GENOTYPIC STABILITY ANALYSIS FOR SEVERAL GENOTYPES OF BREAD WHEAT (*Triticum aestivum* L.)

By

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INTRODUCTION

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Wheat is one of the most important cereal crops in Egypt, many efforts had been made to increase the production of wheat by increasing area of cultivation in new reclaimed lands and increasing yield of wheat per unit area. However, most of Egypt is desert like sinai peninsula, and western desert with harsh environmental conditions (semi-arid environment) characterized by limited water supply, low soil fertility and soil salinity. Recent varieties of wheat were developed to maximize grain yield under favorable environmental conditions. However, wheat production in some new reclaimed lands is below average production because of some adverse conditions dominating some regions as drought stress in new reclaimed lands and heat stress in upper Egypt.

Wheat is considered one of the main crops planted in new reclaimed areas at Nubaria region (about 100,000 faddans). In the new reclaimed lands lack of water is one of the most important environmental conditions that limiting crop yield. It is also the factor for which we are needed to improve cultivars to be stable in their yield to grow in arid and semi-arid conditions with high yielding ability. Wheat producers in this region prefer cultivars that produce high yields when water is not so limiting but suffer minimum loss during drought season. Wheat breeders are thus challenged by difficult task of developing cultivars with wide adaptation.

The interpretation of observed interactions between genotype and the environments has been discussed on numerous occasions. Several authors including Yates and Cochran (1938), Finaly and Wilkson (1963), Eberhart and Russell (1966), Perkins and Jinks (1968). Freeman and Perkins (1971), Tai (1971), and Shukha (1972), have proposed that where a number of genotypes have been tested in several environments, the yield of a genotype should be regressed on the mean yield over all genotypes in each environment.

The information on adaptability and performance stability of cultivars over years and agricultural treatments is important for national policy in crop production , but a grain producer is interested primarily in growing cultivars with high yield and performance stability at his environments .

The main objectives of this investigation were :-

1-To evaluate the eight bread wheat genotypes under different agricultural treatments.

2-To study the effect of some agricultural treatments on yield and yield components .

3-To estimate the stability parameters .

4-To selection of best genotypes to different environments through the study of stability .

REVIEW OF LITERATURE

REVIEW OF LITERATURE

A- Effect of Irrigation Treatments :

Dubtez and Bole (1973) showed that water stress can effect yield by modifying the grain directly by reducing the number of kernels . They also showed that tillering was not affected and kernel weight was increased under water stress conditions .

Mohamed (1976) observed that plant height , number of spikes per plant , spike yield , number of tillers per plant , spike length , number of grain per spike , 1000-grain weight and straw yield were highly and significantly affect by irrigation . Four to six irrigations were found to be the best treatment .

Jana and Sen (1978) found that plant height , spike length and number of grain per spike in wheat were significantly influenced by moisture stress at various stages of growth . They also found that the grain and straw yield , on the average were significantly increased by applying four irrigations over one and two irrigations .

Gebeyehou and Knott (1983) studied the effect of drought stress on yield and yield components as compared with irrigated conditions using 9 and 12 wheat varieties in 1976 and 1977 seasons , respectively . The varieties did not significantly differ in drought resistance in terms of yield but differed in the effect of water stress on yield components such as number of grains per spike , number of spikes per plot, and 1000-kernel weight .

Sayed and Al-Sayaa (1983) studied 21 genotypes of barley , two triticale and one durum wheat at two sites . In the first site the plants were kept free of water-stress during the entire growth period , at the second site the plants were subjected to a water-stress period seven days with holding irrigation during the boot-antithesis (heading) stage . They found that the effect of water-stress period were very severe on grain yield and its related trait number of kernels per spike , the ratio of the first site mean / the second site mean was 2.75 and 2.52 for grain yield and kernels per spike, respectively .

Kailasnathan (1986) studied 17 cultivars from *Triticum aestivum* , *Triticum durum* , and triticale under irrigated and rainfed conditions. He found that grain yield of all cultivars were reduced by drought stress and cultivars were different in yield stability .

Phiboonwat and Homdok (1987) evaluated six wheat cultivars under various irrigation frequency (4 times - after seeding , 15 days after emergence , at flowering and 20 days after flowering . 3 times after seeding , 15 days after emergence and at flowering . 3 times - after seeding , 15 days after emergence and 20 days after flowering . 2 times - after seeding and flowering) . They found that irrigation frequencies and wheat cultivars gave significant difference on grain yield , 4 times irrigation gave higher grain yield than 3 or 2 times irrigation . Interaction among irrigation frequency and cultivar was not found , number of spikes per m^2 and number of kernels per spike were dominated by 4 times irrigation whereas 1000-kernel weight was declined and also 4 times irrigation showed the higher plant .

Abd-Mishani and Jafari-Shabestari (1988) studied 35 wheat cultivars under normal and limited irrigation , and found that irrigation increased grain yield , 1000-kernel weight , plant height , number of kernels per spikelet , and number of kernels per spike . The stress and non-stress yield potential under normal irrigating give some indication of performance of cultivars under limited irrigation . The performance of cultivars with limited irrigation was positively correlated with drought resistance index (r=0.63**).

Sharar *et al* (1989) used five genotypes grown with irrigation 2 , 3 , or 5 times between tillering and grain development. They found that the different irrigation regimes had no significant effect on yield but did affect grain number , plant height , and 1000-kernel weight . There was no advantage to be gained from more than two irrigations (one at tillering , the other at grain development) .

Islam, (1990) evaluated wheat genotypes under water stress and non stress conditions . He found that the ranges of reduction were 2.33 to 14.3 in grain set per spike and 16 to 116 g in yield per plot in stress as compared to non-stress environment . Five genotypes produced high number of grains per spike ranging from 51.9 to 67.1 , nine genotypes produced heavy grains ranging from 5 to 5.9 g for 100 grains and four genotypes gave high yield ranged from 150 to 202 g per plot , 51 genotypes were able to produce medium high yield per plant . Most of these genotypes showed earliness in flowering , short plant height, medium high to high grain yield set and grain size under late planting condition.

Magdadi (1990) studied several durum wheat genotypes at three Agricultural Station deferring in rainfall (Ramtha 220 mm, Mushaquar 350 mm and Jubeiha 470 mm) . Results indicated that few genotypes of Hourani X Stork crosses were found to be superior to Hourani . The genotype Hnxst.13 gave high fertile tillers at Ramtha and Mushaquar indicating that a promising drought tolerant genotype . In the greenhouse experiment, two irrigation treatments " field capacity and one third available water were applied . The differences between the means of the two treatments were significant for biological yield , peduncle length , number of fertile spikes per plot . Interaction between irrigation treatments and genotypes was not significant except for plant height , heading date , flag leaf area and biological yield characters indicating that each factor was acting independently .

Gharti-Chhetr and Lales (1990) studied six cultivars from Nepal and two from the Philippines under water stress . Drought enhanced maturity , lengthened grain filling duration and adversely affected grains per spike and 100 grain weight of the cultivar . Siddhartha , NL 292 , NL 370 and NL 496 all from Nepal gave the highest grain yield and had the highest harvest index under stress condition.

Abdalla and Trethowan (1991) found that highly significant biomass differences were observed between crops among moisture regimes . Similarly grain yield differences were detected , under full irrigation durum wheat outperformed other crops . However under moisture stress bread wheat cultivars were superior , and suggest that high stable yield performance under drought stress is a function of drought tolerance and high yield potential .

Islam (1991) studied 33 genotypes of wheat under stress environment (late planting, non irrigated) . The results showed that stress environment caused reduction in number of grain bearing tillers , biomass and grain yield . Most of the genotypes were medium late in maturity having medium number of grain bearing tillers and biomass production . Nineteen genotypes in stress and ten genotypes in non stress produced medium high yield . However tolerance to stress condition as indicated by the expression of these characters varied with genotypes .

Islam and Islam (1991) found that wheat yields reduced from 17 to 50 % due to soil moisture stress , and irrigation has maximum beneficial effect if it is applied on the ripening phase .

Okuyama and Riede (1991) evaluated 25 wheat genotypes under drought stress at two sowing dates . They found that yield and its components were varied into two soil moisture regimes .

Trethowan *et al* (1991) studied the factors influencing grain filling (GF) . Trials were sown under varying moisture regimes in northern and southern Mexico in 1989/1990, and found that duration of the vegetative phase under drought positively influenced accumulated biomass , 1000-grain weight (TGW) and rate of grain filling but did not influence the duration of grain filling .

Clarke *et al* (1992) evaluation 25 hexaploid (*Triticum aestivum* L.) and 16 tetraploid (*Triticum turgidum* L . *var durum*). Wheat genotypes were sown in separate experiments under dry and irrigated conditions on a swinton loam (Aridic Haploboroll) soil. There was year -to-year variation in drought susceptibility index within genotypes and changes in genotype ranking within years .

Iqbal *et al* (1992) found that yield losses due to drought vary between 60 and 70 % in very severe and between 50 to 60 % in severe drought-prone areas of the country , supplemental irrigation at critical growth stages of the crop increase the yield of wheat as far as 50 % .

Shalaby *et al* (1992) evaluated 16 genotypes of bread wheat (*Triticum aestivum* L.) under three irrigation regimes (two irrigation's , at seeding and at shooting stage , three irrigation's , at seeding , at shooting , and at heading , four irrigation's , at seeding , shooting , heading and grain filling stages) . They found that irrigation treatments had significant effects on some studied traits . However excepted decreasing effect for different traits was detected with less irrigation . Significant variations were detected among wheat genotypes in heading date , plant height , grain yield , spike length , number of spikelet per spike , 100-kernels weight , and number of productive tillers .

B- Effect of Planting Dates :

Gorashi (1988) studied the effects of sowing dates and irrigation treatments on wheat yields and its components . He reported that best sowing date for Giza 155 was 15 Nov. and the highest grain yield was obtained when the tenth irrigation was skipped .

Khan *et al* (1988) evaluated six cultivars of bread wheat (*Triticum aestivum* L.) under five different planting dates (from 1*th* Nov. to 1 *th* Dec.) with 10 days intervals . They found that crop planted during 10 *th* Nov. to 10 *th* Dec. took higher days to heading and maturity , but produced significantly taller plants and maximum grain yield / ha . The spike length and grain weight / plant was not affected by planting dates , varieties also differ significantly for days to heading , days to maturity , plant height and spike length , but did similar yield .

Samre *et al* (1989) studied six wheat cultivars and two durum wheat cultivars sown on 10 dates at 10 days intervals between 15 Oct. and 15 Jan. They found that delay in sowing after 25 Nov. decreased yields of all the cultivars .

Bouzerzour and Oudina (1990) studied the response of four cultivars to three sowing dates and to supplementary irrigation at Setif (Algeria) .They found that early sowing in November significantly decreased the number of plants / m^2, but significantly increased number of heads /m^2 . Supplementary irrigation increased number of heads / m^2 by 42 over rainfed cultivation, mean grain yields for the irrigated and non-irrigated treatments were 5160 and 680 kg /ha , respectively . Mean grain yield for November sowing was significantly higher than those obtained with later sowings . However , a significant sowing date X irrigation interaction was present . November sowing produced higher yield under irrigation , but lower yield under rainfed conditions as compared to later sowings. Significant variety X irrigation interaction was also detected .

Lauer and Partridge (1990) found that early planting increased kernel weight 14 % and kernel density 16 % compared to late planting , spike density was not affected , grain yield decreased from 4.7 to 4 Mg ha^{-1} with later planting date . Spring barley grain yield and kernel plumpness response to planting date for furrow irrigated cropping was similar to responses for dry land cropping .

Saini and Gautan (1990) studied 11 parents , 10 F3s , 10 F4s , 10 two-way and 4 high order mixtures grown under 4 environments (differing in sowing date and either irrigated or rainfed) revealed significant difference between the genotypes and significant genotype X environment interactions for all characters (5 yield related traits) .

Sumague and Lales (1991) evaluated two local wheat varieties during normal and late cropping seasons , regardless of cropping season , both varieties had similar final height , yield and reproductive development but differed significantly in spike length . Late planting resulted in shorter plants , extended vegetative growth , less number of grain per spike , higher percentage of light grains , lower 1000-seed weight and remarkable reduction in grain yield . The effect of cropping season X variety interaction on plant height , phenological stages , yield and yield components was not significant .

Dahlke *et al* (1993) found that heads per square feet and kernel weight decreased as seeding was delayed . Grain yields of wheat decreased due to yield component to environment , and to stage of plant development when growth ceased .

Paul and Ganguli (1996) investigated yield and yield components in 30 varieties of wheat under two sowing dates for two years . Number of spikes per plant , grain weight per spike and number of grains per spike were positively and significantly associated with grain yield . The number of grains per spike and 100-grain weight were negatively and significantly correlated with grain yield in all four environments tested , it is concluded that number of spikes per plant , grain weight per spike and number of grain per spike were the primary yield component characters and should be considered when selecting wheat genotypes .

C-Stability of Genotypes Under Different Environments :

Many studies described that genotype- environment interactions are inconsistent differences among genotypes from one environment to another. In addition, when cultivars are compared under a series of stress environments, the reductions in yield and its components are different from genotype to another . The year-to year variations in the climatic conditions at a given location can be minimized by developing stable varieties (Allrad and Bradshaw 1964) .

Genotype - environmental interaction is very important for developing improved cultivars which stable and adapted under harsh environmental conditions . A major problem in selection of genotypes with wide adaptability is the absence of stability across environments as a result of the occurrence of genotype-environments interaction (Ghaderi *et al* 1981) . Numerous methods of measuring genotype response to environments have been applied . Measures of stability parameters for performance of genotypes in different environments were suggested by

Finally and Wilkinson (1963) , Eberhart and Russel (1966) , Perkins and Jinks (1968) , Baker (1969) , Baker (1981) and recently reviewed by Lin *et al* (1986) . Cultivars or genotypes fall into three categories , those with uniform superiority over all environments , those relatively better in poor environments , and those relatively better in favoured environments .

Eberhart and Russell (1966) examined the data collected from two single cross diallels and a set of three-way crosses by regression analysis in maize . They defined the stable variety as which had 1) b= 1(regression coefficient) 2) deviation from regression near zero and 3) had high yielding ability . Their analysis attempted to determine the linear response of variety to the environmental effects .

Ghaderi *et al* (1980) studied the contribution of testing sites to genotype X environment interaction for test weight of soft winter wheat .The results indicated that deletion of only one location from the variance analysis has resulted in a group within which genotype X sites interaction was not significant . Cluster analysis was used to group genotypes according to their stability response .

Slavko and William (1982) found that the mean square of the number of spikes / m^2 due to genotype X year interaction was greater than the mean square due to years or genotypes alone . The mean square due to genotypes were greater than the mean square for years and genotype X year interactions for number of kernels per spike , 1000-kernel weight , as well as for grain yield . The preference in the choice of cultivars should be given to the mean grain yield rather than to the other stability parameters .

Bangarwa *et al* (1983) found that interactions were found for all traits except harvest index . In general and particularly for yield the linear component of the interactions was greater than the non-linear . Plant height and spikes per plant influenced responsiveness for yield but did not influence stability .

Carvalho *et al* (1983) investigated 19 genotypes of hexaploid wheat (Triticum aestivum L.) grown at 9 locations in 4 years . The results indicated that most productive genotypes were unstable . While genotypes with average stability had the same productive ability as the average of all genotypes tested , under all environmental conditions considered , three genotypes showed the greatest stability .

Sharma and Nanda (1985) found that grain yield was highly influenced by genotype X environment interaction in both the generations (biparental progenies and F3 lines) . The other characters like tiller number and number of grains were also significantly influenced by the interaction . The days to heading , plant height , ear length , number of spikelets and seed size were less influenced by change in environments .

Lin *et al* (1986) studied the interrelationship of nine stability statistics and nine similarity measures . They resolved that stability statistics fall into four groups depending on whether they are based on the deviation from the average genotype effect or on the genotype X environment term , and whether or not they incorporate a regression model on an environmental index .These groups of stability statistics are shown to be related to three concepts. A genotype may be considered to be stable 1) if its among environment variance is small 2) if its response to environments is parallel to the mean response of all genotypes in the trial , or 3) if the residual mean square from a regression model on the environmental index is small

Sayed (1987) studied 27 cultivars of bread wheat grown through the period 1978-1982 . He found that genotype X season interactions were highly significant and relatively smaller than seasonal effects .

Fatih (1987) determined genotypic stability of grain yield and yield components under different environments in wheat agropyron derivatives and two spring wheat . Results indicated that highly significant differences among genotypes , environments and their interactions for all traits . The linear responses of genotype X environment were significant for three yield components . Whereas such responses for grain yield or the rest of yield components were not significant .Deviations from linear responses were highly significant for all traits . Stability of grain yield was not associated with the stability of yield components . Mean grain yields in severe environment were correlated with the genotypic stability parameter.

Gullord and Aastveit (1987) found significant interaction for grain yield between genotypes and locations , and between genotypes and years when studied oats lines and cultivars over different years and locations .The main results could be shortened as follows : (1) There seemed to be good agreement between the stability parameters calculated by different methods . (2) The principal component methods both divided the cereal growing area in Norway into four sub-regions . (3) Temperature and rainfall from tillering untile harvest had large influences and opposite effects on the genotype-location interaction . (4) There was a large genetic variation in developmental stability for grain yield . (5) No close relationship was found between average grain yield and stability over a range of environments .

Musavium and Ehdaie (1987) studied specific and general adaptation and grain yield stability of 12 genotypes of wheat and one triticale sown at 4 locations for 4 years .They found that highly significant genotype - environment interactions . The results showed that a greater part of genotype - environment interaction could be accounted for by differences in the regression of the individual genotypes . With few exceptions all genotypes had significant regression mean square under all sets of environments . Mean yields regression coefficients and the mean squares associated with deviations from regression varied greatly over the sets of environments .

Sharma *et al* (1987) studied the stability of harvest index and grain yield in winter wheat genotypes grown at six locations in two years . They showed that genotypes differed significantly for harvest index and grain yield , and significant genotype - environment interactions occurred for both traits . The correlation between harvest index and grain yield was inconsistent in different environments , both harvest index and grain yield were significantly affected by environmental changes .

Ehdaie *et al* (1988) studied 15 wheat genotypes including lines from landraces of southwestern Iran and improved cultivars from Iran and California.Genotypes were grown in non-stress and three artificially imposed stress environments .They found that genotype X environment interactions were significant for grain yield and its components. Landraces generally had lower yield potential than the cultivars .

Ghandorah (1989) evaluated the performance and yield stability of five high yielding varieties of wheat (two durum wheat and three bread wheat) for five seasons . Results indicated that significantly affected all traits by season effect and the interaction between seasons and varieties was also significant . Regression analysis showed that varieties No. 1 , 2 and 3 were stable . Whereas varieties No. 4 and 5 were unstable . With regard to grain yield production across seasons , the high grain yield was associated with long grain filling period and high rate of grain filling and high kernel weight .

Rahman *et al* (1989) used Eberhart and Russell model (1966) to studied phenotypic stability of 16 wheat genotypes for grain yield . The estimates of stability parameters (bi and s^2d) revealed that solitary genotypes Baw 53 showed greater bi value and out yielded the grand mean indicating its suitability for favorable environment (irrigated optimum sowing) . The genotypes Baw 56 and Baw 60 showed b values less than unity , minimum s^2d and higher mean yield indicating their suitability for less favorable environment (irrigated optimum irrigated late sowing) . But the genotypes Baw 59 , Kanchon and Akbar having almost unit regression coefficient , minimum deviation from regression and greater mean values indicate that such entries might be considered fairly stable in yield performance across the growing conditions .

Mitkees *et al* (1989) investigated yield stability of 12 wheat varieties through the data of national yield trials during the period 1979-1986 .The commercial varieties Giza 157 , Giza 160 , Sakha 8 , Sakha 61 , Sakha 69 , and Stork"s" showed significantly less stability and yield ability as compared to the new entries . Giza 163 and Giza 164 which showed wide stability and highest yielding ability over all Egypt , Sakha 92 was the highest stable one , but yielded the best at North Delta , Giza 162 may compete Giza 163 and Giza 164 in South Delta .

Sariah *et al* (1990) evaluated ten bread wheat varieties in 11 environments for grain yield potential , stability and adaptation in Tanzanian environment . Results of the analysis of variance did not show differences in yield amongst varieties , the environmental component and the variety X environment interaction term were highly significant , suggesting different ranking of varieties in individual environment . Mean yield for individual varieties ranged from 2431 Kg / ha to 2797 . The regression coefficients obtained ranged from 0.69 to 1.28 . Generally the wheat varieties grown commercially in Tanzania were inclined to have specific adaptation . They concluded that results of stability analysis should be considered before variety recommendations are made for general and specific environments .

Jalauddin and Harrison (1990) suggested that selection for high yield and test weight as well as high stability can be performed simultaneously by using regression parameters .

Golmirzaie *et al* (1990) used data for 28 cultivars from five cropping districts , the districts represent environments with about 770 mm precipitation to 450 mm or less. Results showed in three of four districts that cultivar X year interaction were not significant , indicating that the present 3 - year testing period is adequate . In contrast, cultivar X location interaction was significant for all districts suggesting that the number of locations used was inadequate

Saini and Gautan (1990) studied 11 parents , 10 F3s , 10 F4s , 10 two-way and 4 high order mixtures grown under 4 environments (differing in sowing date and either irrigated or rainfed). The resukts revealed significant difference between the genotypes and significant genotype X environment interactions for all characters (5 yield related traits) .

Aguilar -Mariseal and Hunt (1991) conducted a study to determine whether for soft white winter wheat in a region with a humid continental climate . They found that grain ranged from 180 to 570 g / m^2 and increased with spike number / m^2 , total dry weight which ranged from 720 to 1670 g / m^2 also increased with spike number/m^2 . However harvest index was decreased with spikes number per plant and was related to kernel weight but not to kernel number / spike .

Geleta *et al* (1991) in Ethiopia studied eight bread wheat varieties were grown in trails at nine locations in Arsi , Bale and Shewa regions under rainfed conditions during 1988/1989 , to estimate the relative phenotypic stability of genotypes for grain yield , biological yield thousand kernel weight , and harvest index . They found that variety X location interaction effects were highly significant for all of the traits except harvest index . Enkoy , K6295 and Har 416 were better adapted to a wide range of test environments , and were stable for the four traits .

Kinyua (1991) studied ten varieties grown in six locations over six years in Kenya . Genotype X environment interaction was highly significant , indicating that recommendations should be based on climatic and edaphic conditions .

Riede (1991) studied four triticale and two wheat cultivars in 30 environments using the methods of Eberhart and Russel , Verma , Chahal , and Murty . Triticale Iapar 23 and Iapar 38 produced high yields and responded better to improved environmental conditions , genotype Iapar 13 , Iapar 23 , and Iapar 38 are the most predictable . When the environments were separated into unfavorable and favorable , Iapar 23 showed the best performance , being stable in poor environments and responsive in the good ones, variance indicated significance for genotype and for year X location interaction .

Ozgen (1991) studied the effect of genotype environment interaction on yield in ten (*Triticum aestivum*) and five (*Triticum durum*) cultivars and lines . The bread wheat cultivars Tosun 21 , Tosun 144 , and Gerek 79 and the lines 115 and 116 always gave high yields even in less favorable environments . The remaining genotypes either gave high yield only in good conditions or gave consistently poor yield .

Yang and Baker (1991) studied genotype X environment interaction in two wheat crosses . They found that variation and covariation among and within F2 families were significant for all traits in both crosses .

Duarte and Zimmermann (1995) studied the determination of the degree of correlation among the 13 statistical parameters that can be used for the analysis of phenotypic stability . Such correlation's could be used to assess the extend in which these 13 parameters identify unique genetic effect . They concluded that i) the segmented linear regression coefficient (bi) was overall the most independent parameter, indicating that the other stability statistics do not satisfactorily reflect genotypic response in poor environments ii) the strong correlation between the regression coefficients and the coefficient of determination indicates that the latter are not needed to measure the predictability of the estimated genotypic response , and iii) the variance of the deviations from regression can provide assessment of the relative contribution of the genotype to the genotype X environment interaction as well as its biological stability .

Bhavsar *et al* (1996) evaluated 14 genotypes of bread wheat at 12 locations in Karnataka and Maharashtra for grain yield . They found that mean differences between genotypes and environments were highly significant, indicating substantial variability among genotypes and environments . Genotype X environment interaction was significant . Both linear and non-linear components of G X E interaction played an important role in the expression of grain yield . The genotypes NI9947 and DL802-3 were the most stable for grain yield . Akw 619 and Akw 2294 were adaptable to all types of environments . While Niaw 34 was stable under favourable environments conditions .

D.Correlation Between Yield , Yield Components and Some Agronomic Traits :

Johnson *et al.* (1966) studied phenotypic and genotypic correlation between some traits of hard red winter wheat . They reported that plant height positively and significantly correlated with kernel weight , spike length , grain yield and number of spikes per plant .

Fonesce and Patterson (1968) studied interrelationships among plant characters through simple correlation in winter wheat . The three components of yield (number of spike / m^2 , number of kernels / spike and kernel weight were highly positive correlated with grain yield .

Sidwell *et al.* (1976) reported that kernel weight and number of kernels / spike had significant positive phenotypic correlation with grain yield . In addition significant negative association was observed between kernel weight and each of number of tillers and number of kernels per spike.

Sornprach (1988) reported that yield components showed positive correlations to grain yield and number of kernels / spike was the most important direct effect on grain yield .

Uddin and Marshall (1989) studied simple correlation coefficients of yield and yield components with plant height in bread wheat . Plant height was negatively and significantly correlated with grain yield . While no correlation was found between plant height and each of grains weight and number of tillers per plant .

El-Marakaby *et al.* (1992) studied relationships between grain yield and yield components . They found that grain yield was positively correlated with number of spike per plant and negatively associated with number of spikelets per spike .

Budak and Yildirim (1995) studied the relationship between harvest index , biomass and yield in wheat . They reported that grain yield was positively correlated with harvest index (r = 0.86) and biomass (r = 0.85) and reported that multiple regression analysis showed that harvest index a greater contribution to yield than biomass , suggesting that harvest index should be included in selection criteria for higher yielding genotypes .

Sayre *et al* (1997) reported that grain yield progress was correlated with kernels number of m^2 (r = 0.84) and harvest index (r = 0.81) but not with total biomass production , kernel weight , days to anthesis , number of spikes / m^2 ,or number of kernels / spike .

MATERIALS AND METHODS

MATERIALS AND METHODS

The present investigation was carried out during the 1995/1996 and 1996/1997 growing seasons at Nubaria Agriculture Research Station , Agriculture Research Center , at North Tahrir (latitude 30-22 N , longitude 30-21 E) under calcareous soil and surface irrigation conditions.

The materials used in this study in both seasons consists of eight bread wheat cultivars (*Triticum aestivum* L) , names and pedigree of those cultivars are presented in Table (1) , the materials were subjected to twelve different environments .

Environments :

Twelve different agricultural treatments (artificial environments) were included all combinations between four planting dates and three irrigation treatments .

Planting Dates :

In the first season the planting dates were 25/10 , 10/11 , 25/11 , and 10 / 12 /1995 . But in the second season were 28/10 , 12/11 , 27/11 , and 11/12 /1996 .

Irrigation Treatments :

Three irrigation treatments were :

I1- One irrigation (first irrigation) was applied after 21 days from planting.

I2- Two irrigations were applied after planting (first irrigation after 21 days from planting + second irrigation after 21 days from first irrigation).

Table (1) : Pedigree and origin of eight cultivars of bread wheat used in the study .

Cultivar	Pedigree	Origin
Gemmiza 1	Maya 74 'S'/0n//1160-73/Bb/Ga11/4/chat 'S' CM 58924-1Gm-0Gm	Egypt
Giza 163	T.aestivum / Bon// Cno / 7c CM33009-F-15M-4Y-2Y-1M-1M-1Y-0M	Egypt
Giza 164	Kvz/Buho ''S''//Kal/Bb-Very ''S''#5 CM 33027 -f-15M-500y-0M	Egypt
Sakha 8	Indus 66 -Norteno ''S'' PK 3418-6s-1sw-0s	Egypt
Sakha 69	Inia/RL4200//17c/Yr ''S'' CM 15430-2s-6s-0s	Egypt
Giza 167	301//G11/SX/3/Pew ''S''/4/Mai ''S''//Maya ''S'' /Pen	Egypt
Sahel 1	N.S. 732 / Pim //Vee"S" CSD 735-4SD-1SD-1SD-0SD	Egypt
Sids 1	HD 2172 /Pavon ''S''//1158.57/Maya74 "S'' SD 46-4SD-2SD-1SD-0SD	Egypt

I3- Five irrigation were applied after planting as recommended .

Experimental Design :

These eight cultivars were planted in each environment in randomized complete block design with four replicates , the cultivars were randomly allocated to plots of each replicate , each plot consists of eight rows with 3.5 meter long and 20 cm. apart (plot size 5.6 m^2).

Agricultural Practices :

At seedbed preparation fertilizers were applied at a rate of 100 Kg P_2O_5 per faddan , 24 Kg K_2O per faddan , and 90 Kg N per faddan in form of Ammoium Sulphate . The nitrogen fertilization application were split into two equal doses , top dressing , the first dose was applied at planting and the second dose was applied after 21 days from the planting irrigation . Seeds were drilled in rows by hand , the seeding rate was 60 Kg per faddan for both seasons .

Rainfall of the two growing seasons were reported from October to May presented in Table (2) .

Data Recorded :

At harvest time the central(guarded) four rows of each plots with 2.5 meter long were cut by hand and mechanically threshed (harvest area $2m^2$) . Data were recorded for yield and its components on the following characters :

1- Grain yield per plot : was estimated as the weight of clean grains of each plot by gram .

2- Number of spikes per square meter : were estimated by taken two samples from each plot with one meter long .

3-Number of kernels per spike : the average of number of kernels per ten spikes taken at random from each plot .

4- One thousand kernel weight : the average of two samples with one thousand kernel of clean grain from each plot .

5- Biological yield per plot : the total above ground dry matter of each plot .

6- Straw yield per plot : the total above ground dry matter minus grain yield of each plot .

7-Harvest index : as a ratio of grain yield to above ground dry matter = (grain yield ÷ biological yield) X 100

8- Plant height (cm) : the height from the soil surface to the top of the main spike (the average of four record from each plot) .

Table (2) : Total mounthly precipitation (mm) for the experimental site .

Year	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May	Total
1995/96	6.0	11.3	43.2	2.5	00	00	00	63.0
1996/97	27.0	23.0	33.0	00	00	00	00	83.0

Stability Analysis :

For all the studied traits , stability was computed according to Eberhart and Russell model (1966) ,

The parameters are defined with the following model :

$Yij = \mu i + BiIj + \delta ij$

Yij = Mean of the *i* th variety at *j* th environment ,

μ = Mean of the *i* th variety overall the environments,

Bi = regression coefficient that measures the response of *i*th variety to varying environments ,

Ij = Environmental index obtained as the mean of all varieties at the *j* th environment minus the grand mean ; i.e.,

$Ij = \Sigma Yij / v - \Sigma_i \Sigma_j Yij / vn$

where :

$\Sigma_i T_j$ = zero ; and δij = deviation from regression of the *i* th variety at the *j* th environment .

This model provides a mean of partitioning genotype - environmental interaction of each variety into two parts :

(1) the variation due to the response of the variety to varying environmental index (sum of squares due to the regression) and (2) the unexplainable deviations from the regression on the environmental index .

The first stability parameters is a regression coefficient estimated in usual manner .

$$b_i = \Sigma_j \Sigma_{ij} - ij / \Sigma_j I^2_j$$

The performance of each variety can be predicted by using the estimates of the parameters , where :

$$Y_{ij} = X_i + b_i I_j$$

where : X_i = is an estimate of the μ i.

The deviations ($\delta ij = Yij - Yij$) can be squared and summed to provide an estimate of another stability parameters (s^2di) ,

$$s^2di = \{\Sigma_j \delta i j^2 / (n-2)\} - s^2e / r .$$

where : s^2e / r is the estimate of the pooled error (or the variance of a variety mean at the j *th* environments .

The definition of a stable variety in this method will be one with :

$b_i = 1.0$, $s^2d_i = 0$ and a high mean yield .

To test b_i significant standard error for bi was estimated using the following equation :

$$S.E.(b_i) = \sqrt{\frac{\text{mean squares due to pooled deviation}}{\Sigma_j I^2_j}}$$

Also , the following formula was used to test the significance of s^2d_i :

$$S.E.(s^2d_i) = \sqrt{\frac{\text{M.S due to pooled deviation}}{\text{Degree of freedom} + 2} + \frac{\text{M.S due to pooled deviation}}{\text{Degree of freedom} + 2}}$$

Any values of b_i and s^2d_i exceeded twice their corresponding standard error may be considered significant . All sources of variations of this model are presented in (Table 3) .

The significance of the differences among variety means Ho = $\mu_1 = \mu_2 = \ldots\ldots\ldots\ldots \mu_v$ can be tested approximately by the F-test

F = MS_3 / MS_4 (Table 3) .

The hypothesis that there are no genetic differences among varieties for the regression on the environmental index , Ho : $B_1 = B_2 \ldots\ldots\ldots B_v$ can be tested approximately by the F-test . F = MS_3 / MS_4 (Table 3) .

An approximate test of deviation from regression for each variety can be obtained : F = ($\Sigma_j \delta i j / n - 2$)

Pooled error = $M_{4.1} / M_1$, ...$M_{4.v} / M_1$ (Table 3) .

Table 3 : Analysis of variance for Eberhart and Russell's model (1966) .

Source of variation	d.f	M.S	F- test
Total	(nv -1)		
Varieties (Var.)	v -1	M_2	M_2 / M_4
Environments(Env.)	n - 1		
Varieties X Env .	(v - 1) (n - 1)		
Env. (Linear)	1		
Var.XEnv.(Linear)	v - 1	M_3	M_3 / M_4
Pooled deviation	v (n - 2)	M_4	M_4 / M_1
Variety 1	(n - 2)	$M_{4.1}$	
Variety v	(n - 2)	$M_{4.v}$	
Pooled error	n (r -1) (v - 1)	M_1	

where :

n ,v and r are number of environments , genotypes and replications , respectively .

Statistical Analysis :

The data of all experiments were subjected to proper statistical analysis of variance according to Snedecor and Cochran (1967) . The combined analysis was conducted for the data of the two experiments according to Cochran and Cox (1957) . For comparison between means , Duncan's multiple range test was used , Duncan (1955) .

The combined data of grain yield and its components, number of spikes / m^2 , number of kernels /spike 1000-kernel weight , biological yield

, straw yield , harvest index and plant height were subjected to simple correlation calculated according to Snedecor and Cochran (1967) , as follow :

$r\ ph = M_{12} / (M_1)(M_2)$

where M_{12} is the phenotypic covariance between pairs of two traits , and M_1 and M_2 are the phenotypic mean of squares of the two traits .

Path coefficient analysis was done between grain yield and its components . Means of eight cultivars were used in this respect . This analysis was made according to the method outlined by Wright (1921,1923, and 1934) .

RESULTS AND DISCUSSION

RESULTS AND DISCUSSION

A. Effect of Season :

The results of the combined analysis for all the studied traits are shown in Table (4C). Seasons mean squares were significant for all traits except biological yield , straw yield and harvest index , indicating that the mean performance of these traits differed from season to another . Results in Table (5) represents average of seasons effects on the studied traits . Its evident that grain yield (t/ha) , number of kernels per spike , 1000-kernel weight , harvest index and plant height mean values were significantly higher in the second season , whereas the other traits had the highest ones in the first season . These results indicated that the 1000-kernel weight and number of kernels per spike are the important components for high yielding.

B. Effect of Planting Dates (D) :

Planting date mean squares were highly significant for all the studied traits at separate season as well as the combined analysis (Table 4A ,4B and 4C) . Also the interaction effect between planting date and seasons mean squares were significant for all the studied traits except number of spike per m^2 and 1000-kernel weight . Such result indicate the effect of planting dates was fluctuated from season to another .

The mean values of the studied traits as affected by planting dates are presented in Table (6) . The highest mean values of the studied traits were detected when wheat plants were planted in D2 . For the harvest index and plant height the highest values were obtained when wheat was planted in D3 .

Table (4A) : Mean squares of the analysis of variance for grain yield , number of spikes / m^2 , number of kernels / spike , and 1000-kernel weight in season 1995/96 and 96/97 .

		Grain yield		Number of spike /m^2		Number of kernels / spike		1000-kernel weight	
S.O.V	d.f	1995	1996	1995	1996	1995	1996	1995	1996
Date (D)	3	6.37**	8.77**	10559.5**	7740.9**	6.4**	123.0**	203.7**	188.5**
Irrigation (I)	2	183.25**	196.4**	95279.5**	134277.0**	700.5**	2457.9**	4542.7**	2009.4**
Genotype (G)	7	5.19**	7.94**	6740.8**	18062.1**	116.7**	156.4**	63.5**	57.9**
D X I	6	0.70**	0.74**	1177.6**	1302.1**	7.5**	26.7**	17.9**	14.2**
D XG	21	0.14**	0.21**	304.5**	711.6**	5.9**	8.5**	4.9**	5.9**
G X I	14	1.23**	0.91**	774.6**	1869.7**	27.6**	11.7**	18.3**	14.2**
D X IXG	42	0.16**	0.28**	355.2**	335.4**	10.5**	11.4**	3.4**	7.8**
Error	285	0.026	0.11	114.4	602.3	1.04	2.83	1.23	2.6

* Significant at 0.05 level
** Significant at 0.01 level
ns Not significant

Table (4B) : Mean squares of the analysis of variance for biological yield , straw yield , harvest index , and plant height in season 1995/96 and 96/97 .

		Biological yield (t/ha)		Straw yield (t/ha)		Harvest index		Plant height (cm)	
S.O.V	d.f	1995	1996	1995	1996	1995	1996	1995	1996
Date (D)	3	57.81**	45.83**	35.82**	21.63**	0:023**	0.023**	1042.84**	1123.69**
Irrigation (I)	2	987.97**	913.93**	333.49**	263.07**	0.072**	0.103**	854.95**	28.17
Genotype (G)	7	57.07**	86.74**	29.95**	43.96**	0.008**	0.007**	478.85**	530.79**
D X I	6	3.23**	1.26**	2.35**	1.16	0.003**	0.006**	95.29**	78.00**
D XG	21	3.96**	1.63**	3.46**	1.04*	0.002**	0.001 ns	41.58ns	59.61**
G X I	14	8.12**	2.93**	4.49**	1.56**	0.003**	0.004**	29.86ns	102.68**
D X IXG	42	1.47**	0.81**	1.88**	0.60	0.003**	0.002 ns	32.62ns	71.28**
Error	285	0.36	0.48	0.375	0.61	0.0005	0.001	33.93	14.26

* Significant at 0.05 level
** Significant at 0.01 level
ns Not significant

Table (4C) : Mean squares of the combined analysis of variance for grain yield ,biological yield , straw yield , number of spike / m^2 , number of kernel /spike , 1000-kernel weight , harvest index and plant height .

S.O.V	d.f	Mean Squares							
		Grain yield	Biological yield	Straw yield	Number of spike /m^2	Number of kernels /spike	1000-kernel weight	Harvest index	Plant height
Rep. (R)	3	0.035ns	0.634ns	0.54ns	769.28 ns	7.36ns	6.72ns	0.001	80.43
Year (Y)	1	4.06 **	2.063ns	11.92ns	80298.97 **	1178.6**	1886.89 **	0.04*	31827.0**
R X Y	3	0.016	.1.943	2.05	1169.79	23.94	5.12	0.002	740.65
Date (D)	3	14.75 **	100.81 **	54.17**	18063.72 **	71.77 **	388.46 **	0.04 **	1458.95**
Irrigation (I)	2	368.06 **	1889.16 **	594.44**	227887.78 **	2886.32 **	6203.08 **	0.13 **	294.16**
Genotypes (G)	7	12.50 **	118.53 **	55.57**	21467.72 **	181.91 **	104.75 **	0.005 **	935.52**
Y X D	3	0.40 **	2.82 **	3.27**	236.63 ns	57.66 **	3.76 ns	0.006 **	707.58**
Y X I	2	11.59 **	12.74 **	2.13**	1668.40 **	272.18 **	349.07 **	0.046 **	588.95**
Y X G	7	0.63 **	24.97 **	18.34**	3335.16 **	91.19 **	16.71 **	0.01 **	74.11**
D X I	6	0.46 **	0.98 *	1.82**	1934.87 **	4.59 *	5.02 **	0.005 **	120.8**
D X G	21	0.12 *	2.28 **	1.88**	702.31 **	4.70 **	6.20 **	0.0014 *	52.91**
I X G	14	1.73**	9.02 **	4.09**	897.18 **	22.22 **	20.58 **	0.0034 **	38.03
Y X D X I	6	0.98 **	3.51 **	1.69**	544.88 ns	29.56 **	27.15 **	0.0029 **	52.49*
Y X D X G	21	0.23 **	3.30 **	2.63**	313.76 ns	9.61 **	4.59 **	0.0023 **	48.27**
Y X I X G	14	0.41 **	2.03 **	1.96**	1747.13 **	17.06 **	11.94 **	0.0034 **	94.51**
D X I X G	42	0.17 **	1.22 **	1.25**	416.00 ns	9.09 **	6.94 **	0.0022 **	57.5**
Y X D X I X G	42	0.30 **	1.06 **	1.22**	274.59 ns	12.85 **	4.31 **	0.0027 **	46.39**
Error	570	0.07	0.42	0.49	358.39	1.94	1.92	0.0009	24.09

* : Significant at 0.05 level ** : Significant at 0.01 level ns : Not significant

Table (5) : Means of grain yield (t/ha) , biological yield (t/ha) , straw yield (t/ha) ,number of spikes / m^2 , number of kernels / spike , 1000-kernel weight , harvest index and plant height for two seasons over planting dates , irrigation treatments and genotypes .

Season	Grain yield (t/ha)	Biological yield (t/ha)	Straw yield (t/ha)	Number of spikes / m^2	Number of kernels /spike	1000-kernel weight	Harvest index	Plant height (cm)
1995 / 1996	3.78 b	10.99 a	7.22 a	318.80 a	35.85 b	37.34 b	0.34 b	98.83 b
1996 / 1997	3.92 a	10.89 a	6.97 a	298.35 b	38.33 a	40.48 a	0.36 a	111.70 a
Mean	3.85	10.94	7.09	308.58	37.09	38.91	0.35	105.27

Means as the same letter are not significant .

Table (6): Means of grain yield , biological yield , straw yield ,number of spike $/m^2$, number of kernel / spike, 1000-kernel weight , harvest index , and plant height for planting dates over irrigation treatments and cultivars .

Planting date	Grain yield (t/ha)	Biological yield (t/ha)	Straw yield (t/ha)	Number of spikes $/m^2$	Number of kernels /spike	1000-k weight (gram)	Harvest index	Plant height (cm)
D 1	3.73 c	11.26 b	7.53 a	308.00 c	36.96 c	39.23 b	0.33 c	104.68 b
D 2	4.11 a	11.62 a	7.51 a	318.26 a	37.71 a	40.24 a	0.35 b	106.90 a
D 3	4.05 b	10.98 c	6.93 b	312.58 b	37.39 b	39.28 b	0.37 a	107.84 a
D 4	3.52 d	9.93 d	6.41 c	295.46 d	36.30 d	36.89 c	0.35 b	101.64 c

D1 : 25/10/1995 and 28/10/1996 D2 : 10/11/1995 and 12/11/1996
D3 : 25/11/1995 and 27/11/1996 D4 : 10/12/1995 and 11/12/1996
Means as the same letter are not significant .

This result may be due to the prevailing of favorable temperature and day length leading to greater vegetative growth . It could be concluded that D2 sowing date governed growth and consequently yield components of wheat plant . Moreover growing wheat at D2 gave best results of most different characters of yield and yield components . Suitable environmental conditions encourage vegetative growth as well as reproductive organs and this in turn can explain our findings . In addition , translocation of organic components from source to sink depends to a large extent on daily changes in solar radiation and minimum temperature of day and night . However , the minimum ones were obtained from sowing wheat in D4 for all the studied traits except harvest index which obtained from the early sowing date (D1) . Similar results were reported by Samre *et al* (1989) , Lauer and Partridge (1990) , Islam (1990) , Islam (1991) , Dahlke *et al* (1993) .

C. Effect of Irrigation Treatments (I) :

Irrigation mean squares for all the studied traits were significant in both seasons as well as the combined analysis (Table 4A , 4B and 4C) . This finding reflected that the components of each of these indices responded to irrigation treatments .

Mean squares for the interaction between irrigation treatments and seasons were found herein to be significant in all characters (Table 4C) . This finding revealed that these traits responded to irrigation treatments differently from season to season . The fluctuation of response detected herein could be due to that both experimental seasons varied in the amount and distribution of rainfall (Table 2) .

Table (7) presents mean values for all the studied traits in the combined analysis . Mean values for all studied traits reported in Table (7) indicated clearly that plants received five irrigations after sowing exhibited significant increase in all the studied traits compared with those received one or two irrigations . However significantly decreased mean values for all the studied traits were detected by using one irrigation .

For number of spikes per m^2 , mean values detected herein indicated that plants received five irrigations expressed a significant increase in number of spikes per plant compared with those received one or two irrigations . This finding hold fairly true . It can be concluded that the increase in number of available water might be due to the increase in number of tillers per m^2 . These results are agree with those obtained by Gebeyehou and Knott (1983), Magdadi (1990) and Shalaby *et al* (1992) . On the other hand Dubtez and Bole (1973) reported that number of spikes per m^2 was not significant affected by varying the number of irrigation .

With regard to number of kernels per spike , the results indicated that increasing number of irrigation led to a significant increase . The decrease in number of kernels per spike detected by lowering the level of available water in the soil reflected the probable effect of deficiency on spike fertility (Torop and Koryakin 1990) .

Table (7): Mean of grain yield , biological yield , straw yield ,number of spike /m^2 , number of kernel / spike, 1000-kernel weight , harvest index and plant height for irrigation treatments over planting dates and cultivars .

Irrigation	Grain yield (t/ha)	Biological yield (t/ha)	Straw yield (t/ha)	Number of spikes (m^2)	Number of kernels (spike)	1000-kernel weight(g)	Harvest Index	Plant height (cm)
I 1	2.72 c	8.26 c	5.53 c	281.35 c	33.60 c	34.46 c	0.33 c	104.03 b
I 2	3.72 b	10.89 b	7.17 b	303.91 b	37.38 b	38.07 b	0.34 b	105.77 a
I 3	5.11 a	13.69 a	8.58 a	340.47 a	40.29 a	44.20 a	0.38 a	105.98 a

I 1 : One irrigation　I 2 : two irrigation　I 3 : Five irrigation
Means as the same letter are not significant .

1000-kernel weight mean values indicated that there was a significant increase in harvest index by increasing the number of irrigations . Plants received five irrigations exhibited a significant increase in 1000-kernel weight compared with one or two irrigations .The lowest value was detected by one irrigation . The increase in harvest index by increasing the amount of available water in the soil might be attributed to an increase in all the metabolism process in the plant which led to increase in dry matter accumulation in the different plant organs . Similar results were obtained by Mohamed (1976) , Gebeyehou and Knott (1983) , Phiboonwat and Homdok (1987) , Abd-Mishani and Jafari-Shabesteri (1988) , Gharti-Chhetr and Lales (1990) , Okuyama and Riede (1991) and Shalaby *et al* (1992) . On the other hand Sharar *et al* (1989) reported that weight of 1000-kernel of wheat was not significantly affected by varying the number of irrigations .

Grain yield (t/ha) was found to be appreciably influenced by the application of water regime treatments in the combined analysis . Plants received five irrigations significantly outyielded those received one or two irrigations . Such increase in grain yield was logically due to the achieved increase in its components . In addition , increasing number of irrigations (five irrigations) decreased the osmotic pressure of soil solution and consequently increased water and minerals absorption by growing wheat plants. This finding agrees with those obtained by Jana and Sen (1978) , Kailasnathan (1986) , Abd-Mishani and Jafari-Shabesteri (1988) , Islam (1990) , Islam (1991) ,Iqbal *et al* (1992) , Shalaby *et al* (1992) .

Data indicated that a significant increase in straw yield (t/ha) , biological yield (t/ha) and plant height mean values were exerted by increasing the amount of available water in the soil .Also , there was a progressive and consistent significant increase in straw yield t/ha by increasing irrigation number from one , two and five irrigations respectively . The highest straw yield and biological yield (t/ha) were obtained from plants received five irrigations . The highest straw yield (t/ha) , in fact , is the out product of its main components ,i.e., plant height , stem thickness , and number of tillers . Any increase in one or more of such components without decrease in the others will lead to an increase in straw yield . Therefore , the increase in straw yield (t/ha) under irrigation conditions was the logical result of the increase in both of number of tillers per m^2 and plant height at similar condition . These results are agree with those obtained by Jana and Sen (1978) , Abd-Mishani and Jafari-Shabestari (1988) , Islam (1990) , Islam (1991) , and Shalaby *et al* (1992) . who reported that increasing soil moisture stress by increasing amount of available water of the soil irrigation depressed straw and biological yield of wheat .

Harvest index mean values was found to be increased by increasing the number of irrigations .These findings go parallel with those presented by Fischer and Wood (1979) .

Again , the obtained results clearly reflected the great effect of water deficiency on the mean performances of all the studied traits . This effect , also , varied from year to year .

Generally , plants received five irrigations after sowing expressed the highest mean values . A gradual depression in mean values parallel to the decrease in amount of available water in the soil was detected .

D.Varietal Differences :

Mean squares associated with varietal differences was found herein to reach the level of significant in all studied traits in the combined analysis (Table 4C) . Mean squares for the interaction between varieties and years were found herein to be significant in all studied traits . This finding revealed that the tested varieties ranked differently from season to season in all the studied traits .

Mean performances of the investigated wheat varieties in the combined analysis are presented in Table (8) . With regard to number of spikes per m^2 , data indicated that there was a significant difference between varieties, Table (8) .It is clear that the cultivar Sids 1 had the highest mean values for all the studied traits except harvest index . While , some varieties showed lowest values ,i.e., Giza 167 and Sahel 1 for plant height , straw yield , number of spikes per m^2 , biological yield and grain yields (t/ha) , Giza 164 for number of kernels per spike , Sakha 8 for 1000-kernel weight and Sakha 69 for harvest index . Whereas , the variety Sakha 69 gave the highest values for harvest index . For grain yield , biological yields (t/ha) , straw yield (t/ha) and number of spikes per m^2 , the variety Sids 1 gave the highest values followed by Sakha 8 and then by Sakha 69 . In this connection it could be concluded that these results are quite expected since the tested varieties had some differences in their genetic stracture . Similar results were reported by Fatih (1987) , Musaviun and Ehdaie (1987) and Bhavsar *et al*. (1996a) .

Table (8): Mean of grain yield , biological yield , straw yield ,number of spike /m^2 , number of kernel /spike, 1000-kernel weight , harvest index and plant height for eight genotypes over planting dates and irrigation treatments .

Genotype.	Grain yield (t/ha)	Biological yield (t/ha)	Straw yield (t/ha)	Number of spikes / m^2	Number of kernels /spike	1000-k. weight (gram)	Harvest index	Plant height (cm)
Gemmiza1	3.77 c	10.78 c	7.01 c	310.63 bc	36.70 c	38.77 c	0.348 cd	106.58 bc
Giza 163	3.80 c	10.93 c	7.13 bc	306.85 bc	36.28 d	38.57 c	0.346 cd	108.28 a
Giza 164	3.75 c	10.83 c	7.08 bc	299.46 d	35.76 e	39.60 b	0.345 cd	108.0 ab
Sakha 8	4.05 b	11.33 b	7.28 b	312.24 b	37.79 b	38.53 c	0.354 bc	103.57 d
Sakha 69	3.74 c	10.88 c	7.14 bc	305.83 c	36.26 d	39.30 b	0.342 d	106.15 c
Giza 167	3.53 d	9.68 d	6.16 d	297.88 de	36.93 c	37.82 d	0.364 a	101.08 e
Sahel 1	3.54 d	9.83 d	6.29 d	293.71 e	36.84 c	37.73 d	0.358 ab	100.57 e
Sids 1	4.65 a	13.32 a	8.67 a	342.02 a	40.16 a	40.95 a	0.347 cd	107.87 ab

Means as the same letter are not significant .

E. Effect of Interaction Between Planting Date and Irrigation Treatments (D X I) :

Mean squares associated with interaction effect between planting date and number of irrigation treatments were found herein to reach the level of significance for all studied traits (Table 4A , 4B and 4C), and that was true in both seasons and their combined analysis . This results revealed that the effect of planting dates differed at various irrigation treatments , on the other words , the effect of planting dates differed in their response to available soil moisture .

Table (9) showed the mean values of wheat yields and its components as affected by the interaction between planting date and number of irrigation treatments in the combined analysis .It is clear that the D2 (10/11) and five irrigation's treatment expressed significantly increased of number of spikes per m^2 , 1000-kernel weight , number of kernels per spike and biological yield followed by the effect of interaction between D3 (25/11) and five irrigation's treatment . However , the lowest values of these traits were detected from effect of interaction between D4 (late of planting date 10/12) and one irrigation treatment .

For straw yield (t/ha) the highest value was detected from D1 (first planting date 25/10) and five irrigation's treatment followed by effect between D2 (the second planting date) and five irrigations treatment . Suitable environmental conditions encourage vegetative growth as well as reproductive organs can explain our finding . For plant height the highest mean values were detected from effect of interaction between D3 and the three irrigations treatment and D2 and one the irrigation treatment .

Meanwhile the highest value of harvest index was recorded from effect of interaction between D3 and five irrigation treatment . However, the lowest ones for straw yield and plant height were recorded from D4 and one irrigation treatment .

For grain yield (t/ha) , the highest value was obtained from effect of interaction between D2 and five irrigation's treatment , but without superiority than effect of interaction between D3 and five irrigation's treatment . Also , the lowest one was detected by effect of interaction between D4 and one irrigation treatment . This result may be attributed to decreased the osmotic pressure of soil solution and consequently increased water and minerals absorption by growing wheat plant when increasing number of irrigation's . This finding agrees with those obtained by Islam (1990) , Islam (1991) , Bouzerzour and Oudina (1990) .

The effect of interaction between planting date , irrigation treatments and seasons was significant for all the studied traits except number of spikes per m^2 (Table 4C) . This result may be due to the unstable effect of the interaction of planting dates and number of irrigation treatments .

Table (9) : Means of grain yield (t/ha) , number of spikes /m^2 , number of kernels / spike , 1000-kernel weight, biological yield (t/ha) , straw yield (t/ha) , harvest index , and plant height (cm) as affected by different irrigation treatment and planting dates over genotypes and seasons .

Planting date	Grain yield (t/ha)			Number of spikes / m^2			Number of kernels/ spike			1000-kernel weight (g)		
	I 1	I 2	I 3	I 1	I 2	I 3	I 1	I 2	I 3	I 1	I 2	I 3
D 1	2.72	3.60	4.88	282.13	308.06	333.83	33.70	37.44	39.73	34.74	38.76	44.18
D 2	2.94	4.02	5.38	293.72	305.75	355.31	34.24	37.97	40.93	35.95	39.16	45.60
D 3	2.88	3.94	5.32	285.25	308.06	344.44	33.84	37.59	40.73	34.71	38.27	44.85
D 4	2.36	3.33	4.87	264.31	293.75	328.31	32.61	36.51	39.78	32.43	36.09	42.16
LSD 0.05		0.09			6.56			0.48			0.48	
LSD 0.01		0.12			8.62			0.63			0.63	

I 1 : One irrigation I 2 : two irrigation I 3 : Five irrigation
D1 : 25/10/1995 and 28/10/1996 D2 : 10/11/1995 and 12/11/1996
D3 : 25/11/1995 and 27/11/1996 D4 : 10/12/1995 and 11/12/1996

Table (9) Cont. :

Planting date	Biological yield (t/ha)			Straw yield (t/ha)			Harvest index			Plant height (cm)		
	I 1	I 2	I 3	I 1	I 2	I 3	I 1	I 2	I 3	I 1	I 2	I 3
D 1	8.48	11.27	14.02	5.76	7.67	9.14	0.323	0.322	0.350	106.09	104.67	103.28
D 2	8.78	11.59	14.49	5.84	7.57	9.11	0.338	0.350	0.373	107.89	108.38	104.42
D 3	8.43	10.87	13.64	5.55	6.93	8.33	0.344	0.364	0.391	108.66	107.23	107.63
D 4	7.34	9.85	12.62	4.98	6.51	7.74	0.323	0.340	0.388	100.45	103.66	100.8
LSD 0.05		0.23			0.24			0.010			1.70	
LSD 0.01		0.30			0.32			0.014			2.24	

I 1 : One irrigation I 2 : two irrigation I 3 : Five irrigation
D1 : 25/10/1995 and 28/10/1996 D2 : 10/11/1995 and 12/11/1996
D3 : 25/11/1995 and 27/11/1996 D4 : 10/12/1995 and 11/12/1996

F. Effect of Interaction Between Cultivars and Planting Date (C X D) :

Mean square associated with interaction between wheat cultivars and planting date was found herein to reach significance level for all the studied traits (Table 4A ,4B and 4C) , and that was true in both seasons as well as the combined analysis . The result reveal that the tested cultivars different rank at various planting dates . Generally , the most cultivars gave the highest values at D2 for all studied traits . However , the lowest ones were detected at the late planting (10/12) . Table (10) indicates the mean values of wheat yields and its components as affected by interaction between cultivars and planting date .

The highest value of number of spikes per m^2 was obtained when Sids 1 cultivar sown in D2 , However , the lowest value for this trait was obtained from sowing Giza 164 cultivar in 10 / 12 (D4) late planting .The maximum values of number of kernels per spike were 40.70 , 40.27 , and 40.17 obtained by Sids 1 when sowing at 25/10 , 25/11 , and 10/11 (D1 , D3, D2) respectively . Whereas , Giza 163 gave the minimum value for this character at late planting date (D4) .

The highest values of 1000-kernel weight were detected by Sids 1 at the first , second and third planting dates (D1,D2,and D3) . However the lowest one was detected by Gemmiza 1 at late of planting (D4) .

The Sids 1 cultivar had the highest values for grain yield t/ha at the second , third and first planting dates (D2 , D3, and D1) . However the lowest ones were obtained from Giza 167 and Sahel 1 at late of planting (D4) .

Sids 1 gave the highest values of biological and straw yield t/ha at the first planting date followed by Sids 1 at second sowing date (D2) . This result might be attributed to the long day led to short growth habit in the later sowing date , such condition induces wheat plants to flowering ,maturity and limited the growth attributes . On the other hand , the lowest ones were detected from Giza 167 and Sahel 1 at late of planting (D4) .

For plant height, the highest values were recorded by Giza 164 and Sids 1 at the third planting date , and Giza 163 at the second sowing date. However , the lowest ones were detected by Giza 167 and Sahel 1 at the later sowing date (D4). For harvest index the highest value was recorded by Giza 167 at the third planting date . However the lowest one was detected by Sahel 1 at the first planting date .

Significant mean squares of interaction between cultivars , sowing date and season were detected for all traits except number of spikes per m^2 (Table 4C) . This result may due to the fluctuated of this effect of cultivars and planting dates from season to another .

Table (10) : Means of grain yield (t/ha) , number of spikes /m^2 , number of kernels / spike , 1000-kernel weight (g), biological yield (t/ha) , straw yield , harvest index , and plant height (cm) as affected by planting dates and genotypes over irrigation treatments and seasons .

	Grain yield (t/ha)				Number of spikes / m^2				Number of kernels / spike				1000-kernel weight (g)			
Genotype	D1	D2	D3	D4	D1	D2	D3	D4	D1	D2	D3	D4	D1	D2	D3	D4
Gemmiza 1	3.53	4.13	3.96	3.47	310.67	317.83	316.83	297.17	36.63	36.98	37.20	35.97	38.78	40.92	39.53	35.83
Giza 163	3.69	4.07	3.98	3.42	301.75	325.17	313.50	287.00	35.98	37.22	37.07	34.83	39.02	39.75	39.10	36.42
Giza 164	3.66	3.96	3.92	3.47	306.50	306.67	303.00	281.67	35.35	36.42	35.92	35.37	39.22	41.23	40.32	37.63
Sakha 8	3.90	4.34	4.24	3.72	311.38	326.42	313.83	297.33	38.20	38.33	38.20	36.42	39.15	39.42	38.67	36.90
Sakha 69	3.66	3.94	3.98	3.37	300.67	311.83	313.83	297.00	35.63	36.88	36.78	35.73	39.98	40.87	39.85	36.50
Giza 167	3.37	3.74	3.77	3.24	301.67	303.33	300.17	286.33	36.30	38.13	37.02	36.28	38.50	38.83	37.65	36.30
Sahel 1	3.39	3.77	3.70	3.30	290.66	296.50	296.50	291.17	36.85	37.58	36.63	36.28	37.72	38.95	37.92	36.32
Sids 1	4.66	4.94	4.82	4.18	340.75	358.33	343.00	326.00	40.70	40.17	40.27	39.50	41.45	41.93	41.17	39.23
LSD 0.05	0.15				10.71				0.79				0.78			
LSD 0.01	0.19				14.08				1.04				1.03			

D1 : 25/10/1995 and 28/10/1996 D2 : 10/11/1995 and 12/11/1996
D3 : 25/11/1995 and 27/11/1996 D4 : 10/12/1995 and 11/12/1996

Table (10) Cont. :

Genotype	Biological yield (t/ha) D1	D2	D3	D4	Straw yield (t/ha) D1	D2	D3	D4	Harvest index D1	D2	D3	D4	Plant height (cm) D1	D2	D3	D4
Gemmiza 1	10.95	11.27	10.90	9.99	7.42	7.15	6.93	6.52	0.323	0.363	0.360	0.345	104.75	111.0	108.33	102.25
Giza 163	11.35	11.57	10.95	9.85	7.65	7.47	6.97	6.44	0.324	0.358	0.360	0.341	108.50	111.83	109.5	103.29
Giza 164	10.71	11.79	10.92	9.89	7.05	7.83	7.00	6.42	0.340	0.340	0.357	0.345	108.38	108.92	110.83	103.88
Sakha 8	11.34	12.11	11.51	10.37	7.44	7.78	7.27	6.64	0.341	0.355	0.367	0.352	102.38	105.42	106.21	100.29
Sakha 69	11.33	11.43	10.74	10.03	7.67	7.49	6.76	6.65	0.323	0.344	0.369	0.333	104.71	107.96	109.96	101.96
Giza 167	9.91	10.26	9.78	8.79	6.54	6.52	6.01	5.55	0.342	0.364	0.383	0.366	101.21	102.04	101.92	99.17
Sahel 1	9.95	10.52	9.99	8.87	6.56	6.74	6.28	5.57	0.318	0.356	0.368	0.368	100.58	99.00	104.33	98.38
Sids 1	14.53	13.99	13.07	11.68	9.87	9.05	8.25	7.50	0.363	0.350	0.368	0.354	106.96	109.0	111.63	103.88
LSD 0.05		0.37				0.40				0.017				2.78		
LSD 0.01		0.48				0.52				0.022				3.65		

D1 : 25/10/1995 and 28/10/1996 D2 : 10/11/1995 and 12/11/1996
D3 : 25/11/1995 and 27/11/1996 D4 : 10/12/1995 and 11/12/1996

G. Effect of Interaction Between Cultivars and Irrigation Treatments (C X I) :

Mean squares associated with interaction between cultivars and the number of irrigation were significant for all the studied traits except plant height (Table 4A and B), and was true in both seasons as well as the combined analysis . This result revealed that the tested cultivars differentially ranked at various irrigation treatments . In other words , the tested cultivars differed in their response to the available soil moisture . As mentioned before plants received five irrigations after sowing expressed in all cultivars the highest mean values for all traits (Table 11) .

Concerning number of spikes per m^2 , the combined data over two seasons showed that increasing number of irrigation of all cultivars significantly increased the number of spikes per m^2 . Thus the higher number of spikes per m^2 was obtained from Sids 1 when received five irrigations followed by Sakha 8 at the same irrigation treatment . However the lowest ones were detected by cultivars Giza 164 , Giza 167 and Sahel 1 by five irrigations treatment .

As shown in Table (11) number of kernels per spikes was considerably affected by the interaction effect of wheat cultivars and number of irrigation treatments . The obtained results showed that increasing mean values by increasing number of irrigation treatments in all cultivars . The highest values were recorded by Sids 1 followed by Sakha 8 at five irrigations treatment . However , the lowest ones were recorded by Giza 163 and Sahel 1 when received one irrigation after sowing .

Concerning 1000-kernel weight the combined data over two seasons showed that highest mean values were recorded by Sids 1 followed by Giza 164 at five irrigations treatment . On the other hand , the three cultivars Gemmiza 1 , Giza 164 , and Sahel 1 expressed the lowest ones for this trait .

Data presented in Table (11) cleared that grain yield t/ha was significantly affected by cultivars X number of irrigation treatments . It is observed that under the tested wheat cultivars , grain yield was noticeably increased by increasing irrigation numbers . Each cultivar , the higher number of irrigation's (five irrigations after sowing) produced higher grain yield comparing one or two irrigation's after sowing . Also the highest value of grain yield was achieved by Sids 1 followed by Sakha 8 and then by Giza 164 at five irrigation's after sowing .The superiority of Sids 1 , Sakha 8 and Giza 164 might be refereed to its maximized yield components . Moreover this findings may be related to genetical differences between cultivars (Jana and Sen 1978 , Kailasnathan 1986 , and Okuyama and Riede 1991) .

Data presented in Table (11) cleared that biological and straw yields t/ha was significantly affected by effect of interaction between cultivars and the number of irrigation treatments . The highest mean values were recorded by Sids 1 followed by Sakha 8 and then by Giza 164 at five irrigation's . However the lowest ones were recorded by Giza 167 and Sahel 1 at one irrigation after sowing . Under each cultivar the higher irrigation numbers produced the higher biological yield t/ha . This result may be due to high number of stems per m^2 and high plant height .

Table (11) : Means of grain yield (t/ha) , number of spikes /m^2 , number of kernels / spike , 1000-kernel weight (g), biological yield (t/ha) , straw yield (t/ha), harvest index, and plant height (cm)as affected by different irrigation treatment and genotypes over planting dates and seasons .

Genotype	Grain yield (t/ha)			Number of spikes /m^2			Number of kernels /sp			1000-kernel weight		
	I 1	I 2	I 3	I 1	I 2	I 3	I 1	I 2	I 3	I 1	I 2	I 3
Gemmiza 1	2.74	3.61	4.97	283.63	309.25	339.00	33.96	36.01	40.11	33.69	37.40	45.21
Giza 163	2.61	3.88	4.90	281.25	299.94	339.38	32.58	37.08	39.18	34.59	37.98	43.15
Giza 164	2.60	3.60	5.05	269.75	295.88	332.75	33.00	34.66	39.63	33.77	39.50	45.54
Sakha 8	2.95	3.74	5.46	280.69	302.63	353.41	34.65	38.00	40.71	34.15	37.53	43.93
Sakha 69	2.73	3.55	4.94	288.25	299.25	330.00	32.74	37.19	38.85	35.01	38.13	44.76
Giza 167	2.63	3.44	4.51	268.63	295.50	329.50	33.34	37.85	39.56	34.59	36.81	42.06
Sahel 1	2.45	3.50	4.67	267.00	292.50	321.63	32.66	37.97	39.88	33.68	36.71	42.79
Sids 1	3.09	4.47	6.40	311.63	336.31	378.13	35.79	40.26	44.43	36.20	40.51	46.13
LSD 0.05		0.13			9.28			0.68			0.68	
LSD 0.01		0.17			12.19			0.90			0.89	

I 1 : One irrigation I 2 : two irrigation I 3 : Five irrigation

Table (11) Cont. :

Genotype	Biological yield (t/ha)			Straw yield (t/ha)			Harvest index			Plant height (cm)		
	I 1	I 2	I 3	I 1	I 2	I 3	I 1	I 2	I 3	I 1	I 2	I 3
Gemmiza 1	8.40	10.43	13.49	5.67	6.83	8.53	0.327	0.346	0.371	105.56	108.41	105.78
Giza 163	8.32	10.99	13.47	5.71	7.11	8.57	0.314	0.356	0.367	108.63	108.49	107.78
Giza 164	7.90	10.98	13.61	5.30	7.38	8.56	0.331	0.332	0.373	109.63	108.53	105.84
Sakha 8	9.13	10.91	13.96	6.18	7.17	8.50	0.324	0.344	0.393	103.47	103.88	103.38
Sakha 69	8.19	11.07	13.39	5.46	7.52	8.45	0.334	0.323	0.370	106.78	108.25	103.41
Giza 167	7.47	9.65	11.93	4.83	6.21	7.42	0.354	0.358	0.379	100.94	102.38	99.94
Sahel 1	7.24	9.73	12.52	4.78	6.24	7.85	0.341	0.359	0.375	102.00	100.38	99.34
Sids 1	9.42	13.40	17.13	6.34	8.93	10.74	0.331	0.336	0.375	109.19	107.63	106.78
LSD 0.05		0.32			0.34			0.015			2.40	
LSD 0.01		0.42			0.45			0.019			3.16	

I 1 : One irrigation   I 2 : two irrigation   I 3 : Five irrigation

For plant height the highest values were recorded by Giza 163 , Giza 164 and Sids 1 at one or two irrigation treatments and Gemmiza 1 at two irrigation's after sowing . However the lowest ones were recorded by Giza 167 and Sahel 1 at five irrigation's after sowing .

For harvest index , the highest value was recorded by Sakha 8 at five irrigation's after sowing .However the lowest value was detected by Giza 163 at one irrigation treatment .The effect of interaction between cultivar , number of irrigation and seasons was significant for all the studied traits (Table 4B) . This indicated the changeable effect of interaction between cultivar and number of irrigation's for these characters from season to another .

H. Effect of Interaction Between Planting Date, Irrigation Treatments and Cultivars (D X I X C) :

Mean squares associated with interaction between wheat cultivars ,planting date and irrigation treatments were significant for all the studied traits except number of spikes per m^2 , in the combined analysis (Table 4A and B) . The cultivar Sids 1 expressed the highest values of grain yield t/ha at the different planting dates by one irrigation after sowing compared with other cultivars . Also the cultivar Sids 1 gave the highest mean values of grain yield t/ha in different planting dates with five irrigation after sowing . While the highest mean value was recorded by Sids 1 in the second planting date (10/11) with five irrigations after sowing (Table 12) . This was expected since drought stress during grain filling may effect greatly amount of photosynthates in the grain . In addition this is to be expected since average 1000-kernel weight and number of kernels per spike .

However the lowest mean values of grain yield t/ha were recorded by Giza 163 and Sahel 1 at the fourth planting dates (D4 10/12) and one irrigation after sowing but without significant differences of those recorded by Gemmiza 1 , Giza 163 , Sakha 8 , Sakha 69 and Giza 167 in fourth planting date with one irrigation after sowing and Sahel 1 in the third planting date with one irrigation after sowing .

Concerning number of kernels per spike , the combined data over two seasons showed that Sids 1 recorded the highest mean value when plants received five irrigation's (Table 12) under all cultivars at different planting dates .

In different planting dates , increasing number of irrigation's let to a significant increase in number of grains per spike . Again , the decrease in number of kernels per spike detected herein by lowering the level of available water in the soil reflected the probable effect of deficiency on spike fertility (Torop and Koryahin 1990) . The lowest mean values were recorded by cultivars Giza 163 and Gemmiza 1 when plants received one irrigation after sowing at fourth planting date of Sakha 69 in the second planting date (Table 12) . (Islam 1990 , Saini and Gautan 1990 and Islam 1991) .

As shown in Table (12) , biological yield was considerable affected by the interaction effect of wheat cultivars , planting dates and number of irrigation treatments . The obtained results showed that Sids 1 had the highest biological yield at first planting date with five irrigation's but without superiority of Sids 1 at the second planting date with five irrigation's . However lowest values of biological yield were recorded by Sahel 1 , Giza 164 at fourth planting date with one irrigation after sowing.

For straw yield the highest mean value was detected by Sids 1 at the first planting date with five irrigations after sowing , followed by Sids 1 at the second and third planting dates with five irrigation's treatment . However , the lowest ones were recorded by Giza 167 and Sahel 1 at fourth planting date with one irrigation after sowing .

For plant height, the highest values were recorded by Sids 1, Sakha 69 and Giza 164 at the third planting date with one irrigation after sowing . However , the lowest one was recorded by Sahel 1 at the second planting date with five irrigation's treatment (Table 12) .

Significant effect of interaction between cultivars, planting dates , irrigation regime and seasons was obtained for all the studied traits except the number of spikes per m^2 (Table 4 B) . This result indicated the fluctuated of this effect from year to another .

Concerning 1000-kernel weight , the highest mean values were recorded by Sids 1 at the first , second and third planting dates , Sakha 69 at the first and second planting dates , Sakha 8 at the first planting dates and Giza 164 and Gemmiza 1 at the second and third planting dates when plants received five irrigations after sowing . However the lowest ones were recorded by Gemmiza 1 , Giza 164 , Sakha 8 and Giza 167 at fourth planting date when received five irrigation's (Table 12) .

Table (12) : Means of grain yield (t/ha), number of spikes / m^2 , number of kernels / spike , 1000-kernel weight (g) , biological yield (t/ha), straw yield (t/ha) , harvest index , and plant height (cm)as affected by planting dates , irrigation treatments , and genotypes over two seasons .

Genotype	I	Grain yield (t/ha) D1	D2	D3	D4	Number of spikes / m^2 D1	D2	D3	D4	Number of kernels / spike D1	D2	D3	D4	1000-kernel weight (g) D1	D2	D3	D4
Gemmiza1	I 1	2.61	2.98	2.88	2.47	279.5	289.5	290.5	275.0	33.7	35.1	34.9	32.2	34.2	35.7	34.5	30.5
	I 2	3.18	4.21	3.75	3.26	320.5	309.0	316.5	291.0	36.6	35.4	35.7	36.3	37.9	40.5	37.9	33.4
	I 3	4.78	5.17	5.24	4.66	332.0	355.0	343.5	325.5	39.6	40.4	41.0	39.5	44.3	46.7	46.3	43.7
Giza 163	I 1	2.56	2.98	2.72	2.13	279.0	303.0	293.0	250.0	32.2	34.0	33.0	31.2	34.5	36.7	34.1	33.2
	I 2	3.71	4.27	4.00	3.53	301.2	312.0	302.5	284.0	36.6	37.9	37.4	36.8	39.5	38.8	38.1	35.6
	I 3	4.77	5.02	5.21	4.59	325.0	360.5	345.0	327.0	39.1	39.9	40.9	36.8	43.1	43.9	45.2	40.5
Giza 164	I 1	2.57	2.88	2.78	2.16	278.0	281.5	272.0	247.5	34.0	34.4	32.8	30.9	33.8	35.0	34.9	31.5
	I 2	3.50	3.69	3.83	3.35	294.5	294.5	305.5	289.0	34.0	34.8	34.9	35.0	39.0	41.9	40.0	37.3
	I 3	4.89	5.29	5.13	4.88	347.0	344.0	331.5	308.5	38.1	40.2	40.1	40.2	44.9	46.9	46.2	44.2
Sakha 8	I 1	2.98	3.17	3.16	2.46	280.0	292.2	285.5	265.0	36.8	34.8	34.1	33.0	34.7	35.9	34.3	31.8
	I 2	3.62	4.01	3.99	3.32	311.5	311.5	300.0	287.5	38.1	38.6	39.3	36.1	38.6	37.2	37.8	36.6
	I 3	5.08	5.81	5.56	5.37	342.6	375.5	356.0	339.5	39.8	41.6	41.3	40.3	44.2	45.2	44.0	42.4
Sakha 69	I 1	2.75	2.91	2.91	2.33	282.0	301.0	300.5	269.5	32.8	31.4	33.2	33.6	35.1	36.8	36.6	31.7
	I 2	3.46	3.77	3.79	3.16	296.5	296.5	308.0	296.0	37.1	38.5	37.8	35.5	39.2	39.8	37.9	35.7
	I 3	4.76	5.13	5.25	4.61	323.5	338.0	333.0	325.5	37.1	40.8	39.5	38.1	45.7	46.1	45.1	42.2
Giza 167	I 1	2.68	2.76	2.71	2.36	282.0	282.5	266.5	243.5	31.9	34.8	33.5	33.4	36.1	36.2	32.8	33.3
	I 2	3.22	3.67	3.76	3.10	297.0	289.5	333.5	295.0	37.6	39.5	37.4	37.1	37.1	36.8	37.2	36.2
	I 3	4.19	4.76	4.84	4.23	326.0	338.0	333.5	320.5	39.5	40.2	40.2	38.4	42.3	43.6	43.0	39.4
Sahel 1	I 1	2.52	2.62	2.48	2.16	265.5	274.5	267.5	360.5	32.0	33.4	32.9	32.4	34.5	34.4	33.7	32.2
	I 2	3.46	3.77	3.65	3.07	301.5	283.0	297.0	288.5	38.5	39.8	37.6	36.1	36.6	37.8	37.0	35.6
	I 3	4.16	4.90	4.96	4.64	305.0	332.0	325.0	324.5	40.1	39.6	39.5	40.4	42.1	44.7	43.1	41.3
Sids 1	I 1	3.00	3.18	3.40	2.73	311.0	325.5	306.5	303.5	36.3	36.2	36.5	34.3	35.1	37.2	37.0	35.6
	I 2	4.59	4.70	4.73	3.84	341.7	350.0	334.5	319.0	41.2	39.4	40.9	39.6	42.4	40.9	40.4	38.4
	I 3	6.38	6.92	6.31	5.96	369.5	399.5	388.0	355.5	44.7	44.9	43.5	44.7	46.9	47.8	46.1	43.8
LSD0.05			0.25				18.55				1.36				1.30		
LSD0.01			0.33				24.38				1.79				1.78		

I 1 : One irrigation I 2 : two irrigation I 3 : Five irrigation D1 : 25/10/1995 and 28/10/1996 D2 : 10/11/1995 and 12/11/1996 D3 : 25/11/1995 and 27/11/1996
D4 : 10/12/1995 and 11/12/1996

Table (12) Cont.:

Genotype	I	Biological yield (t/ha) D1	D2	D3	D4	Straw yield (t/ha) D1	D2	D3	D4	Harvest index D1	D2	D3	D4	Plant height (cm) D1	D2	D3	D4
Gemmiza1	I 1	8.1	9.1	9.0	7.5	5.47	6.07	6.11	5.02	0.324	0.329	0.321	0.331	103.4	109.1	109.5	100.3
	I 2	10.5	10.9	10.5	9.8	7.30	6.68	6.75	6.57	0.306	0.385	0.358	0.331	105.3	112.4	108.4	107.6
	I 3	14.3	13.9	13.2	12.7	9.48	8.69	7.95	7.98	0.338	0.375	0.399	0.371	105.7	111.5	107.1	98.9
Giza 163	I 1	9.0	8.7	8.3	7.4	6.37	5.68	5.55	5.25	0.288	0.345	0.330	0.289	108.1	113.3	110.6	102.5
	I 2	11.6	11.2	11.3	9.9	7.86	6.92	7.28	6.38	0.325	0.383	0.355	0.357	109.3	110.0	108.6	105.9
	I 3	13.5	14.8	13.3	12.3	8.73	9.81	8.07	7.68	0.356	0.346	0.392	0.374	108.1	112.3	109.3	101.5
Giza 164	I 1	8.0	8.6	8.2	6.9	5.38	5.72	5.38	4.71	0.326	0.341	0.341	0.314	112.1	109.8	112.8	103.9
	I 2	10.5	12.4	11.0	10.0	7.03	8.67	7.19	6.62	0.333	0.307	0.348	0.338	108.4	110.8	108.6	106.4
	I 3	13.6	14.4	13.6	12.8	8.74	9.11	8.44	7.94	0.359	0.369	0.381	0.382	104.6	106.3	111.1	101.4
Sakha 8	I 1	9.5	9.6	9.3	8.1	6.50	6.46	6.13	5.62	0.316	0.331	0.343	0.305	105.8	106.6	103.0	98.5
	I 2	10.6	12.1	10.7	10.2	7.01	8.11	6.70	6.84	0.340	0.333	0.373	0.329	101.8	105.6	109.0	99.1
	I 3	13.9	14.6	14.5	12.8	8.82	8.75	8.97	7.47	0.365	0.401	0.384	0.419	99.6	104.0	106.6	103.3
Sakha 69	I 1	8.4	9.0	8.0	7.3	5.64	6.12	5.09	4.98	0.328	0.322	0.365	0.320	104.8	107.6	113.3	101.5
	I 2	11.6	11.2	11.0	10.4	8.14	7.46	7.19	7.28	0.299	0.343	0.345	0.303	103.5	114.0	110.4	105.1
	I 3	14.0	14.0	13.2	12.3	9.22	8.90	7.99	7.70	0.341	0.366	0.397	0.376	105.9	102.3	106.3	99.3
Giza 167	I 1	7.5	7.8	7.9	6.7	4.82	5.03	5.16	4.33	0.359	0.356	0.346	0.352	104.0	103.9	99.1	96.8
	I 2	10.0	10.3	9.6	8.7	6.81	6.58	5.86	5.58	0.322	0.359	0.393	0.357	103.5	102.9	101.3	101.9
	I 3	12.2	12.7	11.9	11.0	7.99	7.95	7.01	6.74	0.343	0.376	0.408	0.386	96.1	99.4	105.4	98.9
Sahel 1	I 1	7.4	7.8	7.3	6.42	4.92	5.13	4.89	4.25	0.341	0.339	0.340	0.344	100.0	101.6	107.4	99.0
	I 2	10.2	10.4	9.7	8.8	6.66	6.58	6.0	5.72	0.344	0.363	0.378	0.348	98.6	101.4	101.4	100.1
	I 3	12.3	13.4	13.0	11.4	8.12	8.54	8.01	6.75	0.339	0.365	0.385	0.411	103.1	94.0	104.3	96.0
Sids 1	I 1	10.1	9.7	9.5	8.4	7.05	6.51	6.11	5.69	0.300	0.336	0.362	0.325	110.6	111.3	113.6	101.3
	I 2	15.[illegible]	14.3	13.2	11.0	10.58	9.55	8.46	7.13	0.302	0.329	0.356	0.354	107.1	110.0	110.3	103.1
	I 3	18.4	18.0	16.5	15.7	12.0	11.09	10.18	9.68	0.351	0.384	0.383	0.382	103.1	105.8	111.0	107.3
LSD0.05			0.64				0.69				0.029				4.81		
LSD0.01			0.84				0.90				0.039				6.32		

I 1 : One irrigation I 2 : two irrigation I 3 : Five irrigation D1 : 25/10/1995 and 28/10/1996 D2 : 10/11/1995 and 12/11/1996 D3 : 25/11/1995 and 27/11/1996
D4 : 10/12/1995 and 11/12/1996

For harvest index the highest values were recorded by Sakha 8 at fourth planting date with received five irrigation's after sowing followed by Sakha 8 at second planting date when plants received five irrigation's . However the lowest one was detected by Sakha 69 at first planting date with five irrigation's after sowing , Sakha 69 at fourth planting date with two irrigation's after sowing and by Sakha 8 at fourth planting date with one irrigation (Table 12) .

I. Stability Analysis :

Mean squares of environments , genotypes and genotypes X environments interaction were significant for all traits (Table 13) . Significant mean squares for environments was detected for all traits , indicating that the performance of these traits differed from environment to another . Significant varieties and varieties X environment interaction were detected , revealing that varieties carried genes with different additive and additive X additive effects which seemed to be inconstant from environment to another . These results emphasize that the environments had stress and non-stress conditions . The significance of varieties X environments interaction is in agreement with Sharma and Nanda (1985) , Sayed (1987) , Fatih (1987) , Gullord and Aastveit (1987), Ghandorah (1989) , Sariah *et al* (1990) , and Bhavsar *et al* (1996) .

Eberhart and Russell Model (1966)

This model provides a mean of partitioning the genotype environmental interaction for each variety into two parts : (1) The variation due to the response of the variety to varying environmental index (sum of squares due to regression) . (2) The unexplainable deviation from the regression on the environmental index . They added that a stable prefered variety would have approximately :

1- bi = 1.0

2- $S^2d = 0.0$

3- A high mean yield

Differences among variety mean values were statistically significant for all the studied traits . This results not only the amount of variability that existed among environments but also the presence of genetic variability among genotypes included in the study .

Data in Table (15) showed that the linear response of environment was significant for all the studied traits , consequently , the regression coefficient (bi) of seed yield on the environmental index and deviation from regression mean squares (s^2d) pooled over the 24 environments were calculated for each variety are presented in Table (15) .

Significant varieties X environments linear was detected for all the studied traits Table (15) . This indicated that the differences among varieties for their regression on the estimate the (bi) values when this interaction is significant . Pooled deviations mean squares were significant suggesting linear regressions also assume importance considering deviation mean squares for individual variety deviation .

Mean square for individual variety was significant except for deviation squares due to cultivar Gemmiza 1 , Sakha 8 , Sakha 69 , Giza 167 and Sahel 1 for number of spikes per m^2 , variety Giza 167 for straw yield and variety Giza 163 and Giza 164 for plant height whereas insignificant ones were detected . This result indicated that the high stability for the previous cultivars .

According to Langer *et al* (1979) , the regression coefficient is a measure of response to varying environments . Backer *et al* (1982) regarded s^2d for deviation from regression to be the most appropriate criterion for measuring phenotypic stability to micro changes in the environment while the regression coefficient would indicate the response to the major feature of the environment . The variation in regression coefficients indicates that eight cultivars had different response to environmental changes .

Ideally , a cultivar would be adapted to all environments (bi did not differ significantly from unity) , stable (s^2d did not differ significantly from zero) and had above yielding ability particularly for a given production area . The highest yielding cultivars were Sids 1 , followed by Sakha 8 and then Giza 163 , Gemmiza 1 and Sakha 69 . Also , the bi values for the above mentioned cultivars were not significantly from unity (Table 14) .

The minimum deviation from regression mean squares (s^2d) pooled over 24 environments were obtained for Giza 163 , Gemmiza 1 , Giza 164 , and Sakha 69 followed Sids 1 while Sakha 8 had the highest s^2d . These results revealed that the mention cultivars except Sakha 8 were more stable than the others under the environments study . According to Eberhart and Russell (1966) , these cultivars were more stable than others under the environments studied . Also , these cultivars might be considered as a stable and desired cultivars because there performance was outstanding . Therefore , it could be used in breeding programs in this respect . At the same times , the other cultivars had undesired stability parameters .

Results of stabiliiy for number of spikes per m^2 presented in Table (14) showed that values of regression coefficient (bi) were not significant all cultivars except Sakha 8 and Sakha 69 . Whereas values of deviation from regression (s^2d) were significant for all cultivars except Giza 163 , Giza 164 and Sids 1 , revealing the importance of s^2d

parameter in measuring the stability of performance of the eight wheat cultivars . Such results suggested that cultivars exhibited general adaptability to the most environments under study for that trait . But we take into account the magnitude of s^2d and the two other stability parameters ($\bar{X}$ and bi) , it is evident that , the cultivar Gemmiza 1 was the almost having the lowest s^2d value it is bering the more stable cultivars for this trait . For the two cultivars Giza 163 and Sids 1 had high values for s^2d , suggesting that both cultivars are being as moderately to low stable ones . On the other hand , the significant bi and low s^2d for Sakha 8 and Sakha 69 show that this type is perform relatively better under favorable environments .

Regarding number of kernels per spike results of stability parameters Table (14) showed that all cultivars had non significant values for bi from unity and variable significant values for s^2d .The highest number of kernels per spike were recorded by Sids 1 and Sakha 8 , while the deviation from regression s^2d were significant , therefore they are considered as adapted but characterized by specific instability .

Considering all stability parameters it is appeared that , the most desirable cultivars are Gemmiza 1 , Giza 163 and Sakha 69 . Such they had as shown , high mean performance and low magnitude of variability as compared with other cultivars .

Regression coefficient values of 1000-kernel weight Table (14) did not significantly from unity for all cultivars except Giza 163 , Giza 164 and Giza 167 . Meanwhile their deviation from linear regression were significant for Gemmiza 1 and Giza 167 . Therefore the Sakha 8 , Sakha 69 , Sahel 1 and Sids 1 had more stable for most environments used in this investigation .

For biological yield t/ha , the stable performing cultivars were Giza 163 , Giza 164 and Sakha 8 . Also for straw yield t/ha the cultivar Sakha 69 exhibited more stable for this trait . Meanwhile , the Giza 163 expressed more stable over all environments for plant height . Also the three cultivars Giza 164 , Sakha 69 and Giza 167 expressed more stability for harvest index.

Finally , there is a need to test these cultivars in a more diverse and wider range of locations and agricultural treatments to confirm its conclusion .

Table (13) : Mean squares of the combined analysis using the combination between both planting dates and irrigation treatments as different 24 artificial environments .

S.O.V	d.f	Mean Squares							
		Grain yield	Biological yield	Straw yield	Number of spikes /m2	Number of kernels /spike	1000-kernel weight	Harvest index	Plant height
Environment (E)	23	8.89 **	45.04 **	15.20 **	6621.64 **	87.92 **	177.84 **	0.0066 **	447.09 **
Genotype (G)	7	3.12 **	29.70 **	13.89 **	5366.93 **	45.48 **	26.18 **	0.0013 *	233.88 **
E X G	161	0.093 **	0.84 **	0.64 **	171.91 **	3.74 **	1.97 **	0.0007 **	13.76 **
Pooled error	504	0.02	0.103	0.123	85.56	0.46	0.49	0.00022	5.20

* Significant at 0.05 level
** Significant at 0.01 level

Table (14) : Estimates of stability parameters for eight genotypes of wheat based on 24 different artificial environments in 1995/96 and 1996/97 seasons .

Trait and Parameter		Gemmiza 1	Giza 163	Giza 164	Genotype Sakha 8	Sakha 69	Giza 167	Sahel 1	Sids 1	Mean
Grain yield (t/ha)	$\bar{X}$	3.77 c	3.79 c	3.75 c	4.05 b	3.74 c	3.53 d	3.54 d	4.65 a	3.85
	bi	0.94	0.95	0.99	1.06	0.94	0.80*	0.94	1.38**	
	s^2d	0.04	0.03	0.02	0.6	0.02	0.01	0.03	0.1	
Number of spike /(m2)	$\bar{X}$	310.63 bc	306.85bc	299.46 d	312.24 b	305.83 c	297.88 de	293.71 e	342.02 a	308.58
	bi	0.93	1.14	1.12	1.28**	0.69**	1.03	0.86	0.95	
	s^2d	- 15.1	113.8	53.3	- 9.13	13.6	- 18.5	7.9	185.6	
Number of kernel/ spike	$\bar{X}$	36.7 c	36.28 d	35.76 e	37.79 b	36.26 d	36.93 c	36.84 c	40.16 a	37.09
	bi	0.88	0.99	1.13	0.73	0.88	1.07	1.06	1.25	
	s^2d	1.4	1.2	2.8	5.5	1.6	2.3	2.4	3.9	
1000-kernel weight	$\bar{X}$	38.77 c	38.57 c	39.6 b	38.53 c	39.3 b	37.82 d	37.73 d	40.95 a	38.91
	bi	1.15	0.89*	1.08*	1.01	1.01	0.84*	0.98	1.04	
	s^2d	1.3	0.5	2.6	0.5	0.7	1.3	0.9	0.7	

$\bar{X}$: Mean of the genotype in all environments   bi : Regression coefficient S^2d : Deviation from regression .

Table (14) Cont. :

Trait and Parameter		Gemmiza 1	Giza 163	Giza 164	Genotype Sakha 8	Sakha 69	Giza 167	Sahel 1	Sids 1	Mean
Biological yield (t/ha)	$\bar{X}$	10.78 c	10.93 c	10.83 c	11.53 b	10.88 c	9.68 d	9.83 d	13.32 a	10.94
	bi	0.90	0.96	1.04	0.91	0.95	0.82*	0.96	1.42**	
	s^2d	0.56	0.22	0.58	0.57	0.07	0.07	0.74	1.17	
Straw yield (t/ha)	$\bar{X}$	7.01 c	7.13 bc	7.08 bc	7.28 b	7.14 bc	6.16 d	6.29 d	8.67 a	7.09
	bi	0.89*	0.98	1.09	0.79**	1.00	0.87*	0.93	1.45**	
	s^2d	0.46	0.30	0.51	0.36	0.13	0.008	0.52	0.81	
Harvest index	$\bar{X}$	0.348 cd	0.346 cd	0.345 cd	0.354 bc	0.342 d	0.364 a	0.358 ab	0.347 cd	0.35
	bi	0.89*	1.14*	1.02	1.26**	1.00	1.02	0.70**	0.97	
	s^2d	0.0004	0.0005	0.0004	0.0002	0.0005	0.0001	0.0003	0.0003	
Plant height (cm)	$\bar{X}$	106.58 bc	108.28 a	108.00 ab	103.57 d	106.15 c	101.08 e	100.57 e	107.87 ab	105.27
	bi	0.99	0.97	0.91*	0.89*	1.04	0.86*	1.12*	1.22**	
	s^2d	7.0	1.0	2.72	12.1	8.54	8.36	10.05	4.1	

$\bar{X}$: Mean of the genotype in all environments bi : Regression coefficient S^2d : Deviation from regression .

Table (15) : Analysis of variance for grain yield , Number of spikes / m^2 , Number of kernels / spike , 1000-kernel weight , biological yield , straw yield , harvest index and plant height under 24 artificial environments (Eberhart & Russell's model 1966) .

S.O.V	d.f	Mean Square: Grain yield	Number of spikes / m^2	Number of kernel /spike	1000-kernel weight	Biological yield	Straw yield	Harvest index	Plant height
Total	191								
Genotypes(G)	7	3.12**	5366.93**	45.48**	26.18**	29.7**	13.89**	0.0013*	233.88**
E.+(G X E)	184	1.19**	978.13**	14.26**	23.95**	6.37*	2.46	0.0014	67.93
Environment (E) linear	1	204.47**	152297.72**	2022.16**	4090.32**	1035.92**	349.63**	0.1518**	10783.14**
G X E linear	7	0.72**	628.38**	6.74*	4.98**	4.29**	1.86**	0.00047	16.42
Pooled deviation	17υ	0.06	132.26	3.15	1.60	0.6	0.51	0.00062	11.94
Gemmiza 1	22	0.059**	75.65	1.95**	1.81**	0.68**	0.59**	0.0007**	12.20**
Giza 163	22	0.049**	204.70**	1.72**	1.05**	0.32**	0.42**	0.0007**	6.20
Giza 164	22	0.041**	144.17*	3.33**	3.16**	0.69**	0.63**	0.0007**	7.92
Sakha 8	22	0.056**	81.67	5.97**	1.01**	0.67**	0.49**	0.0004*	17.31**
Sakha 69	22	0.044**	104.46	2.16**	1.23**	0.17*	1.40**	0.0007**	13.74**
Giza 167	22	0.032*	72.24	2.80**	1.83**	0.174*	0.13	0.0004*	13.57**
Sahel 1	22	0.051*	98.76	2.89**	1.47**	0.84**	0.64**	0.0006**	15.25**
Sids 1	22	0.120**	276.46**	4.42**	1.28**	1.27**	0.93**	0.0009**	9.30*
Pooled error	504	0.02	85.56	0.46	0.49	0.103	0.123	0.00022	5.2

J. Correlation and Path Coefficient Analysis

Table (16) shows that values of simple correlation coefficient between different characters . Highly significant and positive association were obtained between grain yield and each of number of spikes / m2, number of kernels / spike , 1000-kernel weight , straw yield , biological yield and harvest index . Therefore , selection for higher number of spikes , or number of kernels / spike , and / or heavy seed index , biological yield , straw yield and higher harvest index is more effective for obtaining new higher yielding strains . Ahmed (1972), Ibraheim *et al* (1974) and Sornprach (1988) concluded that number of kernels per spike is the one of the main yield components which might improve directly the yielding ability in new varieties .

Highly significant positive correlation coefficient was found between number of spikes / m^2 and each of number of kernels/spike , 1000-kernel weight , biological yield , straw yield and harvest index . Highly significant correlation coefficient was detected between number of kernels/spike and each of 1000-kernel weight , biological yield , straw yield, harvest index and plant height . The same trend was previously reported by Shanahan *et al* 1984 .

Significant positive correlation coefficient between 1000-kernel weight and each of biological yield , straw yield harvest index and plant height . Also significant positive correlation coefficient between biological yield and each of straw yield and harvest index . However significant negative correlation coefficient between straw yield and harvest index (Ahmed and Rashid 1992) .

Partitioning of simple correlation coefficient between grain yield and its components i.e number of spikes /m^2 , number of kernels per spike and 1000-kernel weight are presented in Table (17) .1000-kernel weight proned to high direct effect followed by both number of spikes / m^2 and number of kernels /spike . Also , the results showed that the indirect effect of number of kernels / spike through 1000-kernel weight and number of spikes /m^2 through 1000-kernel weight . These results revealed that the most important sources of variation for plant yield in dedcending order were 1) the direct effect of 1000-kernel weight , number of spikes / plant and number of kernels / spike respectively . 2) the indirect effects of number of kernels / spike through 1000-kernel weight and number of spikes throught 1000-kernel weight .

The coefficient of determination were calculated for the direct and indirect effects of the three yield factors studied and transformed into percentages in order to evaluate these factors as to their importance as sources of variation in plant yield . The components in percent for grain yield variation over all environments are presented in Table (18) . From this table , it could be concluded that the most important sources of variation in plant yield are :

The direct effect of 1000-kernel weight followed by indirect effect of number of kernels / spike through 1000-kernel weight and indirect effect of number of spikes /m^2 through 1000-kernel weight . The three previous sources account for approximately 55.62 of grain yield variation . While , the direct effect of number of spikes /m and number of kernels per spike account for approximatly 18.69 of grain yield variation . In this connection Bhowmik *et al* (1989) found that the most important sources of variation in plant yield were the direct effect of number of spikes / m^2 , 1000-kernel weight and spike length . On the other hand Sayed and Al-Sayad (1983) reported that 1000-kernel weight had the largest direct effect on grain yield .

Table (16) : Correlation coefficients for Yield , its components and some other agronomic characters .

Character	Number of spikes/m^2	Number of e	1000-kernel weight	Biological yield	Straw yield	Harvest index	Plant height
Grain yield	0.71**	0.75**	0.83**	0.89**	0.72**	0.55**	0.07
Number of spikes /m^2		0.48**	0.55**	0.73**	0.67**	0.20**	-0.13
Number of kernels/spike			0.64**	0.69**	0.57**	0.39**	0.26**
1000-kernel weight				0.79**	0.67**	0.37**	0.25**
Biological yield					0.95**	0.12**	0.04
Straw yield						-0.16**	0.02
Harvest index							0.14*

Table (17) : Path coefficient analysis for yield , and yield components .

Character	Number of spikes/m^2	Number of kernels/spike	1000-kernel weight	Correlation coefficients
Number of spikes/m^2	<u>0.3076</u>	0.1458	0.2564	0.71**
Number of kernels/spike	0.1476	<u>0.3038</u>	0.2984	0.75**
1000-kernel weight	0.1692	0.1944	<u>0.4662</u>	0.83**

Table (18) : The components in percent for grain yield variation .

Source of Variation	Coefficient of determination	Percentage contributed
Number of spike /m2	0.0946	9.46
Number of kernels / spike	0.0922	9.23
1000-kernel weight	0.2173	21.73
Number of spikes /m2 X Number of kernels / spike	0.0897	8.97
Number of spikes /m2 X 1000-kernel weight	0.1577	15.77
Number of kernels /spike X 1000-kernel weight	0.1812	18.12
Residual factors	0.1671	16.71
Total	1.00	100

SUMMARY

SUMMARY

The present investigation was carried out during 1995/96 and 1996/97 growing seasons at Nubaria Agriculture Research Station , Agriculture Research Center , at North Tahrir under calcareous soil and surface irrigations .

The main objectives of this investigation were to evaluated eight bread wheat cultivars (Gemmiza 1, Giza 163 , Giza 164 , Sakha 8 , Sakha 69 , Giza 167 , Sahel 1 and Sids 1) under twelve different agricultural treatments (environments) included all combinations between four planting dates (25 /10 , 10 /11 , 25 /11 , and 10 / 12) and three irrigation treatments (one irrigation , two irrigations and five irrigations) . The eight cultivars were planted in each environment in randomized complete block design with four replications .

The data were recorded on grain yield t/ha , number of spikes per aquare meter , number of kernels per spike , 1000-kernel weight , biological yield t/ha , straw yield t/ha , harvest index and plant height .The data of all experiments were subjected to proper statistical analysis of variance according to Snedecor and Cochran (1967) and the combined analysis was conducted according to Cochran and Cox (1957) . The stability analysis were performed by using the method of Eberhart and Russell's (1966) . Correlation coefficients were also claculated between all pairs the studied traits .

The results can be summarized as follows :

1-Seasons mean squares were significant for all traits except biological yield , straw yield and harvest index .

2-The highest mean values of the studied traits were detected when wheat plants were planted in D2 (10/11) . For the harvest index and plant height the highest mean value were obtained when wheat was planted in D4 (10/12) .

3- Plants received five irrigations after sowing exhibited significant increase in all the studied traits compared with those received two or one irrigations .

4- Mean squares associated with varieties and interaction between varieties and years were significant for all traits under study , the cultivar Sids 1 had the highest mean values for all the studied traits except harvest index .

5- The D2 (10/11) and five irrigations tratment expressed significantly increased of number of spikes per square meter , 1000-kernel weight , number of kernels per spike and biological yield followed by the effect of interaction between D3 (25/11) and five irrigations treatment . However the lowest values of these traits were detected from effect of interaction between D4 (late planting date 10 /12) and one irrigation treatment .

6- The effect of interaction between planting date , irrigation treatments and seasons was significant for all the studied traits except number of spikes per square meter .

7- Sids 1 gave the highest values for grain yield t/ha , number of spikes per square meter , number of kernels per spike and 1000-kernel weight at the second planting date . While , the highest values for biological yield and straw yield were recorded by Sids 1 at the first planting date .

8- Mean squares associated with interaction between cultivars and the number of irrigation treatments were significant for all the studied traits . Grain and biological yields were noticeably increased by increasing irrigation numbers . The highest value of grain yield was achieved by Sids 1 followed by Sakha 8 and then by Giza -164 at five irrigations after sowing .

9- Mean square associated with interaction between planting date , irrigation treatments and wheat cultivars were significant for all the studied traits except number of spikes per square meter in the combined analysis . The Sids 1 expressed the highest values of grain yield t/ha at the different planting dates by one or five irrigations after sowing compared with other cultivars . Also the straw and biological yields , the highest values were detected by Sids 1 at the first planting date with five irrigations after sowing .

10- For stability parameters , the cultivars Giza 163 , Gemmiza 1 , Giza 164 , Sakha 69 and Sids 1 were more stable than the others under the envirobnents study for grain yield t/ha . For biological yield , the stable performing cultivars were Giza 163 , Giza 164 and Sakha 8 . Also for straw yield t/ha the cultivar Sakha 69 exhibited more stable for this trait .

11- Based on path coefficient analysis , the most important sources of variation in plant yield were : the direct effect of 1000-kernel weight , indirect effect of number of kernel /spike through 1000-kernel weight and indirect effect of number of spike /m through 1000-kernel weight .

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ARABIC SUMMARY

تحليل الثبات الوراثى لبعض التراكيب الوراثية لقمح الخبز

الملخص العربى

يهدف هذا البحث إلى دراسة ثبات المحصول (حبوب وقش) وبعض المكونات الأخرى لثمانية أصناف من قمح الخبز هى : جميزة ١ ، جيزة ١٦٣ ، جيزة ١٦٤ ، سخا ٨ ، سخا ٦٩ ، جيزة ١٦٧ ، ساحل ١ وسدس ١ حيث أقيمت ٢٤ تجربة حقلية(بيئات) هى عبارة عن التوافيق بين أربعة مواعيد زراعة مختلفة هى ٢٥ /١٠ ، ١٠ /١١ ، ٢٥ /١١ ، ١٠ /١٢ وثلاث معاملات رى هى رية واحدة بعد رية الزراعة ، ريتان ، وخمس ريات وذلك فى موسمين ١٩٩٥ /٩٦ و١٩٩٦ /٩٧ فى محطة البحوث الزراعية بالنوبارية التابعة لمركز البحوث الزراعية فى شمال التحرير ذات الأرض الجيرية وتحت ظروف الرى السطحى .

وقد سجلت البيانات على محصول الحبوب بالطن / هكتار ، عدد السنابل بالمتر المربع ، عدد الحبوب بالسنبلة ، ووزن الألف حبة ، المحصول البيولوجى ، محصول القش ،دليل الحصاد وطول النبات . وقد حللت البيانات تبعا Snedecor and Cochran ١٩٦٧ وتم إجراء التحليل المشترك تبعا Cochran and Cox ١٩٥٧ وتحليل الثبات الوراثى تبعا لطريقة Eberhart and Russell ١٩٦٦ وقد حسب معامل الإرتباط بين الصفات المدروسة .

ويمكن تلخيص أهم النتائج المتحصل عليها كما يلى :

١ – كان التباين الراجع إلى السنوات معنويا لكل الصفات عدا صفة المحصول البيولوجى ، محصول القش ودليل الحصاد .

٢– كانت أعلى القيم المتحصل عليها من الصفات المختلفة عند الزراعة فى الميعاد الثانى (١٠ /١١) عدا صفة دليل الحصاد حيث سجلت أعلى القيم عند الزراعة فى الميعاد الرابع (١٠ /١٢) .

٣- أعطت معاملة الرى خمس مرات بعد الزراعة لنباتات القمح أعلى القيم بالنسبة للصفات تحت الدراسة .

٤- كان التباين الراجع إلى الأصناف وكذلك التفاعل بين الأصناف والسنوات معنويا لكل الصفات تحت الدراسة وأعطى الصنف سدس ١ أعلى قيمة بالنسبة للصفات المختلفة عدا صفة دليل الحصاد .

٥- أظهر تأثير ميعاد الزراعة الثانى ١٠ /١١ والرى خمس ريات بعد الزراعة زيادة معنوية فى عدد السنابل بالمتر المربع ووزن الألف حبة وعدد الحبوب بالسنبلة والمحصول البيولوجى وجاء بعده تأثير التفاعل بين ميعاد الزراعة الثالث فى ٢٥ /١١ والرى خمس ريات بعد رية الزراعة بينما أعطى التفاعل بين ميعاد الزراعة الرابع فى ١٠ /١٢ والرى مرة واحدة بعد الزراعة أقل قيمة للصفات تحت الدراسة .

٦- كان التباين الراجع إلى التفاعل بين ميعاد الزراعة وعدد الريات والمواسم معنويا لكل الصفات تحت الدراسة عدا صفة عدد السنابل فى المتر المربع .

٧- أعطى الصنف سدس ١ أعلى قيمة بالنسبة لمحصول الحبوب طن / هكتار وعدد السنابل بالمتر المربع وعدد حبوب السنبلة ووزن الألف حبة وذلك عند زراعتة فى الميعاد الثانى (١٠ /١١) ، بينما كانت أعلى قيمة فى المحصول البيولوجى أيضا لنفس الصنف فى الميعاد الأول (٢٥ /١٠) .

٨- كان التباين الراجع إلى التفاعل بين الأصناف وعدد الريات معنويا لكل الصفات تحت الدراسة . زادت قيمة محصول الحبوب والمحصول البيولوجى بزيادة عدد الريات وكانت أعلى قيمة لمحصول الحبوب للصنف سدس ١ ثم سخا ٨ ثم جيزة ١٦٤ عند الرى خمس ريات بعد الزراعة .

٩- كان التباين الراجع إلى التفاعل بين ميعاد الزراعة وعدد الريات والأصناف معنويا لكل الصفات تحت الدراسة عدا صفة عدد السنابل فى المتر المربع ، فى التحليل المشترك أعطى الصنف سدس ١ أعلى قيمة لمحصول الحبوب طن / هكتار عند مواعيد الزراعة المختلفة

بالمقارنة بالأصناف الأخرى وسجلت أعلى قيمة للمحصول البيولوجى ومحصول القش بواسطة الصنف نفسة عند الزراعة فى الميعاد الأول (٢٥ / ١٠) مع خمس ريات بعد الزراعة .

١٠ - كانت الأصناف جيزة ١٦٣ ، جميزة ١ ، جيزة ١٦٤ ، سخا ٦٩ أكثر ثباتا لصفة محصول الحبوب تحت الظروف البيئية تحت الدراسة بينما الأصناف جيزة ١٦٣ ، جيزة ١٦٤ ، سخا ٨ أكثر ثباتا بالنسبة لصفة المحصول البيولوجى وكان الصنف سخا ٦٩ أكثر ثباتا لصفة محصول القش للبيئات تحت الدراسة .

١١- أشارت نتائج معامل المرور إلى أن التأثير المباشر لوزن الألف حبة والغير مباشر لعدد الحبوب بالسنبلة خلال وزن الألف حبة وعدد السنابل بالمتر المربع من خلال وزن الألف حبة كانت تشكل أهم مصادر الإختلاف فى المحصول .

بسم الله الرحمن الرحيم

قالوا سبحانك لا علم لنا
إلا ما علمتنا إنك أنت
العليم الحكيم

صدق الله العظيم

لجنـــة الإشــــــراف :

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قسم بحوث القمح

معهد بحــــوث المحاصيــــل الحقليــــــة

مركز البحوث الزراعية

تحليل الثبات الوراثى لبعض التراكيب الوراثية لقمح الخبز

رسالة علمية
مقدمة إلى الدراسات العليا بكلية الزراعة بمشتهر جامعة الزقازيق
أستيفاء للدراسات المقررة للحصول على درجة

الماجستير فى العلوم الزراعية

فى

المحاصيل

مقدمة من

أحمد محمد أحمد جادالله

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