

RESPONSE OF YIELD AND YIELD ATTRIBUTES OF SOME BREAD WHEAT VARIETIES TO IRRIGATION LEVELS AND SEEDING RATE UNDER OLD LAND CONDITIONS

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ABSTRACT

Two field experiments were performed in the experimental Farm, at Zankalon, Water Requirements Research Station, El-Sharkia Governorate, Water Management and Irrigation Systems Research Institute, National Water Research Center (NWRC), Egypt during two successive seasons at 2005/2006 and 2006/2007 to study the response of yield and yield attributes of some bread wheat varieties i.e., (Sakha 93 , Giza 168 and Gimmeiza 9) to irrigation levels (100% of field capacity , 80% of field capacity and 60% of field capacity) and seeding rates (60 , 70 and 80 Kg./feddan) under in old land conditions. The obtained results could be summarized as follows:

Increasing irrigation levels from I_3 (60% of field capacity) to I_1 (100% of field capacity) gives significant for plant height, number of grains/spike , number of spikes/m², 1000 grain weight, grain yield/feddan and straw yield/feddan with in significant differences between I_1 (100% of field capacity) and I_2 (80% of field capacity). Increasing irrigation levels from I_3 (60% of field capacity) to I_1 (100% of field capacity) was in significantly affect for spike length, number of spikelets/spike and spike grain weight.

The cultivar Giza 168 gave taller plants followed by Gimmeiza 9, while Sakha 93 had shorter plants. The cultivar Gimmeiza 9 gave the longest spikes and much number of spikelets and grains /spike and number of spikes/m² followed by Sakha 93 and Giza 168 cultivars Gimmeiza 9 and Sakha 93 cultivars. significantly surpassed Giza 168 for 1000-grain weight and grain yield/feddan. Meanwhile, Giza 168 significantly surpassed Sakha 93 and Gimmeiza 9 cultivars in straw yield/feddan. However significant was showing with increasing seeding rate for plant height, number of spikes/m², and grain and straw yields/feddan with no significant differences between 60 to 70 Kg. /feddan in one side and from 70 to 80 Kg. /feddan for both grain and straw yield /feddan. However, the increasing seeding rate from 60 to 80 Kg. /feddan significantly increased plant height and number of spikes/m². However, increasing seeding rates from 60 to 80 Kg./feddan decreased significantly, number of spikelets/spike, number of grains /spike and 1000-grain weight with no significant difference between 60 to 70 Kg./feddan. Raising seeding rates from 60 to 70 or 80 Kg./feddan did not significantly affect spike grain weight.

Grain yield (ardab/feddan) was positively and significantly correlated with each of plant height (0.598919*) and number of spikes/m² (0.679488*). While the relation was positive and insignificant with each of spike length (0.212270), number of spikelets/spike (0.448344) , number of grains/spike (0.268315) spike grain weight (0.539816), 1000-grain weight(0.457077) and straw yield/feddan (0.331902).

Results of interactions between irrigation levels and varieties , between irrigation levels and seeding rates and between seeding rates and varieties recommended that Gimmeiza 9 cultivar. should be sown at irrigation levels I_2 (80% Of field capacity) and at seeding rates of 80 Kg./feddan. While Giza 168 cultivar. should be sown at irrigation levels I_2 (80% Of field capacity) and at seeding rates of 70 Kg./feddan. However, Sakha 93 cultivar. should be sown at irrigation levels I_1 (100% Of field capacity) and at seeding rates of 70 Kg. /feddan.

INTRODUCTION

Wheat is considered the first leading cereal crop in the world. Increasing wheat yield per unit area had a national interest. In Egypt, the local production is not sufficient to meet the exponential increase in population. Therefore, any attempts for raising wheat production are considered a matter of utmost importance. Such attempts could be achieved either by increasing area cultivated with wheat or by raising the yield per feddan. Irrigating for maximum crop yield and quality is often a matter of correct timing as well as correct amounts. It is necessary to have a good understanding of the crop water needs and timing, as well as knowledge of the physical and chemical soil characteristics such as available water holding capacity and infiltration rate.

To obtain maximum yields from any crop, plants should retain relatively free of water stress. The relationships between crop yields of wheat and water use are complicated. Wheat yield may depend on when water is applied or on the amount. Information on optimal scheduling of limited amounts of water to maximize yields of high quality crops is essential if irrigation water is to be used most efficiently (Al-Kaisi *et al.*, 1997).; English and Nakamura, 1989; Ghahraman and Sepaskhah, 1997). Husman *et al.* (2000) cleared that irrigation at 50% soil water depletion or less is optimal for wheat grain yield. Aly *et al.* (2007) reported that, the highest yield of wheat was obtained with the low water deficit. Ouda (2006) showed that the yield of both wheat varieties were reduced under deducting 20% of irrigation water by 8.62 and 8.76 % for Sakha 93 and Giza 168, respectively.

Many researchers cleared that wheat cultivars differ in their ability to yield and yield attributes. They reported that the varietal differences might be attributed to genetical constitution as well as the range of cultivar response. Blum and Punel, (1990) tested 12 spring wheat cultivars. and reported significant differences among in number of spikes/m² and grain weight/spike. El-Banna and Aly, (1993) reported that Sakha 8, Sakha 61, Giza 164 and Gimmeiza 10 cultivars. attained higher number of spikes/m² and grain yield/fed. Compared with Giza 157, Giza 163, Sakha 69, Sakha 92. Darwish, (1994) found that sakha 69 wheat. Surpassed Giza 157 in number of spikes/m², grain weight /spike and grain yield/fed. Khater *et al.*, (1997) found that Gimmeiza 10 surpassed Sakha 8, Sakha 69, Giza 163 and Giza 164 wheat in number of spikes/m²; grain weight/spike and grain yield/fed. El-Banna, (1999) reported that Gimmeiza 10 had higher number of spikes/m² compared with the other wheat. tested (Sids 6, Giza 163 and Sakha 8) and less number of grains/spike and grain yield/fed. Ramadan, (2003) revealed that Giza 167 had higher number of spikes/m² meanwhile, Sids 2 gave the highest grain number/spike and grain yield/fed., Sakha 69 produced heaviest grain weight/spike . However, the heaviest 1000-grain was observed with Giza 164.

Most of the previous studies have shown different effects for seeding rate on yield and yield attributes of wheat. El-Bana and Basha, 1994; Abdalla and Bassiouny, 1994; Abo Warda 1997; El-Karamity, 1998; and Ramadan,

2003, reported increases in plant height, number of spikes/ unit area, grain and straw yields with increasing seeding rates, while number of grains /spike and 1000-grain weight were decreased. Spike length, number of spikelets and grains/spike in addition to 1000-grain weight were decreased but plant height , number of spikes /unit area , grain and straw yields were increased with increasing seeding rates from (20 to 60 Kg./fed. (Salem *et al.*, 1990); 25 to 75 Kg. /fed. (Mahmoud, 1988), 45 to 75 Kg. /fed. (Bassal, 1997) , El-Karamity,1998) and from 50 to 90 Kg./fed (El-Banna, 2000). However, El-Banna, (2000) did not find significant effect on 1000-grain weight with the increasing in seeding rate from 70 to 90 Kg./fed. On the other hand, Hussein, (2005) reported that maximum grain yield was obtained with a seeding rate of 70 kg./fed.

This study was aimed to investigate the response of yield and yield components of three local wheat cultivars to irrigation levels and seeding rates

MATERIALS AND METHODS

1- Description of the studied materials and experimental layout

Two field experiments were conducted during two winter successive seasons of 2004/2005 and 2005/2006 at Zankalon, Water Requirements Research Station, El-Sharkia Governorate, Water Management and Irrigation Systems Research Institute, National Water Research Center (NWRC).

In each experiment, 27 treatments which were the combination of three Irrigation levels, three wheat cultivars and three seeding rates are tested in a strip split plot design with three replicates. Irrigation levels were assigned to vertical plots, wheat varieties occupied the horizontal plots, whereas seeding rates were devoted to sub plots in horizontal. The preceding crops were rice and maize in the two seasons, respectively.

The agricultural method was drill on ridges 120cm; width; length was 10m every ridge contents 6 rows ;20cm apart between hills 10cm. The plot size was 12m². The irrigations was applied after sowing for optimum water implations.

Phosphorus and potassium fertilizer levels were applied in one dose before sowing in form of calcium super phosphate (15.5 % P₂O₅) and potassium sulphate (50% K₂O). Calcium superphosphate and potassium sulphate were added by rates of 100 and 50 Kg. /feddan, respectively. Seventy Kg.N/feddan was added in three equal doses at sowing, tillering and booting stage in the form of Urea (46.5% N).

This site is located at 30-35 N Latitude and 30-57 E Longitude with an elevation of East Nile Delta region. Soil of experimental site was clay in texture. Soil samples were collected to determine some soil physical and chemical properties of the experimental site. The average values of these measurements at different soil depths down to 60 cm are presented in Table (1).

Table (1): Some soil physical and chemical properties of the experimental site

Depth (cm)	Sand %	Silt %	Clay %	texture	Bulk density (g/cm ³)	Field capacity (%)	Witting point (%)	Available water (%)	E.C dsm ⁻¹	pH
0-15	25.80	28.90	43.51	Clay	1.25	43.51	23.55	19.96	1.40	8.10
15-30	25.12	30.10	42.50		1.27	40.50	21.06	19.44	1.22	8.00
30-45	26.90	31.50	40.50		1.35	37.12	17.59	19.53	1.25	8.01
45-60	29.78	31.50	37.12		1.40	36.25	16.62	19.63	1.05	8.02
Average	26.90	30.50	40.91		1.32	39.34	19.70	19.69	1.23	8.03

II- studied treatments

The treatments were as follows:

1- Irrigation levels (I):

Irrigation water was applied to refill the soil profile (60 cm depth) to the

Following levels:

- a-100% of field capacity (I₁)
- b-80 % of field capacity (I₂)
- c- 60 % of field capacity (I₃)

2- Wheat cultivars (C):

- a- Sakha 93 (C₁)
- b- Giza 168 (C₂)
- c- Gimmeiza 9 (C₃)

3- Seeding rates (S):

- a- 60 kg. /feddan (S₁)
- b - 70 kg. /feddan (S₂)
- c - 80 kg. /feddan (S₃)

C- Collected data

At harvest, the third and the fourth ridge by area of 4.2 m² were taken from each sub-sub plot to record, number of spikes/m², 1000 grain, grain yield /feddan, biological yield /feddan. Twenty seedlings from (second ridge) from each sub-sub plot were labeled at seedling stage for record plant height. In the meantime, 10 spikes were randomly taken to study, number of spikelets, number of grains/spike and grain weight/spike.

D- Statistical analysis

Fisher technique (Fisher's 1960) for comparison between means. Duncan multiple range tests were applied (Duncan, 1955). In interaction Tables, capital and small letters were used to compare both rows and columns averages, respectively. The combined data of yield attributes and characters related to quality with yield were subjected to simple correlation coefficients calculated according to Sendecor and Cochran (1967).

RESULTS AND DISCUSSION

A- Effect of Irrigation levels:

Data presented in Tables (2),(3) and (4) showed the effect of irrigation levels on yield and yield attributes of wheat in the two seasons and their combined analysis. Irrigation levels had significant effects in both seasons and their combined analysis on plant height, number of grains/spike, number

of spikes/m², 1000 grain weight, grain yield/feddan and straw yield/feddan. These characters were increased with increasing irrigation levels from I₃ (60% of field capacity) to I₁ (100% of field capacity) with no significant differences between I₁ (100% of field capacity) and I₂ (80% of field capacity). The relative increase (combined data) due to increasing irrigation levels from I₃ to I₁ were 5.16, 5.63, 3.01, 10.19, 15.22 and 23.05 % in plant height , number of grains/spike, number of spikes/m², 1000-grain weight, grain yield/feddan and straw yield/ feddan, respectively.

The decreases in yield and yield attributes due to wheat irrigate at I₃ (60% of field capacity) may be due to changes patterns of plant growth and development (Ouda, 2006) , disturbance metabolites transportation to the grains (Kramer and Boyer, 1995), reduced the number of reproductive tillers which limit their contribution to grain yield (Mosaad *et al* 1995) and caused pollen sterility (Saini *et al* 1984)

Results in tables (2) and (3) indicated that increasing irrigation levels from I₃ (60% of field capacity) to I₁ (100 % of field capacity) did not significantly affect spike length in both seasons and their combined analysis, number of spikelets/spike in the first season and combined analysis and spike grain weight in the first season. Combined data revealed that, maximum average of spike length (9.56 cm), number of spikelets/spike (19.32) and spike grain weight (2.68 gm) were recorded when irrigation level was I₁ (100% of field capacity), while minimum average of spike length (8.23 cm) , number of spikelets/spike (18.11) and spike grain weight (2.30 gm) were recorded when irrigation level was I₃ (60% of field capacity).

These results are in agreement with those obtained by (Mosaad *et al.* 1995) Husman *et al* (2000), Ouda (2006), Aly *et al.* (2007) and Kramer and Boyer (1995) who, reported that low soil moisture conditions caused losses of tissue water , which inhibit cell division and enlargement and reduced number of reproductive tillers and limit their contribution to grain yield.

B- Varieties effect

Results in Tables (2), (3) and (4) indicated that wheat varieties exhibited significant differences for both grain and straw yields, as well as, all studied yield attributes except spike length and number of grains/spike for both seasons and their combined , number of spikelets/spike in the first season and spike grain weight in the first and second seasons.

The combined analysis data in Table (2) revealed that, Giza 168 and Gimmeiza9 varieties significantly surpassed sakha 93 in plant height. Giza 168 gave taller plants (98.88 cm) followed by Gimmeiza 9 (96.89 cm), while Sakha 93 had shorter plants (94.42 cm). Moreover, it has been found herein that, Gimmeiza 9 had the longest spike, while Sakha 93 and Giza 168 gave the shortest ones. Data also showed that Gimmeiza 9 CV. loaded with much number of spikelets/spike (19.55) followed by Sakha 93 (18.73), while Giza 168 had the lowest number of spikelets/spike (17.61).

The average of both seasons data in Table (3) demonstrate that , Gimmeiza 9 cultivar produce highest values of number of grains /spike and spike grain weight followed by Sakha 93 and Giza 168. Furthermore, these results conclude that Gimmeiza 9. was of a high potentiAlyty to bearing

number of spikes/m² (427.78) followed by Giza 168. (411.33) and Sakha93. (396.22), respectively.

Combined data given in Table (4) showed significant differences among wheat varieties in each of 1000-grain weight, grain and straw yield/feddan. It is clear from Table (4) that both Gimmeiza 9 and Sakha 93 significantly surpassed Giza 168 cultivar in 1000-grain weight and grain yield/feddan. Meanwhile, Giza 168 variety significantly surpassed Sakha 93 and Gimmeiza 9 cultivars in straw yield/feddan.

It could be concluded that varietal differences may be due to genetical differences between cultivars concerning partition of dry matter, where wheat varieties differed carbon equivalent, yield energy per plant and per feddan (Abd El-Gawad et al, 1987). The results of varietal differences in yield and yield attributes in this study are in agreement with those obtained by El-Banna and Aly, (1993) Darwish, (1994) Khater *et al*,(1997), El-Banna, (1999) and Ramadan, (2003) .

C- Effect of seeding rates

Data presented in Tables (2) , (3) and Table (4) show the effect of seeding rates on yield and yield attributes of wheat in the two seasons and their combined analysis . Seeding rates had significant effects in both seasons and their combined analysis on plant height, number of spikes/m², and grain and straw yields/feddan. The number of spikelets/spike and 1000-grain weight. These characters were increased with increasing seeding rate from 60 to 80 Kg./feddan with no significant differences between 60 to 70 Kg./feddan in one side and from 70 to 80 Kg./feddan in the other side for both grain yield /feddan and straw yield/feddan. However, the increase in plant height and number of spikes/m² was gradually due to raising seeding rate from 60 to 70 and 80 Kg. /feddan. The increase in plant height in dense sowing may be attributed to the reduction in light intensity within plant canopy, which enhance IAA synthesis and hence, increased cell. The increase in number of spikes/m² is mainly due to the increase of plant number per unit area (El-Karamity, 1998). The relative increase due to raising seeding rate from 60 to 80 Kg. /feddan was 11.17 and 16.15% in plant height and number of spikes/m², respectively. (Combined data)

As shown in Tables (2) and (3) , increasing seeding rates from 60 to 80 Kg./feddan decreased significantly , number of spikelets/spike, number of grain /spike and 1000-grain weight with no significant differences between 60 to 70 Kg./feddan (combined data). On the other hand, raising seeding rates from 60 to 70 or 80 Kg. /feddan did not significantly affect spike grain weight in both seasons and their combined analysis.

In the combined data, the relative decreases due to raising seeding rate from 60 to 80 Kg./feddan in number of spikelets/spike (Table 2), number of grains / spike (Table 3) and 1000 grain weight (Table 4) were 14.25, 4.80 and 5.74 % , respectively. These results showed that dense sowing led to a severe competition among plants for nutrients, water supply and light. So, crowded plants become longer with lower tillering than those of thin sowing. Hence, a reduction in photosynthesis for dense plants could be expected which would be reflected on spike elongation and development as expressed in number of spikelets and grains per spike.

Table (2): Effect of irrigation levels, varieties and seeding rates on plant height "cm" Spike length "cm" and No. of spikelet's/spike of wheat in the 1st and 2nd seasons and the combined.

Main effects and interaction	Plant height "cm"			Spike length "cm"			No. of spikelets/spike		
	1st season	2nd season	combined	1st season	2nd season	combined	1st season	2nd season	combined
Irrigation levels (I):									
100 % of Field Capacity (I1)	93.44 a	103.84 a	98.64 a	9.10	10.02	9.56	16.58	22.06 a	19.32
80 % of Field Capacity (I2)	92.95 a	102.55 a	97.75 a	8.33	9.11	8.72	15.86	21.06ab	18.46
60 % of Field Capacity (I3)	90.45	97.15 b	93.8 b	7.91	8.55	8.23	15.59	20.63 b	18.11
F. Test	*	*	*	n.s	n.s	n.s	ns	*	n.s
Varieties (V):									
Sakha 93 (V1)	89.62 b	99.22 b	94.42 b	8.6	9.18	8.89	15.75	21.71 a	18.73 ab
Giza 168 (V2)	94.07 a	103.69 a	98.88 a	8.12	8.68	8.40	15.66	19.56 b	17.61 b
Gimmeiza 9 (V3)	93.15 a	100.63ab	96.89 a	8.62	9.82	9.22	16.62	22.48 a	19.55 a
F. Test	*	*	*	ns	n.s	n.s	n.s	*	*
Seeding rates (S):									
60 Kg./feddan (S1)	86.98 c	95.86 c	91.42 c	9.08	9.72	9.40	17.32 a	22.96 a	20.14 a
70 Kg./feddan (S2)	92.66 b	101.60b	97.13 b	8.80	9.40	9.10	15.15 b	21.81 a	18.48 b
80 Kg./feddan (S3)	97.20 a	106.08 a	101.64 a	7.46	8.56	8.01	15.56 b	18.98 b	17.27 b
F. Test	**	**	**	n.s	n.s	n.s	*	**	**
Interactions:									
I x V	n.s	n.s	n.s	n.s	*	n.s	n.s	*	*
I x S	n.s	n.s	n.s	*	n.s	**	**	n.s	*
V x S	**	*	**	**	*	**	*	**	**
I x V x S	**	**	**	**	**	**	**	*	**

Table (3): Effect of irrigation levels, varieties and seeding rates on No. of grains/spike , spike grain weight (gm) and No. spikes/m² of wheat in the 1st and 2nd seasons and the combined.

Main effects and interaction	No. of grains/spike			Spike grain weight (gm)			No. of spike/m ²		
	1 st season	2 nd season	combined	1 st season	2 nd season	combined	1 st season	2 nd season	combined
Irrigation levels (I):									
100 % of Field Capacity (I1)	51.54 a	62.40a	56.97 a	2.41	2.95 a	2.68 a	394.35 a	439.87 a	417.11 a
80 % of Field Capacity (I2)	51.11 a	60.11ab	55.61 a	2.26	2.82 a	2.54 ab	392.90 a	433.76 a	413.33 a
60 % of Field Capacity (I3)	49.00 b	58.86 b	53.93 b	2.10	2.50 b	2.30 b	387.29 b	422.49 b	404.89 b
F.Test	*	**	*	ns	*	*	**	**	*
Varieties (V):									
Sakha 93 (V1)	51.07	60.33	55.70	2.34	2.74	2.54 a	377.79 c	414.65 c	396.22 c
Giza 168 (V2)	49.29	59.87	54.58	2.08	2.66	2.37 b	390.81 b	431.85 b	411.33 b
Gimmeiza 9 (V3)	51.29	61.17	56.23	2.35	2.87	2.61 a	405.94 a	449.62 a	427.78 a
F.Test	ns	n.s	ns	n.s	ns	*	**	**	**
Seeding rates (S):									
60 Kg./feddan (S1)	51.31	61.79	56.55 a	2.33	2.83	2.58	366.31 c	399.69 c	383.00 c
70 Kg./feddan (S2)	51.13	61.13	56.13 a	2.30	2.79	2.54	383.96 b	430.92 b	407.44 b
80 Kg./feddan (S3)	49.21	58.45	53.83 b	2.14	2.66	2.40	424.27 a	465.51 a	444.89 a
F.Test	ns	n.s	*	ns	ns	ns	**	**	**
Interactions:									
I x V	**	*	*	*	*	ns	*	*	*
I x S	*	**	**	*	**	*	**	**	*
V x S	**	*	**	**	*	*	*	**	**
I x V x S	**	**	**	**	**	**	**	*	**

Table (4): Effect of irrigation levels, varieties and seeding rates on Thousand grain weight "gm" Grain yield (ardab /fed and Straw yield" ton/fed.) of wheat in the 1st and 2nd seasons and the combined

Main effects and interaction	Thousand grain weight "gm"			Grain yield "ardab/fed."			Straw yield"		
	1 st season	2 nd season	combined	1 st season	2 nd season	combined	1 st season	2 nd season	combined
Irrigation levels (I):									
100 % of Field Capacity (I1)	46.75 a	47.27 a	47.01 a	20.19 a	23.55 a	21.87 a	12.24 a	13.06 a	12.65 a
80 % of Field Capacity (I2)	44.21 ab	46.91 a	45.56 a	19.54 ab	21.54 ab	20.54 ab	11.68 a	12.18 ab	11.93 a
60 % of Field Capacity (I3)	42.85 b	42.47 b	42.66 b	18.59 b	19.37 b	18.98 b	9.27 b	11.29 b	10.28 b
F.Test	*	*	**	**	**	**	**	**	**
Varieties (V):									
Sakha 93 (V1)	45.81 a	45.51 b	45.66 a	19.65 ab	21.91 ab	20.78 ab	10.06 b	10.10 b	10.08 c
Giza 168 (V2)	42.19 b	43.85 c	43.02 b	18.23 b	20.11 b	19.17 b	12.01 a	14.47 a	13.24 a
Gimmeiza 9 (V3)	45.81 a	47.29 a	46.55 a	20.43 a	22.45 a	21.44 a	11.12 ab	11.96 b	11.54 b
F.Test	*	**	**	**	**	**	**	**	**
Seeding rates (S):									
60 Kg./feddan (S1)	45.41 a	46.79 a	46.10 a	17.98 b	20.58 b	19.28 b	9.56 c	11.98 b	10.77 b
70 Kg./feddan (S2)	44.92 ab	46.44 a	45.68 a	19.43 a	21.15 b	20.29 ab	11.29 b	11.45 b	11.37 ab
80 Kg./feddan (S3)	43.48 b	43.42 b	43.45 b	20.90 a	22.74 a	21.82 a	12.34 a	13.10 a	12.72 a
F.Test	*	*	**	**	**	**	**	**	**
Interactions:									
I x V	*	*	*	**	**	**	*	*	**
I x S	*	*	*	*	**	*	*	*	*
V x S	**	*	**	**	*	**	*	**	**
I x V x S	**	**	**	**	**	**	**	**	**

As shown in the combined data (Table 4) grain and straw yield / feddan obtained with seeding rate 80 Kg/feddan out yielded. With no significant differences between 70 and 80 Kg./feddan. The relative increases in grain and straw yields/feddan due to raising seeding rate from 60 to 80 Kg./feddan were 13.17 and 18.10% . The increase in grain yield due to dense sowing may be attributed to increase in number of spikes/m². The increase in straw yield is mainly due to the increase in number of plants per unit area coupled with plant height. These results are in agreement with those obtained by Abdalla and Bassiouny (1994), Abo warda (1997) El-Karamity (1998), Ramadan (2003), (El-Bana, 2000) and Hussein, (2005).

D- Interaction effect:

D.1. Number of spikes/m²:

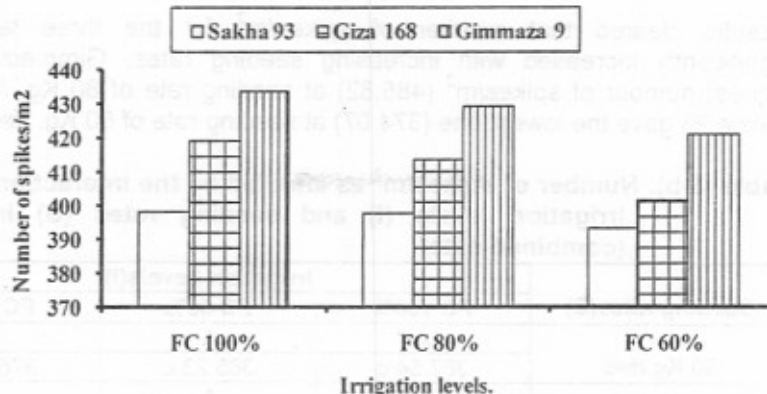
Data presented in Table (3-a) and graphically illustrated in Fig. (1) Revealed that number of spikes/m² of wheat in the combined analysis was significantly affected by the interaction between irrigation levels and varieties. Results indicates that number of spikes/m² for the three tested was significantly increased with increasing irrigation levels. At different irrigation levels Gimmeiza 9 cultivar gave highest number of spikes/m² followed by Gimmeiza 9, Giza 168 and Sakha 93 respectively Gimmeiza 9 and Sakha 93 produced the height number of spikes/m² at Irrigation level I₂ (80% of field capacity) with no significant difference between I₂ and I₁. However, Giza 168 cultivar produced the highest number of spikes/m² at I₁ (100% of field capacity).

Table (3-a): Number of spikes/m² as affected by the interaction between Irrigation levels (I) and Varieties (V) interaction (combined data)

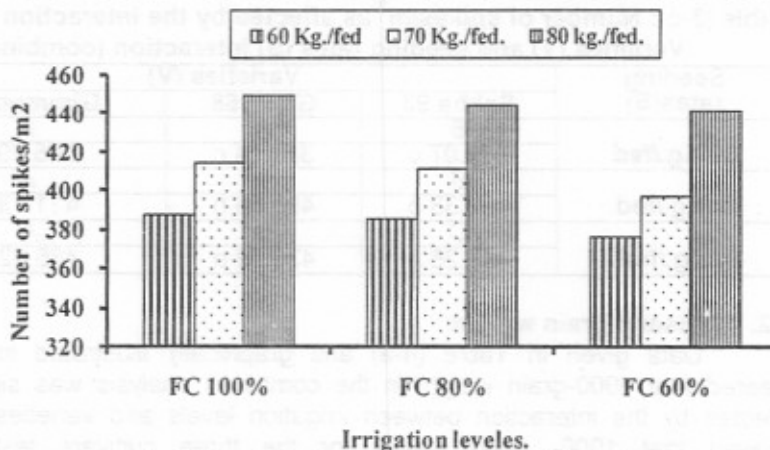
Verities(V)	Irrigation Levels(I)		
	FC 100%	FC 80%	FC 60%
Sakha 93	A	A	B
	398.32 c	397.52 c	392.82 c
Giza 168	A	B	C
	419.23 b	413.51 b	401.25 b
Gimmeiza 9	A	A	B
	433.78 a	428.96 a	420.60 a

Data given in Table (3-b) and graphically illustrated in Fig. (2) Cleared that number of spikes/m² of wheat in the combined analysis was significantly affected by the interaction between irrigation levels and seeding rates .Results showed that number of spikes/m² was significantly increased with increasing irrigation levels under different seeding rates. Plants sown at 80 Kg./feddan and irrigated at level I₁ (100% of field capacity) produced Highest number of spikes/m². While the lowest number of spikes/m² was found under irrigation levels I₃ (60% of field capacity) at different seeding rates

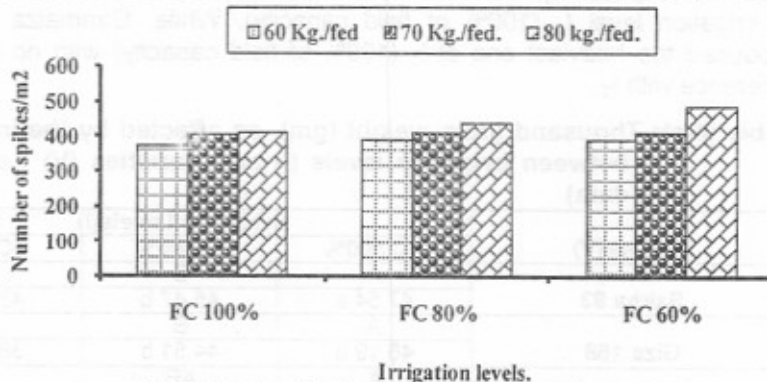
Results in Table (3-c) and graphically illustrated in Fig. (3) Showed that number of spikes/m² of wheat in the combined analysis was significantly affected by the interaction between varieties and seeding rates.



Irrigation levels.
 Fig. 1: Number of spikes/m² as affected by the interaction between Irrigation levels (I) and Varieties (V).



Irrigation levels.
 Fig. 2: Number of spikes/m² as affected by the interaction between Irrigation levels (I) and seeding rates (S)



Irrigation levels.
 Fig. 3 : Number of spikes/m² as affected by the interaction between Varieties (V) and seeding rates (S)...

Results cleared that number of spikes/m² for the three tested was significantly increased with increasing seeding rates. Gimmeiza 9 gave highest number of spikes/m² (485.82) at seeding rate of 80 Kg. /fed. While Sakha 93 gave the lowest one (374.07) at seeding rate of 60 Kg. /feddan.

Table (3-b): Number of spikes/m² as affected by the interaction between Irrigation levels (I) and seeding rates (S) interaction (combined data)

Seeding rates(S)	Irrigation Levels(I)		
	FC 100%	FC 80%	FC 60%
60 Kg./fed	A	A	B
	387.54 c	385.23 c	376.23 c
70 Kg./fed.	A	A	B
	414.65 b	410.64 b	397.03 b
80 kg./fed.	A	AB	B
	449.14 a	444.12 a	441.41 a

Table (3-c): Number of spikes/m² as affected by the interaction between Varieties (V) and seeding rates (S) interaction (combined data)

Seeding rates(S)	Varieties (V)		
	Sakha 93	Giza 168	Gimmeiza 9
60 Kg./fed	B	A	A
	374.07 c	388.54 c	385.39 c
70 Kg./fed.	B	A	A
	402.33 b	408.86 b	411.13 b
80 kg./fed.	C	B	A
	412.26 a	436.59 a	485.82 a

D.2. Thousand grain weight:

Data given in Table (4-a) and graphically illustrated in Fig. (4) Cleared that 1000-grain weight in the combined analysis was significantly affected by the interaction between irrigation levels and varieties. Results showed that 1000- grain weight for the three cultivars tested were significantly increased with increasing irrigation levels. At different irrigation levels Gimmeiza 9 cultivar gave heaviest grains followed by Sakha 93 and Giza 168 respectively. Giza 168 and Sakha 93 produced the heaviest grains at irrigation level I₁ (100% of field capacity). While, Gimmeiza 9 cultivar produced the heaviest one at I₁ (100% of field capacity) with no significant difference with I₂.

Table (4-a): Thousand grain weight (gm) as affected by the interaction between Irrigation levels (I) and Varieties (V) (combined data)

Verities(V)	Irrigation Levels(I)		
	FC 100%	FC 80%	FC 60%
Sakha 93	A	B	C
	47.54 a	45.47 b	43.97 b
Giza 168	A	B	C
	46.19 a	44.51 b	38.36 c
Gimmeiza 9	A	AB	B
	47.30 a	46.70 a	45.65 a

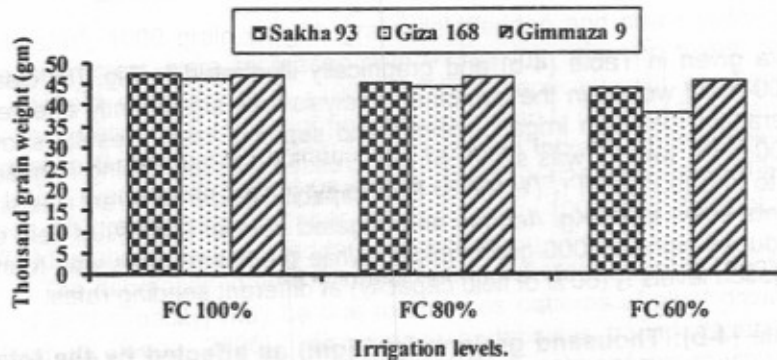


Fig. 4 :Thousand grain weight (gm) as affected by the interaction between Irrigation levels (I)and Varieties (V)

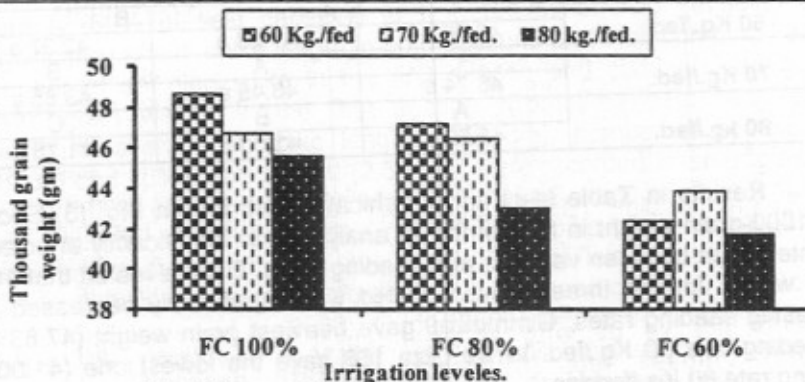


Fig. 5 :Thousand grain weight (gm) as affected by the interaction between Irrigation levels (I)and seeding rates (S)

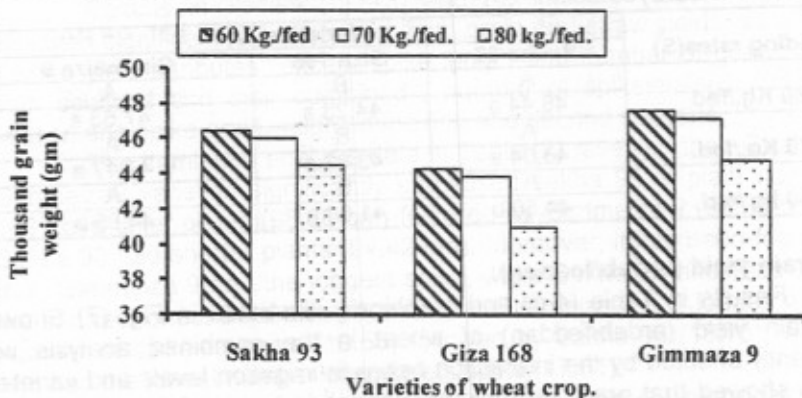


Fig. 6 :Thousand grain weight (gm) as affected by the interaction between Varieties (V) and seeding rates (S)

Data given in Table (4-b) and graphically illustrated in Fig. (5) cleared that 1000-grain weight in the combined analysis was significantly affected by the interaction between irrigation levels and seeding rates. Results showed that 1000-grain weight was significantly increased with increasing irrigation levels up to irrigation level I₁ (100% of field capacity) under different seeding rates. Plants sown at 80 Kg./feddan and irrigated at level I₁ (80% of field capacity) produced highest 1000-grain weight. While the lowest ones was found under Irrigation levels I₃ (60% of field capacity) at different seeding rates.

Table (4-b): Thousand grain weight (gm) as affected by the interaction between Irrigation levels (I) and seeding rates (S) (combined data)

Seeding rates(S)	Irrigation Levels(I)		
	FC 100%	FC 80%	FC 60%
60 Kg./fed	A	A	B
	48.70 a	47.23 a	42.37 a
70 Kg./fed.	A	A	B
	46.74 b	46.45 a	43.85 a
80 kg./fed.	A	B	C
	45.59 b	43.00 b	41.76 a

Results in Table (4-c) and graphically illustrated in Fig. (6) Showed that 1000-grain weight in the combined analysis was significantly affected by the interaction between varieties and seeding rates. Data revealed that 1000-grain weight for the three cultivars tested was significantly decreased with increasing seeding rates. Gimmeiza9 gave heaviest grain weight (47.63 gm) at seeding rate 60 Kg./fed. While Giza 168 gave the lowest one (41.00) at seeding rate 80 Kg./feddan.

Table (4-c): Thousand grain weight (gm) as affected by the interaction between Varieties (V) and seeding rates (S) (combined data)

Seeding rates(S)	Varieties (V)		
	Sakha 93	Giza 168	Gimmeiza 9
60 Kg./fed	A	B	A
	46.44 a	44.23 a	47.63 a
70 Kg./fed.	A	B	A
	46.04 a	43.83 a	47.17 a
80 kg./fed.	A	B	A
	44.50 b	41.00 b	44.85 b

D.3. Grain yield (ardab/feddan):

Results in Table (4-d) and graphically illustrated in Fig. (7) Showed that grain yield (ardab/feddan) of wheat in the combined analysis was significantly affected by the interaction between irrigation levels and varieties. Results showed that grain yield (ardab/feddan) for each of Gimmeiza 9 and Sakha 93 surpassed Giza 168 cultivar at different irrigation levels. Grain yield of wheat (ardab/feddan) significantly increased with increasing of irrigation levels up to I₁ (100% of field capacity) for Sakha 93 cultivar (22.22

ardab/feddan) for Gimmeiza 9 (22.88 ardab/feddan) and Giza 168 (20.56 ardab/feddan).

Table (4-d): Grain yield (ardab/fed.) as affected by the interaction between Irrigation levels (I) and Varieties (V) (combined data)

Varieties(V)	Irrigation Levels(I)		
	FC 100%	FC 80%	FC 60%
Sakha 93	A	B	B
	22.22 a	20.74 ab	19.38 a
Giza 168	A	A	B
	20.56 b	19.36 b	17.59 b
Gimmeiza 9	A	A	B
	22.83 a	21.52 a	19.97 a

Data given in Table (4-e) and graphically illustrated in Fig. (8) showed that grain yield (ardab/feddan) in the combined analysis was significantly affected by the interaction between irrigation levels and seeding rates. Data showed that grain yield (ardab/feddan) was significantly increased with increasing irrigation levels up to irrigation level I₁ (100% of field capacity) under different seeding rates. The highest grain yield of wheat (22.95 ardab/feddan) was obtained when wheat plants sown at 80 Kg./feddan and irrigated at level I₁ (100% of field capacity).

Table (4-e): Grain yield (ardab/fed.) as affected by the interaction between Irrigation levels (I) and seeding rates (S) (combined data)

Seeding rates(S)	Irrigation Levels(I)		
	FC 100%	FC 80%	FC 60%
60 Kg./fed	A	AB	B
	20.83 b	19.22 b	17.79 b
70 Kg./fed.	A	AB	B
	21.83 ab	20.19 b	18.85 b
80 kg./fed.	A	A	B
	22.95 a	22.21 a	20.30 a

Results in Table (4-f) and graphically illustrated in Fig. (9) showed that grain yield of wheat in the combined analysis was significantly affected by the interaction between varieties and seeding rates. Data cleared that grain yield of Gimmeiza9 cultivar increased significantly with increasing seeding rates up to 80 Kg./feddan, while grain yield/feddan increased significantly up to seeding rate 70 Kg./feddan for Sakha 93 and Giza 168. Under seeding rate 60 Kg./feddan Giza 168 cultivar produced lowest grain yield (18.42 ardab/feddan), however Sakha 93 gave highest yield (21.20 ardab/feddan) under seeding rate 70 Kg./feddan, while Gimmeiza 9 cultivar gave highest grain yield (23.48 ardab/feddan) at seeding rate 80 Kg./fed.

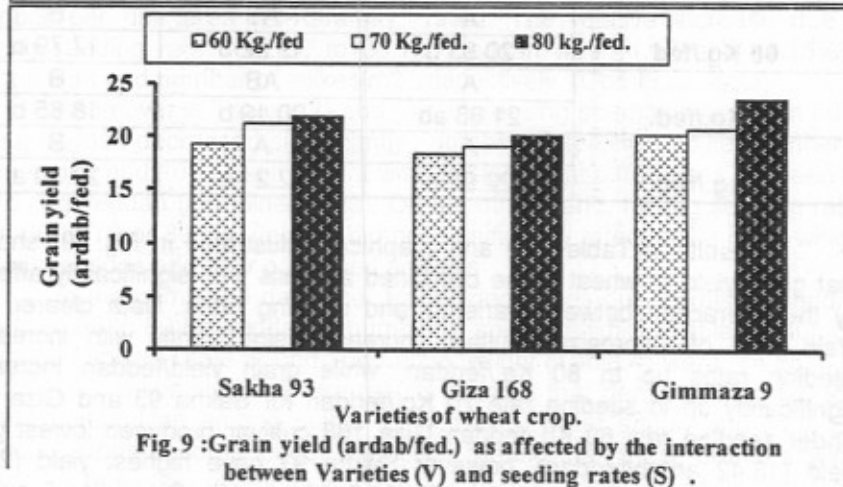
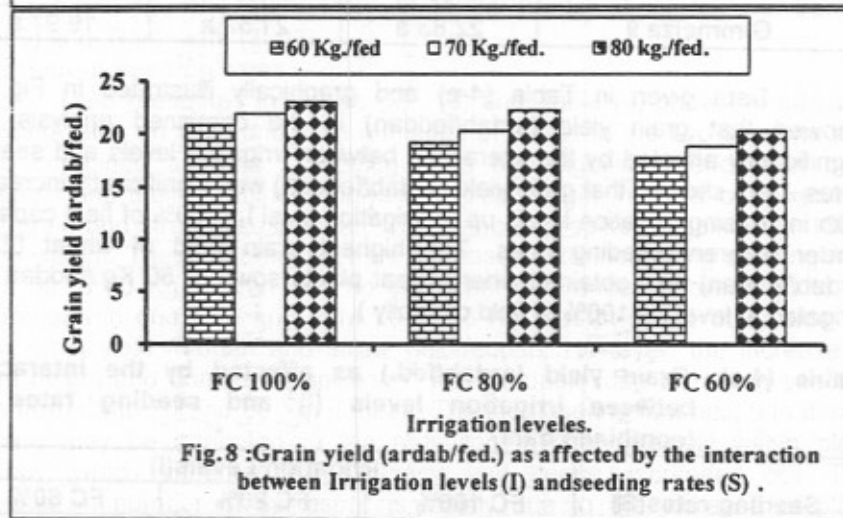
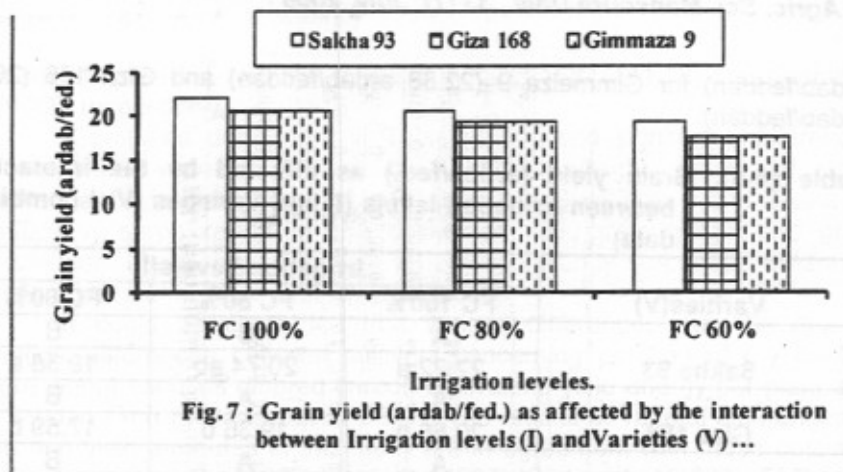


Table (4-f): Grain yield (ardab/fed.) as affected by the interaction between Varieties (V) and seeding rates (S) (combined data)

Seeding rates(S)	Varieties (V)		
	Sakha 93	Giza 168	Gimmeiza 9
60 Kg./fed	A B	B	A
	19.25 b	18.42 b	20.17 b
70 Kg./fed.	A	B	A
	21.20 ab	19.00 ab	20.67 b
80 kg./fed.	B	B	A
	21.89 a	20.09 a	23.48 a

E- Correlation analysis:

The results in table (5) clearly indicated that grain yield /feddan appeared to be positively and significantly correlated with plant height and number of spikes/m². However, positive and insignificant relationship was obtained with each of spike length, number of spikelets/spike, number of grains/spike and spike grain weight, 1000-grain weight and straw yield/feddan. Thus, it seems evident that all the abovementioned characters contributed to grain yield of wheat. in this respect. El- Banna and Aly (1993), Tammam *et al* (2000) , Kamboj *et al* (2000) and Ramadan (2003) showed that significant and positive association of different attributes with grain yield/feddan indicating the importance of different characters, viz number of spikes/m² , number of grains/spike and 1000- grain weight.

Plant height was positively and highly significantly correlated with number of spikes/m² and straw yield/feddan. However, that correlation with the rest characters was negative and insignificant.

Spike length show positive and highly significant correlated with number of spikelets/spike, number of grains/spike, spike grain weight and 1000-grain weight. However, that correlation with number of spikes/m² and straw yield/feddan was negative and insignificant.

Number of spikelets/spike revealed that positive and highly significant correlated with number of grains /spike, spike grain weight and 1000-grain weight. However, that correlation with number of spikes/m² and straw yield/feddan was negative and insignificant

Number of grains/spike showed that positive and highly significant correlated with spike grain weight and 1000-grain weight. However, that correlation with number of spikes/m² and straw yield/feddan was negative and insignificant

Spike grain weight cleared that positive and highly significant correlated with 1000-grain weight. However that correlation with number of spikes/m² and straw yield/feddan was negative and insignificant.

Number of spikes/m² showed that positive and significant correlated with straw yield/feddan. However, that correlation with 1000-grain weight was negative and insignificant

Table (5): Correlation coefficient between grain yield and some yield attributes of wheat (Combined) data)

	1	2	3	4	5	6	7	8
Grain yield (ardab/fed.)	0.598919*	0.21227	0.448344	0.268315	0.539816	0.679468*	0.457077	0.331902
1- Pant height (cm)		-0.370476	-0.33863	-0.297491	-0.092406	0.877098 **	-0.252586	0.839813 **
2-Spike Length (cm)			0.847334**	0.987504**	0.9157187**	-0.41071	0.936422**	-0.156756
3- No. of spikelets/spike				0.820589**	0.863311**	-0.13939	0.910854**	-0.269809
4- No. of grains/spike					0.950292**	-0.37434	0.932908**	-0.10761
5- Spike grain weight (gm)						-0.12592	0.944387**	-0.00403
6- No. of spikes/m ²							-0.213021	0.625998*
7- Thousand grain weight(gm)								-0.195894
8- Straw yield/fed.								

Grain yield (ardab/fed.) x No. spikes/m² of wheat

$R^2 = 0.8243$

Grain yield (ardab/fed.) x Thousand grain weight (gm)

$R^2 = 0.6761$

Grain yield (ardab/fed.) x No. of grains/spike

$R^2 = 0.5180$

Spike length show positive and highly significant correlated with number of spikelets/spike, number of grains/spike, spike grain weight and 1000-grain weight. However, that correlation with number of spikes/m² and straw yield/feddan was negative and insignificant.

Number of spikelets/spike revealed that positive and highly significant correlated with number of grains /spike, spike grain weight and 1000-grain weight. However, that correlation with number of spikes/m² and straw yield/feddan was negative and insignificant

Number of grains/spike showed that positive and highly significant correlated with spike grain weight and 1000-grain weight. However, that correlation with number of spikes/m² and straw yield/feddan was negative and insignificant

Spike grain weight cleared that positive and highly significant correlated with 1000-grain weight. However that correlation with number of spikes/m² and straw yield/feddan was negative and insignificant.

Number of spikes/m² showed that positive and significant correlated with straw yield/feddan. However, that correlation with 1000-grain weight was negative and insignificant

Thousand grain weights showed that negative and insignificant correlated with straw yield /feddan. Similar results were found by Bassiouny (1985), El- Banna and Aly (1993), Ramadan (2003)

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استجابة المحصول ومساهماته في بعض أصناف قمح الخبز لمستويات الري ومعدل التقاوي تحت ظروف الأراضي القديمة.

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أقيمت تجربتان حقليةتان في المزرعة التجريبية بالرنكلون ، محافظة الشرقية - معهد بحوث نظم الري وإدارة المياه - المركز الوطني لبحوث المياه . خلال موسمي النمو ٢٠٠٤/٢٠٠٥ ، ٢٠٠٥/٢٠٠٦م لدراسة استجابة المحصول ومساهماته في بعض أصناف قمح الخبز (سخا ٩٣ ، جيزة ١٦٨ ، جيزة ٩) لمستويات الري (الري عندما يصل مستوي الري بالتربة إلى ١٠٠% ، الري عندما يصل مستوي الري بالتربة إلى ٨٠% ، الري عندما يصل مستوي الري بالتربة إلى ٦٠%) ومعدل التقاوي (٦٠ ، ٧٠ ، ٨٠ كجم/فدان) وكانت أهم النتائج المنحصلة عليها كما يلي:

- ١- أدى زيادة مستوي الري من الري عند ٦٠ ، ٨٠ ، ١٠٠% من السعة الحقلية إلى زيادة معنوية لكل من ارتفاع النبات ، عدد الحبوب / سنبلية ، عدد سنابل المتر المربع ، وزن الد ١٠٠٠ حبة ، محصول الحبوب والقش /الفدان مع عدم وجود اختلاف معنوي بين معاملي الري عند ٨٠ ، ١٠٠% . ولم يؤثر زيادة مستوي الري معنويا علي طول السنبلية ، عدد السنبيلات/سنبلية ، وزن حبوب السنبلية.
- ٢- أظهرت أصناف القمح اختلافات معنوية لصفات المحصول ومساهماته ، حيث أعطى صنف القمح جيزة ١٦٨ أطول النباتات يليه صنف القمح جيزة ٩ بينما أعطى صنف القمح سخا ٩٣ أقصر النباتات. كما أعطى الصنف حميزة ٩ أطول السنايل وأعلى عدد من السنبيلات والحبوب /سنبلية ، وأكبر عدد سنابل/م يليه الصنف سخا ٩٣ بينما أعطى الصنف جيزة ١٦٨ أقل القيم. ومن ناحية أخرى أظهرت النتائج تفوق الصنف جيزة ٩ وسخا ٩٣ معنويا علي الصنف جيزة ١٦٨ في صفة وزن الد ١٠٠٠ حبة ، محصول الحبوب/فدان بينما تفوق الصنف جيزة ١٦٨ معنويا علي صنف القمح حميزة ٩ ، سخا ٩٣ في صفة محصول القش/فدان.
- ٣- أدى زيادة معدل التقاوي من ٦٠ الي ٧٠ ، ٨٠ كجم/فدان إلى زيادة معنوية لصفة ارتفاع النبات ، عدد السنايل/م ، محصول الحبوب ، القش/ فدان وبدون اختلاف معنوي بين معدل التقاوي ٦٠ ، ٧٠ كجم/فدان. ولم يلاحظ اختلاف معنوي بين معدل التقاوي ٧٠ ، ٨٠ كجم/ فدان علي صفتي محصول الحبوب والقش / فدان. كما أدى زيادة معدل التقاوي من ٦٠ إلى ٨٠ كجم/فدان إلى نقص معنوي لصفة عدد السنبيلات/ سنبلية ، عدد الحبوب/ سنبلية ، وزن الد ١٠٠٠ حبة مع عدم وجود اختلاف معنوي بين معدل التقاوي ٦٠ ، ٧٠ كجم/فدان. كما أوضحت النتائج عدم وجود اختلاف معنوي علي صفة وزن حبوب السنبلية نتيجة زيادة معدل التقاوي.
- ٤- أظهر محصول الحبوب ارتباط موجب ومعنوي مع كل من ارتفاع النبات ، عدد السنايل/م بينما كان الارتباط موجب وغير معنوي مع كل من طول السنبلية ، عدد السنبيلات/سنبلية ، عدد الحبوب / سنبلية ، وزن حبوب السنبلية ، وزن الد ١٠٠٠ حبة ، محصول القش/فدان.
- ٥- أوصت نتائج التداخل بين مستويات الري والأصناف ، بين مستويات الري ومعدل التقاوي ، بين معدل التقاوي ، الأصناف إلي أنه وتحت ظروف التجربة يجب زراعة صنف القمح حميزة ٩ بمعدل تقاوي ٨٠ كجم/فدان والري عندما تصل السعة الحقلية عند ٨٠% ، بينما يجب زراعة صنف القمح جيزة ١٦٨ بمعدل تقاوي ٧٠ كجم/فدان والري عندما تصل السعة الحقلية في التربة ٨٠% ، في حين أوصت الدراسة بزراعة صنف القمح سخا ٩٣ بمعدل التقاوي ٧٠ كجم/فدان والري عندما تصل السعة الحقلية في التربة الي ١٠٠%.