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EFFECT OF ENVIRONMENTAL TEMPERATURES ON PRODUCTION AND BREAD CHARACTERISTICS FOR BREAD WHEAT CULTIVARS

I. EFFECT OF ENVIRONMENTAL TEMPERATURES ON YIELD AND ITS COMPONENTS

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ABSTRACT

Four bread wheat cultivars, namely; Sakha 93, Misr1, Gemmeiza 9 and Sids 12 were gown in two different environments in Wheat Research Department, Sakha station (North Egypt) and Asouyt station (South Egypt) during two growing seasons; 2010/2011 and 2011/2012. Data were recorded for yield and its components (grain yield, no. of kernels/spikes, no. of spikes/m^2 and kernels weight) as well as some morphological characters (days to heading, days to maturity, grain filling period, grain filling rate and plant height). The results appeared that Sids 12 and Misr1 were the highest cultivars in grain yield at Asouyt station (South Egypt), while Misr1 was the greatest in grain yield at Sakha station (North Egypt). Grain yield, plant height, no. of kernels/spikes, no. of spike/m^2 and days to maturity were decreased at South Egypt than at Sakha station. Therefore, the current study concluded that it is possible to utilize wheat yield and its components as a good indicator to estimate the impact of heat on the wheat productivity, tolerant and characteristics.

Keywords: Bread wheat, environmental temperatures, yield and its components

INTRODUCTION

Wheat (*Triticum aestivum*, L) is one of the main cereal crops, cultivated the demands of the increasing population for human feeding. Increasing grain yield of cereal crops is considered one of the more important national goals in Egypt to face the needs of increment of Egyptian population. The total production of wheat in Egypt in 2011/2012 season was estimated by 8.8 million tons resulted from 3.1 million faddan with an average of 18.7 ardab/faddan (The Agricultural Economic and Statistics Department, Ministry of Agriculture, 2011). In most wheat growing regions especially in the Mediterranean climate, grain filling is subjected to several physical and biotic stresses. Grain filling often occurs, when temperatures are increasing and moisture supply is decreasing (Mohammadi *et al.,* 2009). Short heat stresses (≥ 35^{o}C) in the post-anthesis period can significantly reduce grain weight in wheat and barley (Wardlaw and Wrigley, 1994) and, also, decrease grain quality (Savin *et al.,* 1996). Terminal heat is a major abiotic stress affecting yield in wheat. Under heat stress, the photosynthetic process is affected especially during grain filling stage when demand for assimilates is the greatest (Kumari *et al.,* 2007). Temperature fluctuations during grain filling cause deviations from expected dough properties (Blumenthal *et al.* 1991).

The rise in daily average temperature, up to about 30 ºC, increased dough strength, while temperatures above this threshold value (35 - 40 ºC), even for periods of only few days, tended to decrease dough strength (Corbellini *et al.,* 1997). Wheat shows a highly significant stress stability genotype by environment interaction (GxE) (Reynolds *et al.,* 2002). The protein content in flour significantly increases with bread wheat as the result of the heat stress (Balla and Veisz, 2007 and Labuschange *et al.,* 2009). The deterioration in the dough quality could be attributed to the decline in the glutenin-to-gliadin ratio and in the percentage of very large glutenin polymers in response to the high temperature (Bencze *et al.,* 2004; Balla and Veisz, 2007 and Balla *et al.,* 2011).

The objectives of this study were to evaluate the yield and its components and quality of some wheat varieties under two successive deferent environments, i.e., North Egypt Sakha station (Normal) and South Egypt Asouyt station (heat environment) conditions.

MATERIALS AND METHODS

Four bread wheat cultivars, Sakha 93, Misr1, Gemmeiza 9 and Sids 12, were grown in this experiment during two seasons (2010/2011 and 2011/2012) in wheat Research Department at two locations, Sakha and Asouyt stations.

Table (1): Max. and Min. temperature(°C) at Sakha and Asyout stations in two growing season (2010/2011 and 2011/2012).

Month	Temp. mean max.	Temp. mean min. (°C)	Relative humidity (%)	Month	Temp. mean max. (°C)	Temp. mean min. (°C)	Relative humidity (%)
	Sakha station 2011				Asyout station 2011		
January	24.1	7.8	51.0	January	26.3	7.6	47.0
February	26.9	10.6	42.0	February	29.1	9.6	38.0
March	29.5	13.4	42	March	30.7	12.9	43
April	32.8	16.5	34.0	April	34.5	16.5	35.0
May	35.6	19.2	31.0	May	36.4	18.2	31.0
	Sakha station 2012				Asyout station 2012		
January	19.9	6.8	63.7	January	22.5	6.6	55.3
February	23.7	8.7	47.7	February	25.5	8.1	47.7
March	26	9.7	43	March	28.2	9.7	43
April	29.8	17.5	34.3	April	29.8	9.6	35.7
May	34.4	18.7	33.0	May	36.6	19.1	27.3

The following data were recorded:

Morphological characters:

Days to heading: were recorded as number of days period from sowing to the date when 50% of spikes completely emergence from the flag sheath, **Days to maturity:** number of the days from sowing to the date when 50% of the peduncles turned yellow, **Plant height (cm):** was measured as the distance between the base of the main Culm and the top of its spike excluding owns, **Grain filling period**: was recorded as the period from heading until days to maturity and ***Grain filling rate***= grain yield/grain filling period.

Yield and its components:

Number of spikes/m^2: (no. of tillers bearing fertile spikes): was determined by counting the number of spikes in a square meter randomly taken from each plot, **Number of kernels/spike:** was determined on ten randomly selected spikes in each experimental plot, **kernel weight (gm):** was recorded as an average of three samples, of 1000-kernel in each plot taken at random and weighted and **Grain yield (ardab/faddan)**: was estimated from the harvested area of each experimental plot and converted to ardab/faddan.

Statistical analysis: Randomized complete block design was followed in each location, then combined analysis was made between the two locations in each season to obtain the effect of location. After the two seasons combined analysis was followed to determine the effect of seasons according to Steel and Torrie (1980).

RESULTS AND DISCUSSION

Morphological characters:

Days to heading:

Days to heading were affected by environments through the two seasons (Table 2). There were deferent significant degrees between varieties through two seasons and tow locations. The lowest values were noticed in Sakha 93 the earliest variety in the two seasons in Sakha station and in Asouyt in the first season. Sids 12 and Gemmeiza 9 were the earliest varieties in Asouyt station in the second season. The increased in grain protein content caused by heat and drought stress after flowering may be associated with yield losses, due to a reduction in the starch production (Fowler 2003). The interaction had a significant difference between environments and genotypes, environments and growing seasons and environments and growing seasons. Wheat shows a highly significant degree genotype by environment interaction (GxE) (Reynolds *et al*., 2002).

Table (2): Effect of environmental temperature on Days to heading of some bread wheat varieties in two growing seasons (2010/2011-2011/2012).

Varieties	Sakha station			Asouyt station			Overall		
	S1	S2	Mean	S1	S2	Mean	S1	S2	Mean
Sakha 93	88.67	90.67	89.67	85.67	101.67	93.67	87.17	96.17	91.67
Misr 1	94.00	96.00	95.00	87.67	100.67	94.17	90.83	98.33	94.59
Gemmeiza 9	95.33	97.33	96.33	88.00	96.67	92.34	91.67	97.00	94.33
Sids12	92.33	94.33	93.33	96.00	96.67	96.34	94.17	95.50	94.83
Mean	92.58	94.58	93.58	89.33	98. 92	94.13	90.96	96.75	93.86
CV%	2.60	2.58	2.59	3.31	2.50	2.95			2.75
LSD 0.05									
V	1.10	1.10	0.69	2.33	0.45	1.13			0.65
S			0.33			0.87			0.46
VS			NS			1.60			0.92
E									0.43
ES									0.61
V E									0.87
VS E									1.22

V=varieties, S= seasons, E= different environments

Days to maturity:

The days to maturity were significantly lower in Asouyt station than in Sakha at the first season. Misr1 was the earliest (lower days to mature) in the two environments in both seasons. Such phenomena could be illustrated as the temperature regulates many of the physiological and chemical processes within a plant, which in turn control the rate of growth and its development towards maturity (Khichar and Ram Niwas, 2007).

Table (3): Effect of environmental temperature on days to maturity of some bread wheat varieties in two growing seasons (2010/2011-2011/2012).

Varieties	**Sakha station**			**Asouyt station**			**Overall**		
	S1	S2	Mean	S1	S2	Mean	S1	S2	Mean
Sakha 93	141.67	144. 33	143.00	131.00	140.67	135.84	136.33	142.50	139.42
Misr 1	140. 67	143.67	142.17	130.67	138.33	134.50	135.67	141.00	138.34
Gemmeiza 9	143. 67	146.67	145.17	133.00	143.67	138.34	138.33	145.17	141.75
Sids12	141. 67	144.67	143.17	137.33	143.67	140.50	139.50	144.17	141.84
Mean	141.92	144.83	143.38	133.00	141.58	137.29	137.46	143.21	140.34
CV%	2.61	2.45	2.53	3.59	2.35	3.12			2.9
LSD 0.05									
V	1.73	1.29	0.96	4.23	1.00	1.93			1.02
S			0.87			0.40			0.72
VS			NS			NS			NS
E									0.78
ES									1.10
V E									1.55
VS E									N.S

V=varieties, S= seasons, E= different environments

On the other hand, there is substantial scope for improvement in productivity under unfavorable environments that are characterized by a significant presence of abiotic stresses such as high temperature (Joshi *et al*., 2007).There was a significant difference in the interaction between environments and varieties through two seasons as detected in Table (3). Plant requires energy to grow and develop and some of this energy is available in the form of heat. The required heat is expressed as degree of temperature. Plant responds to dominant climatic factors like temperature and sunshine hours (Khichar and Ram Niwas, 2007).

Grain filling period:

Through two seasons, grain filling period of all the tested varieties was lower in Asouyt environments than in Sakha environments. There were varied significant differences among varieties through two seasons in the two environments and Misr1 was the lowest (Table 4). On contrary, there was no significant difference in the interaction between varieties and environments through two growing seasons. Protein accumulation also changes in response to stress. Such results were agreed with Hunt *et al*., (1991) who reported that temperatures during early crop development and particularly high temperatures after anthesis may limit yield. Temperature fluctuations during grain filling were found to lower the proteins that play an active role in the biosynthesis and metabolism, storage proteins and those involved in protecting the plants against biotic and abiotic stresses are accumulated preferentially. Specific protein responses depend on whether or not high temperature occurs during the early or middle phases of grain-filling (Hurkman *et al*., 2009).

Table (4): Effect of environmental temperature on Grain filling period of some bread wheat varieties in two growing seasons (2010/2011-2011/2012).

Varieties	Sakha station			Asouyt station			Overall		
	S1	S2	Mean	S1	S2	Mean	S1	S2	Mean
Sakha 93	53.00	53.67	53.33	39.00	45.33	42.17	46.00	49.50	47.75
Misr 1	46.667	47.67	47.17	37.67	43.00	40.33	42.17	45.33	43.75
Gemmeiza 9	48.33	49.33	48.83	47.00	45.00	46.00	47.67	47.17	47.42
Sids12	49.33	50.33	49.83	44.00	41.33	42.67	46.67	45.83	46.25
Mean	49.33	50.25	49.79	41.92	43.67	42.79	45.63	46.96	46.29
CV%	4.24	3.85	4.05	4.07	5.64	4.99			3.96
LSD0.05									
V	2.21	1.85	1.28	1.73	NS	1.61			0.87
S			NS			0.87			NS
VS			NS			2.28			1.24
E									0.75
ES									1.06
V E									1.50
VS E									2.12

V=varieties, S= seasons, E= different environments

Grain filling rate:

Terminal or late heat stress especially during anthesis and grain filling stage of the late planted wheat is considered one of the major environmental factors drastically reducing wheat production (Irfaq *et al.,* 2005). The grain-filling rate was more temperature-sensitive than days to anthesis and duration of grain-filling. Effect of earliness on the yield under high temperature was highly dependent on the temperature regime during the heading stage Zhong-hu & Rajaram (1994). The present study showed that grain filling rate was lower in all the tested varieties at Upper Egypt (Asouyt environment) than Sakha environments in the second season. The variation was significant in case of Sakha station in the two seasons, while it was significant only in the first season in case of Asouyt environment. The greatest grain filling rate in Sakha environments was in Misr 1 variety followed by Gemmeiza 9, Sids 12 and Sakha 93, respectively. The highest value was at Asouyt in Misr 1 variety in the first season and in Sids 12 variety in the second season (Table 5). The interaction between varieties and environments showed significant differences through the two growing seasons.

Table (5): Effect of environmental temperature on Grain filling rate of some bread wheat varieties in two growing seasons (2010/2011-2011/2012).

Varieties	Sakha station			Asouyt station			Overall		
	S1	**S2**	**Mean**	**S1**	**S2**	**Mean**	**S1**	**S2**	**Mean**
Sakha 93	0.14	0.51	0.33	0.25	0.40	0.33	0.20	0.46	0.33
Misr 1	0.20	0.68	0.44	0.37	0.46	0.42	0.29	0.57	0.43
Gemmeiza 9	0.19	0.57	0.38	0.27	0.36	0.32	0.23	0.46	0.35
Sids12	0.17	0.56	0.37	0.31	0.48	0.40	0.24	0.52	0.38
Mean	0.18	0.58	0.38	0.30	0.43	0.36	0.24	0.50	0.37
CV%	8.99	5.72	6.87	6.87	5.46	6.05			6.13
LSD0.05									
V	0.03	0.07	0.03	0.04	0.05	0.03			0.02
S			0.01			0.04			0.01
VS			0.05			0.04			NS
E									NS
ES									0.02
V E									0.03
VS E									0.05

V=varieties, S= seasons, E= different environments

Plant height:

Data in table (6) showed that, environment conditions had significantly affected the plant height. A significant reduction in plant height of all the tested varieties at Upper Egypt (Asouyt) was detected compared to Nouth Egypt (Sakha). There was a significant difference between varieties; Gemmieza 9 was the tallest in Sakha environments through the two growing seasons, while Sids 12 was the tallest in Asouyt through the two seasons. The interaction between varieties and environments showed a significant difference through the two growing seasons. Such results confirmed the article that delayed planting reduced the plant height, days to heading, days to maturity and grain filling duration and ultimately showed the reduction in yield and yield components as reported by Din and Singh (2005) and Mahboob *et al*., (2005).

Table (6): Effect of environmental temperature on Plant height/cm of some bread wheat varieties in two growing seasons (2010/2011-2011/2012).

Varieties	Sakha station			Asouyt station			Overall		
	S1	S2	Mean	S1	S2	Mean	S1	S2	Mean
Sakha 93	106.67	111.67	109.17	85.00	88.33	86.67	95.83	100.00	97.92
Misr 1	115.00	120.00	117.50	86.67	96.67	91.67	100.83	108.33	104.58
Gemmeiza 9	121.67	126.67	124.17	85.00	103.3	94.17	103.33	115.00	109.17
Sids12	110.00	115.00	112.50	100.0	103.3	101.67	105.00	109.17	107.08
Mean	113.33	118.33	115.83	89.17	97.92	93.54	101.25	108.13	104.69
CV%	5.95%	3.86	3.90	3.62	4.95	4.44			3.81
LSD0.05									
V	4.40	4.40	2.77	2.88	5.77	2.87			2.10
S			1.80			2.59			1.45
VS			NS			4.06			2.97
E									1.17
ES									1.65
V E									2.34
VS E									1.10

V=varieties, S= seasons, E= different environments

Yield and its components

Grain yield (Ard/fad):

The results in Table (7) showed the effect of different environments on grain yield (ard/fad) of bread wheat cultivars during the two growing seasons. Different environments had a significant effect on grain yield (ard/fad) at the two growing season. The highest grain yield was obtained in all varieties cultivated at Sakha environment. There was a significant difference among the varieties through the two growing season, Misr1 gave the highest grain yield in both location through the two growing seasons. Environments and varieties interaction had a significant effect on grain yield at the two growing season.

Table (7): Effect of environmental temperature on Grain yield Ardab/faddan of some bread wheat varieties in two growing seasons (2010/2011-2011/2012).

Varieties	Sakha station			Asouyt station			Overall		
	S1	S2	Mean	S1	S2	Mean	S1	S2	Mean
Sakha 93	27.71	27.12	27.42	9.82	18.29	14.05	18.76	22.71	20.74
Misr 1	29.36	31.75	30.56	14.05	19.90	16.98	21.71	25.82	23.77
Gemmeiza 9	29.38	27.41	28.40	12.50	16.25	14.38	20.94	21.83	21.39
Sids12	28.73	27.55	28.14	13.61	19.90	16.75	21.14	23.72	22.45
Mean	28.80	28.46	28.63	12.49	18.58	15.54	20.64	23.53	22.08
CV%	4.8	6.86	5.96	6.91	5.45	6.04			6.94
LSD0.05									
V	NS	2.77	1.39	1.23	1.28	0.79			0.85
S			NS			1.49			0.60
VS			1.97			1.12			1.21
E									0.58
ES									0.82
VE									1.16
VSE									1.65

V=varieties, S= seasons, E= different environments

The results in Table (7) also cleared that growing seasons, VS, ES, EV and VSE interaction had significant effects on grain yield. The factors affecting productivity of any region is climate and its principal weather components- rainfall, temperature and solar radiation (Khichar and Ram Niwas, 2007).

Different environments had a significant effect on grain yield (ard/fad) at the two growing season. The highest grain yield was obtained in all varieties cultivated at Sakha environment. There was a significant difference among the varieties through the two growing season, Misr1 gave the highest grain yield in both location through the two growing seasons. Environments and varieties interaction had a significant effect on grain yield at the two growing season. The results in Table (7) also cleared that growing seasons, VS, ES, EV and VSE interaction had significant effects on grain yield. The factors affecting productivity of any region is climate and its principal weather components- rainfall, temperature and solar radiation (Khichar and Ram Niwas, 2007). With delayed planting, the development of plant organs and transfer from source to sink were remarkably affected. It was reflected by overall shortening of plant height, reduction in number of internodes, days to heading, days to maturity and grain filling period and ultimately in the reduction of yield and yield components (Mahboob *et al.,* 2005). Reduction in grain yield may be attributed to effect on delayed germination, decreasing number of days to 50% flowering, maturity and increasing grain filling period and the different in yield components can result from differences in ability of cultivars to produce more values and sustain yield component characters (Nyamudeza and Mutema, 2002)

Number of spikes/m^2:

Table (8): Effect of environmental temperature on number of spikes/m^2 of some bread wheat varieties in two growing seasons (2010/2011-2011/2012).

Varieties	Sakha station			Asouyt station			Overall		
	S1	S2	Mean	S1	S2	Mean	S1	S2	Mean
Sakha 93	399.33	412.33	405.83	245.33	334.00	289.67	322.33	373.17	347.75
Misr 1	386.00	399.00	392.50	235.00	355.33	295.17	310.50	377.17	343.83
Gemmeiza 9	349.33	362.33	355.83	265.67	423.33	344.50	307.50	392.83	350.17
Sids12	484.33	497.33	490.83	240.33	365.67	303.00	362.33	431.50	396.92
Mean	404.75	417.75	411.25	246.58	369.58	308.08	325.67	393.67	359.67
CV%	3.47	13.39	3.43	4.14	5.26	5.02			6.59
LSD0.05									
V	11.89	11.61	7.40	10.54	24.07	11.70			7.92
S			NS			7.65			5.60
VS			NS			16.54			11.20
E									5.26
ES									8.41
V E									10.52
VS E									14.87

V=varieties, S= seasons, E= different environments

The deferent environments had a significant effect on number of spikes/m^2 at the two growing seasons (Table 8). The highest no. of spikes/m^2 was obtained under Sakha environment in the both seasons. There was a significant difference between the varieties for number of spikes/m^2. Sids 12 was the highest significant number of spike/m^2 in Sakha at the two growing seasons. Gemmeiza9 gave the highest significant number of spike/m^2 in Asuit through the two growing seasons. In the two growing seasons, VS, ES, VE and VSE interactions had significant effect on number of spike/m^2. These results were agreed with those obtained by Mahboob *et al.,* 2005 and Irfaq *et al.,* 2005.

Number of kernels/spike:

Number of kernels/spike at the two growing seasons (Table 9) were significantly affected by the different environments. The highest number of kernels/spikes was obtained in Sakha environment at the two growing seasons. There was a significant difference between the varieties for number of kernels/spike at the two growing seasons. Misr1 gave the highest significant number of kernels/spike at the two growing seasons at Sakha. In Asuit, Sides 12 was the highest number of kernels/spike in the first season, while Misr1 gave the highest value in the second season. The interaction effect of, VS, ES, VE and VSE had significant effect on number of kernels/spike. The effect of late heat stress on yield and other growth parameters include shorter life cycle, reduced number of grains/spike, lower grain weight and reduced grain yield (Irfaq *et al.,* 2005).

Table (9): Effect of environmental temperature on number of Kernels/spike of some bread wheat varieties in two growing seasons (2010/2011-2011/2012).

Varieties	Sakha station			Asouyt station			Overall		
	S1	S2	Mean	S1	S2	Mean	S1	S2	Mean
Sakha 93	63.33	65.63	64.48	54.33	61.00	57.67	58.83	63.32	61.07
Misr 1	84.67	86.97	85.82	65.00	81.00	73.00	74.83	83.98	79.41
Gemmeiza 9	62.67	64.97	63.82	57.00	69.00	63.00	59.83	66.98	63.41
Sids12	65.00	67.30	66.15	72.33	66.00	69.17	68.67	66.65	67.66
Mean	68.92	71.22	70.07	62.17	69.25	65.71	65.54	70.20	67.89
CV%	3.16	7.73	6.19	7.46	3.50	5.82			5.49
LSD0.05									
V	1.60	8.15	3.61	6.78	2.08	3.16			2.46
S			2.43			2.76			1.74
VS						4.47			3.48
E									1.60
ES									2.27
V E									3.21
VS E									4.54

V=varieties, S= seasons, E= different environments

Kernels weight

Deferent environments had significant impact on 1000 kernels weight at the two growing seasons (Table 10).

Table (10): Effect of environmental temperature on 1000 kernels weight of some bread wheat varieties in two growing seasons (2010/2011-2011/2012).

Varieties	Sakha station			Asouyt station			Overall		
	S1	**S2**	**Mean**	**S1**	**S2**	**Mean**	**S1**	**S2**	**Mean**
Sakha 93	49.580	51.460	50.520	37.150	40.747	38.949	43.365	46.104	44.735
Misr 1	56.617	58.497	57.557	34.893	37.850	36.372	45.755	48.174	46.964
Gemmeiza 9	54.443	56.323	55.383	40.320	40.067	40.194	47.380	48.195	47.788
Sids12	52.843	54.723	53.783	38.773	41.310	40.042	45.808	48.017	46.912
Mean	53.371	55.251	54.311	37.784	39.993	38.889	45.577	47.623	46.600
CV%	4.34	4.79	4.58	4.79	3.75	4.30			3.93
LSD0.05									
V	2.50	3.08	2.50	2.11	1.40	1.13			0.93
S			1.48			0.53			NS
VS			NS			1.59			NS
E									0.74
ES									1.04
V E									1.47
VS E									NS

V=varieties, S= seasons, E= different environments

The highest values of kernels weight were recorded under Sakha environment at the two growing seasons. This result was agreed with Refay (2011). Therefore, the current study suggested to utilize the late planting conditions, grain filling duration, tillers/m^2, grains per spike, 1000-grain weight and grain yield per plot would serve as valuable selection criteria, Ali *et al.*, (2008). grain weight has been shown as the main yield component for 20% of variation in wheat grain yield Moghaddam *et al* (1998). Grain yield is a good indicator to estimate the impact of environmental temperatures on the wheat productivities, tolerant and characteristics. The recommendations of the present research is, also extended to study the rheological, chemical and sensory specified conditions.

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تأثير إجهاد البيئة الحرارية على انتاجية وخصائص جودة الخبز لبعض اصناف قمح الخبز

I. تأثير إجهاد البيئة الحرارية على المحصول ومكوناته لبعض اصناف قمح الخبز

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تم تقيبم اربعة تراكيب وراثية من قمح الخبز (سخا٩٣، جميزة٩، سدس ١٢ ومصر ١) تحت بيئتين مختلفتين بمركز البحوث الزراعية بمحطة بحوث سخا وأسيوط خلال موسمى ٢٠١٠/٢٠١١ و ٢٠١١/٢٠١٢ فــى تجربـــة قطاعـــات كاملـــة العشـــوائية (RCBD) فـــى ثلاثـــة مكـــررات مـــع اســـتخدام التحليـــل التجميعى (combined analysis) وهى للجهتين والموسمين لتقدير التـأثيرات المختلفة لكل من المنطقة والموسم الزراعى على الصفات المدروسة. تم تقدير بعض الصفات المورفولوجية مثل عدد الأيام حتى طرد السنابل - عدد الأيام حتى النضج الفسيولوجي- طول النبات– فترة امتلاء الحبة ومعدل امتلاء الحبة كما تم تقدير المحصـول ومكوناتـه (متوسط عدد الحبوب فى السنبلة- متوسط عدد السنابل فى م^2- متوسط وزن الحبوب - متوسط محصول الحبوب ومن أهم النتائج المتحصل عليها وجود اختلافات معنوية بين الأصناف فى جميع البيئات، تفوق الصنف مصر ١ فى الشمال وتفوق الأصناف سدس ١٢ ومصر ١ فى الجنوب. وبصفة عامة انخفضت قيم محصول الحبوب ومكوناتة المختلفة فى أسيوط (جنوب الوادى) مقارنه مع مثيلاتها فى سخا (شمال الوادى) وذلك بفعل التأثير السيء للحرارة المرتفعة عن الحدود المثلى لنمو محصول القمح وبخاصة فى مرحلة امتلاء الحبوب فى جنوب الوادى مقارنة بمثيلاتها فى شمال الوادى.

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