠٠٢).