EVALUATION OF SEVERAL WHEAT GENOTYPES FOR GRAIN YIELD AND OTHER AGRONOMIC CHARACTERISTICS UNDER FIELD AND GREENHOUSE CONDITIONS

By

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TABLE OF CONTENTS

Page

LIST OF TABLES

Page

Page

Page

Page

Page

LIST OF APPENDICES

Appendix Page

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ABSTRACT

Two experiments were conducted to study the performance of several wheat genotypes for grain yield and other agronomic traits under field conditions or simulated drought under greenhouse conditions.

Field experiments were carried out at three locations which were Ramtha Agricultural Research Station where the average rainfall is 220mm, Mushaquar Agricultural Research Station (350mm) and Jubeiha Station (470mm).

Sixteen wheat genotypes which are Hourani (local genotypes), Stork, Jubeiha and thirteen advanced progeny lines derived from Hourani X Stork were evaluated at the two experiments. Maru, Petra Om-Rabi-14 and Golan were also included in the green-house experiment.

The genotypes varied in their biological and grain yields at the three locations tested, indicating that the necessity to practice selection in the target environments. Few genotypes of Hourani X Stork cross were found to be superior to Hourani at Ramtha, the driest site. The association between agronomic traits studied showed that awn length was strongly associated with grain yield, biological yield and fertile tillers at the driest location (Ramtha), whereas flag leaf area was associated with kernel weight at wet sites (Mushaquar and Jubeiha). This shows the importance of awns under moisture-limited conditions and flag leaf area under favorable conditions. The genotype HNXST.13 gave high fertile tillers at Ramtha and Jubeiha locations indicating that it could be a promising drought tolerance genotype.

The negative correlations between heading date and most of the agronomic traits confirme the need to develop early heading cultivars as a way to escape from

drought and high temperature during seed filling period.

In the greenhouse experiment, two irrigation treatments field capacity treatment and one thired available water treatment were applied. The differences between the means of the two treatments were significant for biological yield, straw yield, peduncle length, number of fertile spikes per pot, heading and maturity dates and water use effeciency. The interaction between irrigation treatments and genotypes studied was not significant except for plant height, heading date, flag leaf area and biological yield characters indicating each factor was acting independently.

Late heading genotypes suffered from high temperature in the greenhouse thus resulting in failure of spikes to produce fertile spikelets. Genotypes recieving one third available water treatment headed and matured earlier as compared with the field capacity treatment. Hourani produced the highest values for weight of roots which could be an important factor for Hourani adaptation to rainfed conditions and should be utilized as a source of root weight and length in breeding programs for drought tolerance.

INTRODUCTION

Durum wheat (Triticum turgidum L. var. durum) is one of the most important winter cereal crop grown under dry land conditions generally and in Jordan particularly. It is consumed mainly in the form of bread. Currently, per capita consumption is around 130-150 kg per annum. Despite it is importance in diets, Jordan has to import on the average over 60% of it is wheat requirments. In years of poor harvests, the self suffeciency ratio can drop to as low as 10-15 percent. It grows in areas receiving 200-500 mm of rainfall and occupies the largest area planted to a single crop under Jordanian condition. The Near East and the Maghreb countries produce around 40 million tons of wheat per year, i.e 10% of the world production. In Jordan the average area and production of wheat for the period 1980-1988 were 56.12 thousand ha and 47.2 thousand Mt respectively, whereas the average yield was 0.84 Mt/ha for the same period. (Appendix 2).

The major factors which determine the productivity and adaptability of wheat under rainfed areas are yearly preciptation and distribution over the growing season. Therefore the development of cultivars which tolerate drought and are adapted to the wide range of moisture conditions differing from season to season and from location to other is very important aim in plant breeding programs.

The present study aims at evaluting yield and some of the agronomical traits of different wheat genotypes grown under dry land conditions in the field or simulated drought conditions in the green house.

REVIEW OF LITERATURE

As one of the most important man's principal food crop, research was conducted on wheat all over the world. Breeding, physiology and production researches for wheat have focused on increasing yield potential. Average yield per unit area has risen many folds in high moisture environments, while increasing yield under dry conditions has been less impressive.

In this section drought and it is interaction with yield and other agronomic characterisitcs of wheat is reviewed.

Drought and its effect on the yield and some agronomic traits:

The major climatic factor affecting crop productivity and adaptibility in dry areas is yearly precipitation and its distribution patterns. Many definitions were developed to discribe drought in many ways and means.

Kramer (1983) defined drought as a period of sufficient duration without rain to cause injury to plants. Van Bavel and Verlinder (1956) cited by Kramer (1983) defined agricultural drought that when the readily available water in the root zone is exhausted, meaning that the soil water content has decreased to approximately the permanent wilting percentage. Osmanzai et al (1987) described drought as a condition in which available soil moisture is reduced to the point where the plant cannot absorb it rapidly enough to compensate for transpiration and the drought occurs as a result of low precipitation, high temperature or wind.

Drought resistance is the ability of plants to obtain and retain water as well as continue it's metabolic function during a period of low water potential in it's tissue Osmanzai et al. (1987). Arnon (1972) sited by Osmanizi et al (1987) defined drought resistance as the ability to survive drought conditions without injury.

Maximov, cited by Nour AbdElatif (1978) suggested practical definition for drought resistance as the ability of plants to withstand drought and recover readily after permanent wilting with minimum damage to the plant and to the yield produced. Todd and Webester (1965) stated that the ability to photosynthesize while under water stress or to recover more quickly after rewatering might contribute to drought resistance. Levitt (1972) defined two major components of the resistance which are dehydration avoidance which is characterized by maintenance of favorable plant water status and is measured by the relative maintenance of a higher plant water potential in a given genotype under conditions of soil moisture stress and drought tolerance represent mechanisms which allow the plant to survive and produce under conditions of high internal water stress.

Quizenberry, cited by Osmanzai et al 1987 stated that to plant breeders, drought resistance is the ability of one genotype to be more productive with a given amount of soil water than another.

May and Mithorpe (1962) have defined drought resistance as the ability of varieties or species to grow and yield satisfactorly in areas liable to periodic drought. Also they divided drought resistance to three main types; drought escape or ability to complete the life cycle befor being subjected to serious water stress, drought endurance the ability to survive drought with high internal water content maintained during the drought period by virtue of adeep root system or by reducing transpiration, and drought endurance with low internal water content during the drought but with the ability to recover and grow rapidly when the soil water is replenished.

Blum et al. (1981) proposed that dehydration avoidance is the important component of drought resistance, and he defined dehydration avoidance as plant ability to maintain a relatively higher leaf water potential under conditions of soil moisture stress.

Kozlowski (1968) classified dry region plants into four groups; drought escaping, drought evading, drought enduring and those that resist by storing up awater supply to be used when soil moisture is scorce.

Keim and Kronstad (1979) stated that the main objective of breeding for moisture stress areas should be the development of drought resistance cultivars, these same cultivars also should be adapted to the wide range of moisture conditions encountered from season to season and location to location. Brucker and Frohberg (1987) have stated that development of stress tolerant cultivars is an objective of many breeding programs, but success has been limited due to inadequate screening techniques and the lack of genotypes that show clear differences in response to well defined environmental stresses. Because total drought resistance of a plant cannot yet be defined physiologically Blum et al (1981), and simple tests of tissue for stress tolerance have not been developed adequately (Fisher and Maurer, 1978), grain yield and yield stability under environmental stress remian major selection criteria for stress tolerance in many breeding progams (Brucker and Frohberg 1987).

Yield stability defined as the ability of a genotype to avoid substantial fluctuations in yield over a range of environments. Heinrich et al (1983) proposed that mechanisms in yield stability fall into four general categories, genetic heterogeneity, yield component compensation, stress tolerance and capacity to recover rapidly from stress. Nachit, M. (1988) proposed that stable varieties are necessary to achieve reliable production in dry areas.

Quarrie (1980) had stated that for many years physiologists and breeders have been looking for characters which reliably predict drought resistance, but relatively little success was achieved. The problem is two fold; first, drought itself often varies both in its severity and timing, and this determines the way and extent to which yield may be reduced. Second, few scientists studying the problem have had adequate genetic materials for testing the effect of variation working with breeders to create the genetic diversity necessary for this work.

Asana et al. (1958) and Kozlowski (1972) proposed that the best indicator of drought resistance in cultivated plants is constant yield under field conditions. However, this manner of evaluating drought resistance is the result of many physiological processes and it depends, among other things, on the adaptation of the plants developmental cycles to periodically occuring drought, on changes in the anatomical-morphological structure of above-ground organs which protect tissue against water loss and also on protplast dehydration tolerance.

Nachit and Guassou (1988) explained the acceptance of durum wheat by the farmers in the dry areas due to the tolerance of this type of wheat to drought. The objective of all dry land farming in water limited environments is to maximize economic yield per unit of growing season rainfall (Furner et al 1987).

Plants differ in their response to water stress. In those which are drought susceptible, the physiological processes are adversely affected even by a small reduction in tissue hydration, those that are drought tolerance possess morphological or metabolic properties which enable them to maintain a high degree of tissue hydration even under limited water supply Shinshi et al. (1982). Levitt (1972), Shinshi et al (1982) proposed that truely drought-tolerant species can servive long periods of low tissue hydration.

Hassan (1982) stated that breeding for the drought tolerance could save in the amount of consumed water or produce more yield for the same amount of water consumed. And he suggested few steps in breeding for drought stress including evaluation of materials for individual traits associated with drought resistance as well as for yield performance under stress conditions, then intercrossing of cultivars with anumber of these traits and subsequent selections in the segregating generations of lines combining these characteristic with high yield under stress.

Harris et al (1987) reported that productivity is not only limited by low/or uncertain rainfall, but also by both low and high extremes of temperature. The overall reduction in yield of acrop depends on the number and duration of periods of water stress and the intensities there of experienced by the plant during ontogeny (May and Milthorpe 1962).

Slatyer (1967) stated that water stress is one of the most wide spread environmental variables affecting plant growth. It affectes all phases of plant growth from the seedling to the mature plant. In addition water stress has a prefound influence on plant metabolism from the subcellular to the plant organ levels (Hsiao 1973).

McCree (1974) proposed that water stress affects the growth rate of a plant in at least two ways : the rate of increasing of leaf area is slowed by loss of turgor, and the rate of photosynthesis is decreased both by the closing of the stomata and other means.

It has been shown with various cereals that water stress at almost any growth stage between spike initiation and maturity is likely to cause a significant decrease in grain yield, Aspinall et al (1964) and Gates 1968). However, effects appear to be more pronounced in tissues and organs that are in the most rapid stages of growth or development at the time of stress (Aspinall et al 1964, Begg and Turner 1976).

Oosterhuis (1983) cited that Salter and Goode (1967) concluded from a compr-ehensive literature review that the phase of rapid stem elongation and spike-emergence, when floret development occurs, was especially sensitive to water stress and effects at this time were in many causes irreversible and could not be compensated by providing optimum water conditions during later stages of growth. Grain yield in wheat was particularly sensitive to plant water stress in the phase of growth just prior to spike-emergence (Fischer, 1973).

1. **Biological Yield**:

The biological yield of a cereal crop is the total yield of plant materials which is an integrative major of the combined effects of photosynthesis and respiration during the growing season. Passioura (1977) proposed a simple model for above-ground dry matter which equal to T X WUE where T is the amount of water transpired by the crop and WUE is the efficiency in which this water is used. He reported that biological yield in a water-limited production areas is directly related to the water supply Passioura, (1981).

The usual effect of water stress in reducing biological yield and grain yield is well established, but the intensity of the effects may be greatly influenced by the developmental stage at which the stress occurs (Donald and Hamblin 1976). The organ which is growing most rapidly at the time of stress is the one most affected (Aspinall et al. 1964).

II. Grain Yield

Grain yield of a crop is the expression of it is genetic yield potential in a given environment. Grain yield of a crop can be expressed as the product of biological yield and harvest index Donald and Hamblin, (1976). Grafius (1956) represented yield in oats as the volume of a parallelepiped whose edges represented the components of yield : panicles per unit area (X), the average number of kernels per panicle (Y) and the average kernel weight (Z). Thus yield per unit area is the product, (X) (Y) (Z) and he suggested the importance of working with yield components which are likely to be more simply inherited than yield itself. Yap and Harvey (1972) reported that increased grain yield in cereal crops is achieved by selecting for grain yield or for yield components such as the number of heads per plant, the number of kernels per head or kernels weight.

Grignac (1973) defined yield as the product of the number of spikes at the surface unit by the number of grains per spike and by the weight of one grain. Ibrahim et al (1983) indicated that selection for yield components i.e., number of spikes/plant, kernel number per spike (product of number os spikelets/spike and kernels number per spikelet), and kernel weight, which are under relatively simple genetic control, has been more effecient than selection for yield per se. McNeal et al (1954) concluded that yield increases are the result of increasing number of head per unit area, number of kernels per head and kernel weight. Donald (1968) stated that wheat breeding programs have been based on selection for yield by itself rather than physiological characters which control yield.

Crop yield depends primarily on the amount of moisture available to the plant during growing season. Miglietta et al (1987) considered crop yield as a result of an interaction among amount of water available to a crop during the growth cycle, water use effeciency and harvest index. The quantity of water available to a crop depends on the amount of water stored in the soil profile at sowing plus infiltrated rainfall during the crop life (Miglietta et al 1987).

Fischer (1973) found that water stress applied 10 days befor spike emergence has been shown to have agreater effect on wheat grain yield than when applied at other stages of development.

Fischer et al (1977) found that the most sensitive period for water stress which was largely associated with decrease in grain number extended from 25 days before to 20 days after spike emergance. Thomas et al (1982) found that higher grain yield was associated with improved moisture conditions over the growing period, and the highest correlations being between grain yield and available soil moisture level at ear emergence in the two crosses tested.

Aggarwa (1984) studied the effect of water stress on grain growth and assimilate partitioning in two cultivars of wheat, he found that water stress reduced leaf area, dry matter and grain yield significantly, and concluded that water stress reduced the final grain weight by curtailing the duration of the grain filling phase.

There is some controversy as to the relationship between yield and it's components under stressed compared to non stressed growing conditions. Roy and

Murty (1970) reported that selection for yield and it's components was more effecient under optimal than under suboptimal growing conditions. Donlad, (1968), Hurd (1971) concluded that cultivars selection under well irrigated conditions may not perform well under water stress conditions. Blum (1973) evaluated 21 different grain surghum hybrids under normal and stress conditions. He found that resistant hybrids performed better than the susceptible one understress by producing relatively higher number of panicles per unit area, and more grains per panicle branch. However, under nonstress irrigated conditions, susceptible hybrids performed better than the resistance ones due to arelatively higher number of panicles per unit area and large 1000-kernel weight.

Clarke et al (1984) observed significant differences between irrigated and rainfed yield of ten genotypes of durum wheat exhibited highest grain yield in the non stressed environments as compared to stressed environments. He concluded that selection for high yielding and widely adapted genotypes would be preferable to selection for high drought resistance per se.

Harvest index

Harvest index in cereals is defined as the ratio of grain yield to the biological yield. It measures the effeciency of conversion of photosynthates into economic yield. Harvest index has also been known as coefficient of effectiveness by Nichiporovich (1960) and migration coefficient by others.

Harvest index has been recommended as a selection criteria for increasing yield of cereals by several research workers., Singh and Stoskopf (1971), Fischer and Kertesz, 1976 and sharma 1987.

Bhatt (1967) stated that improved harvest index represents increased physiological capacity to mobilize photosynthates and translate it to organs having economic value. Harvest index is useful measure of yield potential and is relatively easy to measure on alarge number of plants. While kraljevic and Borojevic 1988, have reported that no significant correlation between harvest index and yield.

The relation between plant height and harvest index was studied. A negative correlation between harvest index and plant height was found, Sharma (1987), Kraljevic (1988) and Allan (1983).

Singh and Stoskopf (1971) have concluded that reduction in plant height lowered the dry weight of the vegetative parts and thereby lowered the straw yield which reflected an increased harvest index.

Heading Date:

Date of heading is the period from emergence or sowing date until the spike emergence from the sheath of flag leaf. In an area with a mediterranean climate the most important characteristic of drought resistance of a winter crop is earliness of maturity (May and Milthorpe 1962).

Fischer and Turner (1978) proposed that one of the more successful techniques for increasing yield in dry regions has been to breed for earlier flowering because plants complete more of their life cycles before the dry period arrives and thus avoid the drought. Syme (1969) found that earlier maturity strains of wheat have been shown to have a higher yield potential than later lines under conditions of limited moisture supply.

Hsu and walton (1971) have found that late flowering plants gave higher yield because later plants had more ears, more spikelets and more but smaller kernels. Hegazi et al (1978) have reported that earliness is avery important character in durum wheat to escape from many diseases such as rusts and bunts.

Nachit and Ketata (1986) have found a highly negative correlation between grain yield and time to heading. Nachit (1987) reported that grain yield under stress environments was highly and negatively associated with days to heading, but positively correlated to heading under favorable environmental conditions.

Tillering capacity

Number of productive tillers per plant is one of the most important character determine the productivity of the plant. HSU. and Walton (1971) found that ears number per plant was the most important components in determining yield per plant and they found also a negative correlation between ear numbers and 1000-kernel weight. They concluded that a wheat plant with moderately tillering capacity should give a high yield per plant. Singh et al., (1970) found that grain yield per plant was positively correlated with tillers per plant.

Keim and Kronstad (1981) proposed that the final spikes number was important in contributing to yield and they concluded that the ability to maintain a high number of grain bearing until maturity was considered to be an important trait contributing to yield under drought. Habib et al., (1980) reported that within the limit, greater the spikes per plant, higher the number of kernels per spike with less 1000-kernel weight, and they found spikes per plant was negatively correlated with plant height. Singh et al (1986) reported that tillering is an important yield component in wheat. Osmanzai et al (1987) stated that tiller viability is important character for drought stress situations and should be considered in selecting materials grown under limited moisture conditions.

Hurd (1971) stated that a high tillering ability may be an unwnated luxury in dry areas because it is wasteful of soil moisture which may be needed later in more critical stages of development.

Richards (1987) reported that several advantages to determinate tillering of wheat for yield improvement. First control over leaf area development and hence the opportunity to modify pre and post anthesis water use which may lead to avoiding of severe drought in the period between flag leaf emergence and anthesis. Second, it is a way of eliminating sterile tillers so that there is no water wasted in their production during vegetative growth. Third, flowering is more synchronous, which should increases harvest index when drought is terminal. And finally control of population density. Higher yield were obtained by determinate tillering in dry environments by Donald (1979), Islam and sedgley (1981), and Richards (1983a).

Kernel weight

Kernel weight is one of the most important yield components and quality factor in wheat. Bruckner and Frahbeg (1987) classified genotypes they used according to kernel weight into three groups; group one included widely adapted genotypes had high kernel weight over environments, high predicted kernel weight in a stress environment and were highly responsive to more favourable grain fill environements. Group two produced average kernel weights over all environments and group three a low Kernel weight over all environments.

Hochman (1982) found that stress during grain filling reduced the 1000-

kernel weight and grain yield was 16% below the well watered control. Increase in temperature during grain filling associated with reduction in grain weight was observed by Peters et al (1971), Fischer and Maurer (1976).

Habib et al (1980) have cited that Deidda and Morros (1968) have found a positive correlation between grain yield, number of ears per plant and 1000-kernel weight. Singh et al (1970) found that negative correlation between grain yield per plant and 1000-kernel weight in durum wheat. Habib et al (1980) found asignificant negative correlation between 1000-kernel weight and Spikelets per spike and between 1000-kernel weight and Spikes per plant. Knott and Talukdar (1971) have found that kernel weight was positively correlated with yield and negatively correlated with number of Kernels per plot. Mohiuddin and Croy (1980) have found that kernel weight was positively correlated with grain yield and negatively correlated with kernels per spike. They concluded to use of kernel weight as a selection factor for increasing grain yield.

Spike length

Hsu and Walton (1971) have found that ear length of spring wheat is closely correlated with yield per plant. And they found a positive correlation also between ear length and spikelets and kernel number. HSU and Walton (1971) cited that Morishima et al (1967) classified wheat varieties into ear number types and ear weight or ear length types, then different weighting was given to the yield components for different types of varieties.

Kramer et al (1983) concluded that development of the wheat spike is extremely sensitive to water stress during two periods; during the late vegetative and transition phases and during internode elongation immediately prior to spike emergence.

Spikelets per spike:

Singh et al (1970) found that yield per plant was positively correlated with spikelets per ear, and spikelets per ear was positively correlated with grain per ear and negatively correlated with tillers per plant. Hsu and Walton (1971) found a closely correlation between yield per plant and number of spikelets per ear.

Habib et al (1980) found a positive highly significant correlation between spikelets per spike and spikes per plant. Frank et al (1987) have found that grain yield of spring wheat is influenced by the number of spikelets produced per spike and they found plants exposed to water stress starting 12 days after seedling emergence had a shorter spikelet development stage resulting in fewer spikelets per spike.

Kernels number

There was a close association between yield per plant and yield per ear. In considering yield per ear, the kernels number per ear was the most closely associated character Hsu and Walton (1971). Singth et al (1970) have found grain yield per plant was positively correlated with grain per ear. Habib et al (1980) found a strong correlation between kernels per spike and 1000-kernel weight, and he found also a highly significant and positive correlation between kernels per spike and spikelets per spike, also kernels per spike was found to have positive and highly significant correlation with spikes per plant.

Frank et al (1987) reported that the number of kernels per spike is a major yield components in hard red spring wheat. Knott and Talukdore (1971) have found that the number of kernels per spike showed a high negative correlation with the number of spikes per plot.

Ledent and Moss (1979) have reported that the variations between wheat shoots for grain yield resulted from differential kernel number and kernel size and they found kernels number was ranked first in it's closeness of association with yield.

Ibrahim et al (1983) have found negative nonsignificant phenotypic association between kernels number per spikelet and 200-kernel weight.

Yap and Harvey (1972) found in barley that number of kernels per head strong positive correlated with grain yield in two year studied.

Nachit (1987) reported that a genotypes having a high number of heads and a medium to high number of grain per head were the highest yielders under dry conditions. Hochman (1982) found that stress from tillering to anthesis reduced leaf area index and grain number, and from booting to grain filling resulted in reduced grain number and 1000-kernel weight.

Fischer and Maurer (1976) studied the effect of temperature during different stages of wheat growth, they found that 1^{o}C rise in temperature between end of tillering to begining of grain filling stage was associated with 4% reduction in grain yield, this was related to effect on grain per meter square via changes in spikes per meter square and grains per spikelet.

Flag leaf blade area

Numerous studies have shown a strong positive relationship between wheat yield and area and duration of photosynthetic structure above the flag leaf-node.

Thorne (1965) reported that in wheat 17% of the carbohydrate entering the ear resulted from ear photosynthesis and 83% was translocated from the flag leaf. He reported that photosynthesis in the flag leaves of wheat was greater than in the flag leaves of barley due to their greater surface area. Stoy (1965), Wardlaw (1968) have proposed that flag leaf and parts above it in wheat constitute to the main source of assimilates for the developing grain. Fischer and Kohn (1966) Welbank et al (1966) have found that wheat yield was strongly associated with flag leaf area duration during grain development. Hsu and Walton (1971) cited that Smocek (1969) found that flag leaf area was associated with kernel number per ear and average kernel weight and he showed that maximum genetic advance could be expected if the flag leaf area was used in combination with the components of yield. Hsu and Walton (1971) have found that the flag breadth, flag leaf sheath length were positively correlated with spikelets and kernels number per spike.

Evans et al (1975) reported that over 90% of the grain carbohydrates is derived from CO_2 fixation by the flag leaf and ear during the grain filling period. Patterson and Ohm (1975) found that removal of flag leaf reduced grain yield, test weight and kernel weight significantly. Flag leaf area duration showed a positive correlation with grain yield, kernel weight and a negative relationship with kernel per spike Mohiuddin and Croay (1980). Singh et al (1983) have found that removal of leaf blades significantly reduced the grain yield per plant and other yield components. The removal of flag leaf-blade alone was responsible for more than 50% of the total reduction obtained by removing all leaves.

Duwayri (1984) found that removal of flag leaf reduced grain yield by 10.7%

yield advantage was less (11 percent), and he concluded that the semi-dwarf lines always yielded more grain than the talls in agiven environment, though their yield advantages was some what reduced by drought.

Johnson et al (1966) found that plant height was significantly correlated with kernel weight, spike length, maturity, grain yield, number of spikes/plant and number of rachis internode and he found that short plant height was associated with low kernel weight, short spike length, early maturity, low number of spikes per plant, low number of rachis internodes and low yield.

Briggle and Vogel (1968) reported that the high yields obtained from the semidwarf varieties in Washington state U.S.A. were not obtained when these varieties were grown in areas of lower rainfall.

Buch et al (1981) reported that the semi-dwarf character has an advantages under favorable yield conditions. Hadjichristodoulou (1981) found that tall varieties of barley he tested tended to give higher yield than short varieties at the location where plants were short. By contrast, at the location where plants were tall and lodged, short varieties gave higher yield, and he concluded that the mean height under dryland conditions of the highest yielding wheat varieties is 75-85 cm.

Singh et al (1983) have found that grain yield per plant of different varieties studied was inversely proportional to plant height and they concluded to use dwarf varieties.

Kraljevic and Borojevi (1988) found that a significant negative correlation between plant height and harvest index and a positive correlation between height and grain yield. Donald and Hamblin (1976) have found that negative correlation of harvest index with plant height and leaf length of barley, together with positive and kernel numbers per plant by 11.1%.

Ibrahim and Abu Elenein cited by Duwayri (1984) found that the flag leaf contributed 41-43% to the grain weight due to increase in kerenl weight and kernel number per spike.

Plant height

Plant height can range from 0.3 m in extreme dwarf varieties to 1.5 m in some long-strawed European varieties (Evans et al 1976). Khalifa and Qualset (1975) found that tall genotypes yielded less than those of intermediate height and they found 15.6% greater yields were obtained by using short genotypes than tall ones.

Fischer and Maurer (1978) concluded that tall bread wheat and barley were the most drought resistante entries, dwarf bread wheats were intermediate and durum wheat and triticales were the most susceptible to drought. Jones (1977) concluded that there is no relationship between height and drought resistance.

Nachit and Ketata (1986) found that the association between grain yield and plant height was positive in dry environments but negative in wetter conditions. Nachit (1987, 1988) found that grain yield was associated to plant height by 6% and he found low genotype environment interaction for plant height.

Laing and Fischer (1977) found that semi-dwarf wheat lines selected under adequate moisture conditions generally yielded well under limited moisture conditions as well.

Austin (1987) found that under fully irrigated treatment semi-dwarf lines gave 13-15 percent greater than the tall control and they still gave greater yields than the tall controls when subject either to an early or a late drought, but their relationships with grain yield and it's components. Sharma et al (1987) found that plant height showed a significant negative correlation with harvest index (r=-0.43) which was expected because semi-dwarf wheat plants show high grain yield and high harvest index as compaired to the standared height cultivars, and they also found that positive significant correlation between grain .yield and plant height (r=0.64).

Singh and Stoskopf (1971) have concluded that reduction in plant height lowered the dry weight of the vegetative parts and there by lowered the straw yield which reflected in an increased harvest index. Mcvetty and Evans (1980) have suggested that selection for high grain yield potential be attempted by selecting for biological yield in tall plants and for increased harvest index in short plants.

Sojka et al (1981) stated that the semi-dwarf cultivars were selected for high yield under irrigation, however, the shorter cultivars may be associated with poor yield under drought for this reason. Austin (1987) reported that semi-dwarf lines more adversely affected by drought than tall ones.

Peduncle length

Peduncle is the upper most internode of the stem. Hsu and Walton (1971) have found a negative relationship between peduncle length and yield per ear. Mohiuddin and Coary (1980) have found a positive correlation between peduncle area duration and grain yield, Kernel weight and negative correlation with kernels per spike and they sugguested that use of peduncle area duration which is dependent on peduncle length as aselection criteria in breeding for inereased grain yield. Nachit and Ketata (1986) have reported positive association of peduncle length and grain yield under different moisture levels and suggested that long peduncle may be a useful indicator of yield capacity in dry environments as well as for favourable conditions.

Nachit, (1987, 1988) found a positive correlation between grain yield and peduncle length and reported that grain yield was associated with peduncle length and accounted for 6.6%.

Awn length

Litzenberger and Green (1951) defined awn as a linear extension of vascular tissue of the lemina. The presence of awns increases the photosynthetic rate of wheat ear on the basis of their size and greenness (Evans and Dunston 1970, Evans and Rawson 1970).

Olugbemi et al (1976) found that 4% increase in grain yield due to the presence of awns. He found also awns increase CO_2 fixation by the entire ears by an average of 7.6% in the tall and 11.6% in the dwarf genotypes and concluded that awns increased ear net photosynthesis two to three folds. Evans et al (1972) have found that drought increased the proportion of assimilate contributed by ear photosynthesis to grain filling from 13% to 24% in the awnless ear and from 34 to 43%, in the awned ears. They concluded that awns increased grain yield in the dry but not in the irrigated treatments.

Olugbemi et al (1976) have concluded that for British conditions where no severe drought there is little advantage by breeding awned varieties of wheat. Awned cultivars have significantly outyielded awnless ones only in dried years or places, Evans et al (1972). Atkins and Norris (1955) have found that awned types of wheat out yielded awnless ones in years of drought stress and they found awned types produced significantly higher yield, heavier kernels and highest test weight.

McNeal et al (1969) have found that awned population had heavier kernels and test weight and they yielded 7% more than awnless population. Watson, Thorne, and French (1958) showed that 26% of the dry matter in the barley grain originated from photosynthesis in the spike, including 10% from the awns. Thorne (1965) reported that photosynthesis in awned barley ears was greater than wheat ears because of their greater surface.

Duwayri (1984) found that removal of awns lead to reduced grain yield of wheat by 15.9%, kernel number per plant by 11.3% and kernel weight by 5.2%. Saghir et al.,. (1968) reported that clipping awns at anthesis reduced grain yield by 21% and kernel weight by 13%.

Coleoptile

Stand establishment is very important to maximizing wheat yield under semiarid conditions Duwayri, (1983). The relationship between coleoptile length and emergence rate was studied. Hoff et al (1973) found that most wheat cultivars with long coleoptile emerged better than those with short coleoptiles, especially under adverse soil moisture conditions. Livers (1958) suggested that the coleoptile may be important to seedling emergence, he pointed out that cultivars which emerged well have long heavier coleoptiles than poorly emerged ones. In green house study. Allan et al (1961) have reported that the rapid-emerging varieties had longer coleoptiles than slow emerging varieties.

Sunderman (1964) found that plant height was positively correlated with coleoptile length in three of five laboratory test and with emergence percent in one of two tests.

Allan et al (1961) stated that two main reasons for poor seedling emergence of semi-drwarf winter selections first, growth rate and second coleoptile length.

water being available at heading and the plants produced double the yield. He concluded that plants should be bred for less roots so as to take up less water, thereby conserving soil moisture.

Hurd (1974) reported that cultivars with more root system yielded cultivars with less root system and he stated that extensive root system is associated with drought resistance in wheat and selection for high yield under moisture stress conditions does select for larger root system.

Water use effeciency:

Water use effeciency defined as the amount of above ground dry matter per unit of water transpired Breeding for water use effeciency is an important objective for the improvement in grain yield of crops grown in rain fed areas, which can be improved by either reducing the water use or increasing the dry matter production (Aggarwal and Sinha, 1983). They found that water use effeciency of wheat ranged from 0.5 to 13.8 g dry matter/kg water used depending upon the growth stage, cultivar and water stress.

Singh and Bhushan (1980) cited by Abu-Shriha (1989) stated that supplemental irrigation increased not only crop production but also helped the crop to utilize moisture more effeciency. Luebs and laag (1967) found that yield and water use effeciency of barley were associated with low moisture stress during heading and pollination. Mehrotra et al (1976) and singh et al (1979a) reported that water used increased and water use effeciency of wheat decreased by increasing number of irrigations and availability ot water.

MATERIALS AND METHODS

Experiment I

This experiment was designed to study the performance of different wheat genotypes for yield and some of the agronomic characters under field conditions.

I . Genotypes description :

- **Hourani**:

Is a Jordanian landrace , well adapted to local ecological conditions, it is tolerant to cold and drought , semi-tall, late in maturity and susceptible to lodging and diseases .

- **Stork**:

Is a semidwarf durum wheat which was produced in CIMMYT, Mexico. It has been tested in Jordan since 1973 and proved to be high yielding. It is white awned , has large kernels, is resistant to lodging , heads and matures earlier than Hourani .

- **Hourani x Stork advanced progeny lines** :

The crosses form part of current breeding work at the university of Jordan, and were designed to combine desirable characteristics from the two parents. They were selected from among many entries based on their kernel weight.

- **Jubeiha**:

Is a semi-tall bread wheat which was introduced from Morocco known as Nesmah. It has been tested in Jordan since 1982 and proved to be high yielding. It is short white awned , has large spike, heads and matures earlier than Hourani .

- **Korifla = Petra, Sham 1= Maru.** Durum wheat received from ICARDA and were released in Jordan in 1988.

- **Golan**-bread wheat, the international nursery materials received from ICARDA.

- **Om-Rabi-14.** Advanced durum wheat line received from ICARDA.

II . Description of experimental sites:

- Jubeiha : (university campus field):

Is located near Amman at 32^{o} 01 north latitude and 35^{o} 52 east longitude with an elevation of 980 m above sea level . It is characterized by cold and rain winters, the average rainfall at Jubeiha is 476 mm for the period of 1938 - 1987, (Appendix I) . The soil is clay loam .

- Ramtha (Ramtha agricultural research station) : - It is located 10 km south of Ramtha city in north Jordan . It is located at 32^{o} 46 north latitude and 35^{o} 95 East longitude with an elevation of 590 m above the sea level , and an average annual rainfall of 221.30 mm for the period of 1976 - 1987 (Appendix I).

Temperatures are usually high in spring where as the rainfall is low and occurs usually in winter and ceases in the early spring . This location belong to the barley growing zone of the Country and is characterized by silty clay soil .

- Mushaquar (Mushaquar agricultural research station)

Is about 10 km north of madaba at 31^{o} 43 north latitude and 35^{o} 48 east longitude with an elevation of 785 m above sea level . It is characterized by cold and rainy winters , the average rainfall was 358.4 mm for the period of 1973 -1987 (Appendix I).

The soil was classified as fine , montmorillonitic, thermic, entenc, Chromoxeret .

III Experimental Design :

A randomized complete block design with three replications was used in each experimental site . Plots consisted of six rows 2.5m long and spaced 25 cm apart in Jubeiha and Mushaquar while 30cm in Ramtha station .

Planting was carried out by hand on November 23, 1988 at Mushaquar, December 6 at Jubeiha and on December 15 at Ramtha .

The seeding rate was equivalent to 100 kg/ha . Fertilizers were applied as 150 kg/ha of ammonium sulfate (21% N) and 150 kg/ha of triple super phosphate (46% P_2O_5) in Ramtha station while 200 kg/ha of ammonium sulfate and 150 kg/ha of triple super phosphate at Jubeiha and Mushaquar stations. The fertilizers were broad casted before planting. Broad leaf weeds were controlled by appling 1000 cm^3/ha 2,4-D. Handweeding was also practiced to keep the weeds under control.

At harvesting , only the middle four rows of each plot were harvested on June first 1989 at Ramtha, June 15 at Mushaquar and June 20 at Jubeiha by hand.

IV Characters studied :

The following characters were recorded in the field : -

- Days to heading (Days) : Number of days from emergence to the day where 50 % of the spikes were above flagleaf sheath in the experimental plot.
- Flag leaf blade area (cm^2) obtained as lenght x maximum width x 0.68 (Shalaldeh, 1984 Ghosheh, 1989) , measured on intact leaves two weeks after the beginning of heading on a sample of five leaves taken randomly from each plot .
- Plant height (cm) : At maturity , plant height was measured in centimeters

from the soil surface to the top of uppermost spikelet awns excluded .

At the end of the growing season , ten single plants were randomly selected from each plot and kept in paper bag to study the following traits :

- Number of fertile tillers per plant : Number of spike bearing tillers per plant .
- Peduncle lenght (cm) : Length of the top internode of the culm measured from the base of the spike to the ligule of the flag leaf (Ledent, and Moss., 1979).
- Awn length (cm) : Average length of ten awns taken randomly from each spike .
- Spike length (cm) : Average length of the total spikes per each plant measured from the base of the spike to the terminal spikelet , awn excluded .
- Spikelets / spike : Average number of spikelets in each spike.
- Kernels / spikelet : Average number of kernels per spikelet. Samples taken to study those traits were weighed and threshed to obtain biological and grain yield which were added to the total plot weight .
- To study the biological and grain yield , the four central rows of each plot were harvested by hand , collected and weighed to obtaine the biological yield per unit area . Threshing and cleaning were done with nursery equipment. The clean seeds were weighed and the averaye grain yield per hectar was calculated. In all cases the weight of the 10 plants were included .
- 1000 - Kernel weight (g). 1000 - Kernels were counted by hand and then by seed counter and weighed .
- Harvest index : Estimated by dividing grain yield to the biological yield obtained from the plot .

<u>Seedling traits</u> :

Fifteen seeds of each genotype were placed in a plastic flat with the dimensions 19.5x.14.5 cm and 5 cm deep . Two filter papers were placed one below and one above the seeds .

Ten ml of distilled water were added to each flat then flats were placed in totally darkened germinator maintained at 20° c . Randomized complete block design with three replications was used .

Flats were removed from the germinator when the primary leaves of all seedlings had ruptured their coleoptile . Five seedlings from each flat were rondomly chosen and the following parameters were measured :

1- Average seminal roots number per seedlling

2 - Average seminal roots length per seedling (cm) .

3 - Total seminal roots length (cm) obtained by multiplying average senimal roots number x average seminal roots length .

4 - Coleoptile length-average length of coleoptile for the five seedlings.

All data were statistically analysed according to Little and Hills (1978). The mean values for factors studied were compared at 5% level of significance by LS.D test.

Experiment II

The experiment was carried out in the green house to study the effect of two irrigation treatments on grain yield and some of the agronomic traits for 20 wheat genotypes.

Genotypes studied:

Twenty wheat genotypes were tested which included Hourani, stork, Jubeiha, Maru, Golan, Petra, Om-Rabi-14 in addition to 13 fixed lines derived from Hourani X stork cross which were included in Experiment I.

Germination Procedure:

Twenty five seeds from each genotype were placed in plastic flate with the dimension 19.5x14.5 cm and 5 cm deep. Two filter papers wee placed one below and one above the seeds, and 15 ml of distilled water were added to each flat. Flats were placed in totally darkned germinator maintained at 20°C. After four days when the coleoptile length was about 3 cm, the seedlings were transplanted to the pots in the greenhouse.

Planting procedure :

A split plot design with three replications was used where the irrigation treatments were the main plots and the genotypes were the subplots.

The seedlings were planted in plastic pots with the dimensions 26.5 cm diameter and 25 cm deep. Each pot contained 7 kg oven dry soil. The -0.3 bar soil water content was 32.8% and the -15 bar was 22.0% where the available water was 10.8%. To avoid water loss from the pot holes, glue (cementing materials) was used to close all holes at the bottom of each pot. In each pot, plastic pipe (30 cm long) was placed, one end of the pipe was located in the center of the pot whereas the other end was directed up for watering purposed and was closed by small piece of aluminum foil.

Each pot received 0.41 g triple super phosphate (46% P_2O_5), 1.00 g ammounium sulphate (21% N) and 0.22 g urea (465 N) which was equivelant to 150 kg N/ha and 70 kg P_2O_5/ha then mixed with soil before planting.

Irrigation treatments:

I. Field capacity treatment (T1) : The moisture content maintained around the field capacity with the range between 2/3 of the available water up to field capacity. Pots were weighed daily to maintain moisture content range between 29.2 to 32.8%.

II. One-third available water treatment (T2) : The moisture content was between 1/3 available water and permanent wilting point, i.e the range was between 22.0-25.6%.

Before planting, all pots received the upperlimit of field capacity treatment. Two uniform plants were planted in each pot and the pots were covered by aluminum sheets to avoid evaporation from the pot surface. Planting was on November 26, 1989. Two unplanted pots were used as check.

One tenth strength of Hogland solution at each time of irrigation was added (Acevedo et al. 1971). The following materials were used to prepare the nutrient soltution :

- Macronutrients :

  IM KH_2PO_4, IM KNO_3, IM $Ca(NO_3)_2$, IM $MgSO_4$.

- Micronutrients :

2.86g H_3BO_3, 1.81g $MnCl_2 . 4H_2O$, 0.22g $ZnSO_4 . 7H_2O$, 0.08g CuSO4. $5H_2O$, 0.02 $H_2MoO_4 . H_2O$ (85% MoO_3).

One molar solution was prepared from each macronutrients by dissolving the molecular weight of each substance in one litter of distilled water and shaken by using electrical shakar. To prepare 1/10 Hoglan solution 1 ml of 1M KH_2PO_4 and from micronutrient solution 5 ml of 1M KNO3 and 1M Ca $(NO_3)_2$, and 2ml of 1M $MgSO_4$, were dissolved in 10 liters of tap water.

Daily maximum and minimum temperature, and daily maximum and minimum relative humidity by thermohydrograph instruments, were recorded during the growing season Appendix 3.

Plant characters:

The following plant characters were studied :

- Plant height (cm) : Measured at maturity from the pot surface to the top of upper most spikelet.
- Days to heading : Number of days from planting to the day where the spikes emerged above flag leaf.
- Days to maturity : Number of days from planting till the glumes color turned yellow.
- Flag leaf blade area (cm2) : Obtained as length x maximum width x 0.68 of intact leaves two weeks after the heading on sample of two leaves/pot. (Shalaldeh, 1984. Ghosheh, 1989).
- Peduncle length (cm) : Length of the top internode of the culm measured from the base of the spike to the ligule of the flag leaf (Ledent and Moss., 1979).

- Spike length (cm) : Average length of 3 spikes per pot measured from the base of the spike to the terminal spikelet, awn excluded.
- Number of spikelets per spike : Number of spikelets in each spike.
- Number of kernels per pot.
- Awn length (cm) : Average length of ten awns taken randomly from each sample.
- Biological yield : Total dry weight per pot which is the weight of spikes and weight of straw.
- Weight of spikes and weight of straw.

  straw yield = Biological yield-grain yield.

  Harvest index= grain yield divided by biological yielded.
- Roots weight (g) : Roots were extracted from each pot and cleaned, then placed in oven maintened at 75°C for 24 hours. The oven dry eight of the roots were recorded for each pot.
- Water use effeciency : determined by

$$WUE = \frac{\text{Biological yield (g/pot)}}{\text{Total water transpired (kg)}},$$

Total water transpired was calculated-cumulative amount of water added at each irrigation. The amount is the difference between initial and final weight of the pots at each time of irrigation.

RESULTS AND DISCUSSION

Experiment I :

Environmental Conditions:

Total and distribution of rainfall, mean maximum and mean minimum temperatures at three locations tested are presented in Tables 1,2 and 3.

At Ramtha Agricultural station the amount of rain fall in the growing season 1988/1989 was 147.9 mm. Which was less than the long term average for this site (225.0 mm). Rain fall distribution showed that about 47% of the total rain fall was received in December. However no rainfall was received from mid March till maturity which imposed a severe drought stress at the critical stage of plant growth which is the reproductive stage.

At Jubeiha location, 530.3 mm of rainfall was received during the growing season, 43% of the total rainfall was in December. There was no rain from mid March up to maturity which exposed the plants to moisture stress during seed filling and maturity stages.

At Mushaquar location the total rain fall was 326.1 mm in the 1988/1989 growing season compared to the annual average of 358.4 mm. Rainfall distribution in this location showed that the 37.6% of the total rainfall was received in December, however there was no rain in April which is the most critical month for seed filling and crop maturity.

Grain Yield

Statistical analysis for grain yield at Ramtha location showed no significant differences among genotypes studied. (Table 4) Genotype HNXST. 3 ranked the first in

Table 1 : Montly rainfall distribution (mm), mean maximum and minimum temperature (^{o}C) at Ramtha research station during 1988/1989 growing season.

month	Rainfall (mm)	% of total	Temperature (°C) mean Max.	mean Min.
September	0.00	0.00	—	---
October	5.10	3.45	25.5	11.9
November	13.20	8.92	18.8	6.8
December	70.20	47.46	14.8	5.2
January	17.40	11.76	10.4	0.7
February	21.00	14.2	13.3	0.8
March	21.00	14.2	17.8	4.9
April	0.00	0.00	25.0	8.3
May	0.00	0.00	---	---
Total	147.0			

Table 2 : Monthly rainfall distribution (mm), mean maximum and minimum temperature °C at Jubeiha during 1988/1989 growing season.

month	Rainfall (mm)	% of total	Temperature (°C) mean Max.	mean Min.
September	0.0	0.0	25.8	18.0
October	11.8	2.2	22.3	13.8
November	28.2	5.3	15.8	7.8
December	228.9	43.1	12.0	6.3
January	94.6	17.8	7.4	1.9
February	52.0	9.8	10.8	3.6
March	115.2	21.7	14.4	5.7
April	0.0	0.0	23.7	12.5
May	0.0	0.0	27.4	14.8
Total	530.7			

Table 3 : Monthly rainfall distribution (mm) mean maximum and minimum temperature (C°) at Mushaquar research station during 1988/1989 growing season.

month	Rainfall (mm)	% of total	Temperature (°C) mean Max.	mean Min.
September	0.0	0.0	—	—
October	0.0	0.0	23.2	11.4
November	15.0	4.6	17.2	5.8
December	122.7	37.6	13.1	4.6
January	74.3	22.8	—	—
February	49.3	15.1	11.4	0.9
March	64.8	19.9	15.7	4.6
April	0.0	0.0	24.3	9.4
May	0.0	0.0	—	—
Total	326.1			

— Not available

grain yield and Jubeiha genotype the lowest. Hourani genotype out yielded Stork at this location even though the difference between them was not significant, which is expected because Hourani is a land race cultivar and more adapted to rain fed conditions than Stork which was developed under favorable conditions.

At Mushaquar location there were differences between the genotypes according to grain yield. Genotypes HNXST 11. and 12 were the heighest , whereas Jubeiha and genotype HNXST 1 were the lowest. (Table 4).

At Jubieha location genotype HNXST 7 ranked the first and genotypes HNXST 9 ranked the lowest . Hourani outyielded Stork even though the difference between them was not significant. (Table 4) For all locations tested, genotypes HNXST 7 and HNXST 10 were at the top whereas genotype HNXST. 1 was the lowest. (Table 4) The relative performance of the top two yielder as compared with Hourani in the three locations showed that genotype HNXST 7 gave 117.5 % , 106.6 % and 98.6 % and HNXST. 10 gave 115.8%, 95.4% and 104.2% at Ramtha, Jubeiha and Mushaquar locations, respectively. This means that in two sites those genotypes had better performance than Hourani for grain yield. Genotype HNXST. 1 gave 91.0%, 63.3% and 85.1% of Hourani in the three locations (Tables 5, 6, and 7).

The ranking of grain yield among locations tested showed that Mushaquar location ranked first and was followed by Jubeiha and then Ramtha. The Site means were 3930.5, 2481.9 and 493.7 kg/ha respectively. Ramtha location was the driest among the locations. Rainfall stopped around mid March in all locations, which is the critical period for seed filling and development stage. In case of temperature, Mushaquar location was more suitable for growth compared with Jubeiha and Ramtha locations. Mean maximum temperature during April at Mushaquar was 24.3

Table (4). Mean values of grain yield (kg/ha) for 16 wheat genotypes grown under dryland conditions at the locations in 1988/1989 growing season.

Genotype	Location			
	Ramtha	Jubeiha	Mushaquar	Mean
Stork	400.3	2341.0	3657.3	2132.9
Hourani	424.0	3169.3	3795.0	2462.8
Jubeiha	370.3	2287.3	3285.0	1980.0
HNXST. 1	386.0	2006.7	3231.0	1874.6
HNXST. 2	527.7	2241.0	4245.7	2338.1
HNXST. 3	587.7	2370.0	4026.3	2328.0
HNXST. 4	432.0	2702.3	4204.7	2446.3
HNXST. 5	552.0	2464.3	4002.3	2339.6
HNXST. 6	534.7	2558.7	4160.0	2417.8
HNXST. 7	498.0	3377.3	3743.7	2539.7
HNXST. 8	534.0	2314.7	4006.7	2285.1
HNXST. 9	506.3	1890.7	3563.0	1986.7
HNXST. 10	491.0	3024.0	3959.0	2491.3
HNXST. 11	544.3	2349.0	4432.3	2441.9
HNXST. 12	565.0	2297.3	4418.3	2426.9
HNXST. 13	546.3	2316.3	4158.0	2340.2
Mean	493.72	2481.87	3930.52	2302.04
$L.S.D._{0.05}$	186.18	1128.86	912.15	488.71

Table (5). Mean values of some agronomic characters, the ranking of 16 wheat genotypes for their grain yield and their ralative performance compared to Hourani % grown at Ramtha location in 1988/1989 growing season.

Genotype	Grain yield kg/ha	% of Hourani	Rank	Straw Yield kg/ha	Biological Yield kg/ha	Harvest Index
Stork (P1)	400	94.41	14	1211	1611	0.24
Hourani (P2)	424	100	13	1265	1689	0.25
Jubeiha	370	87/33	16	1141	1511	0.24
HNXST. 1	386	91.03	15	1225	1611	0.24
HNXST. 2	528	124.45	8	1139	1667	0.31
HNXSTt. 3	588	138.60	1	1424	2012	0.29
HNXST. 4	432	101.88	12	1324	1756	0.24
HNXST . 5	552	130.18	3	1293	1845	0.30
HNXST. 6	535	126.10	6	1421	1956	0.27
HNXST. 7	498	117.45	10	1413	1911	0.26
HNXST. 8	534	125.94	7	1422	1956	0.27
HNXST. 9	506	119.41	9	1139	1645	0.30
HNXST. 10	491	115.80	11	1193	1684	0.29
HNXST. 11	544	128.37	5	1267	1811	0.30
HNXST. 12	565	133.25	2	1380	1945	0.29
HNXST. 13	546	128.84	4	1387	1933	0.28
Mean	493.72	——	——	1290.2	1783.9	0.27
L.S.D.$_{0.05}$	186.18	——	——	361.4	400.6	0.07

Table (6). Mean values of some agronomic characters, the ranking of 16 wheat genotypes for their grain yield and their ralative performance compared to Hourani % grown at Jubeiha location in 1988/1989 growing season.

Genotype	Grain yield kg/ha	Grain yield % of Hourani	Grain yield Rank	Straw Yield kg/ha	Biological Yield kg/ha	Harvest Index
Stork (P1)	2341	73.86	9	4419	6760	0.34
Hourani (P2)	3169	100.00	2	5577	8747	0.36
Jubeiha	2287	72.17	13	5979	8267	0.27
HNXST. 1	2007	63.31	15	4540	6547	0.30
HNXST. 2	2241	70.70	14	7112	9353	0.24
HNXST. 3	2370	74.77	7	4130	6500	0.36
HNXST. 4	2702	85.26	4	5258	7960	0.33
HNXST . 5	2464	77.75	6	4956	7420	0.33
HNXST. 6	2559	80.73	5	5028	7587	0.33
HNXST. 7	3377	106.56	1	5983	9360	0.36
HNXST. 8	2315	73.03	11	5685	8000	0.28
HNXST. 9	1891	59.65	16	4823	6713	0.28
HNXST. 10	3024	95.41	3	5923	8947	0.34
HNXST. 11	2349	74.11	8	5938	8287	0.28
HNXST. 12	2297	72.48	12	7663	9960	0.23
HNXST. 13	2316	73.08	10	5004	7320	0.33
Mean	2481.9	----	----	5498.1	7982.9	0.31
$L.S.D._{0.05}$	1128.9	----	----	2099.3	2372.8	0.129

Table (7). Mean values of some agronomic characters, the ranking of 16 wheat genotypes for their grain yield and their ralative performance compared to Hourani % grown at Mushaquar location in 1988/1989 growing season.

Genotype	Grain yield			Straw Yield kg/ha	Biological Yield kg/ha	Harvest Index
	kg/ha	% of Hourani	Rank			
Stork (P1)	3657	69.4	13	7276	10933	0.33
Hourani (P2)	3795	100.0	11	817	11967	0.32
Jubeiha	3285	86.6	15	7040	10325	0.32
HNXST. 1	3231	85.1	16	7969	11200	0.29
HNXST. 2	4246	111.9	3	76623	11908	0.35
HNXST. 3	4026	106.1	7	7193.4	11220	0.36
HNXST. 4	4205	110.8	4	6720	10925	0.38
HNXST . 5	4002	105.5	9	6673	10675	0.37
HNXST. 6	4160	109.6	5	6790	10950	0.38
HNXST. 7	3747	98.6	12	8223	11967	0.31
HNXST. 8	4007	105.6	8	7393	11400.00	0.35
HNXST. 9	3563	93.9	14	6212	9775	0.36
HNXST. 10	3959	104.3	10	6849	10808	0.36
HNXST. 11	4432	116.8	1	7618	12050	0.36
HNXST. 12	4418	116.4	2	7581	12000	0.37
HNXST. 13	4158	109.6	6	7400	11558	0.36
Mean	3930.52	——	——	7300	11228.85	0.35
$L.S.D._{0.05}$	912.15	——	——	1551.17	2196.21	0.05

°C compared with 23.7 °C for Jubeiha and the mean minimum temperature was 9.4 °C for Mashaquar compared with 12.5 °C during April at Jubeiha. Other possible reason for high grain yield at Mushquar compare to Jubeiha could be at Mushaquar location the land was fallowed previous year whereas legumes (lentil) were planted at Jubeiha site previous year. Fallowing helps conserve soil mositure at Mushaquar compared to Jubeiha site for that growing season. (Kharouf. 1989).

Biological yield

Genotypes grown at Ramtha location showed little differences among them. Genotype HNXST. 3 ranked the first and Jubeiha ranked the lowest although the differences among the genotypes were not significant. (Table; 8.) Hourani produced more biological yield than Stork. This could be due to the contribution of other traits such as plant height and total number of tillers.

At Mushaquar location genotypes HNXST. 11 and 12 were the highest whereas genotypes HNXST. 9 and Jubeiha were the lowest. Table 8. Hourani production of dry matter was more than Stork, this may be due to height of Hourani compared to Stork, also Hourani produced more tillers than Stork and there was highly significant difference between them in plant height.

At Jubeiha location there were significant differences among the genotypes yield. Genotype HNXST. 12 ranked the first among all genotypes whereas genotype HNXST.3 ranked the lowest. Hourani genotype produced more biological yield than Stork. (Table 8)The mean of the genotype HNXST. 12 over the three locations ranked the first in the biological yield whereas genotype HNXST. 9 ranked the lowest. . Genotype HNXST. 12 ranked the first in two of three locations, whereas genotype

Table (8). Mean value of biological yield (kg/ha) for 16 wheat genotypes grown under dryland conditions at the three locations in 1988/1989 growing season.

Genotype	Location			
	Ramtha	Jubeiha	Mushaquar	Mean
Stork	1611.3	6760.0	10933.3	6434.9
Hourani	1689.3	8746.7	11966.7	7467.6
Jubeiha	1511.3	8266.7	10325.0	6701.0
HNXST. 1	1611.3	6546.7	11200.0	6452.7
HNXST. 2	1666.7	9353.3	11908.3	7642.8
HNXST. 3	2011.7	6500.0	11220.0	6577.2
HNXST. 4	1755.7	7960.0	10925.0	6880.2
HNXST . 5	1844.7	7420.0	10675.0	6646.6
HNXST. 6	1955.7	7586.7	10950.0	6830.8
HNXST. 7	1911.3	9360.0	11966.7	7746.0
HNXST. 8	1955.7	8000.0	11400.0	7118.6
HNXST. 9	1645.0	6713.3	9775.0	6044.4
HNXST. 10	1683.7	8946.7	10808.3	7146.2
HNXST. 11	1811.3	8286.7	12050.0	7382.7
HNXST. 12	1945.0	9960.0	12000.0	7968.3
HNXST. 13	1933.3	7320.0	11558.3	6937.2
Mean	1783.94	7982.93	11228.85	6998.57
$L.S.D._{0.05}$	400.55	2372.843	2196.21	1180.14

HNXST. 9 ranked the lower order in two of the three locations.

The ranking of locations for biological yield showed that Mushaquar location ranked the first and was followed by Jubeiha whereas Ramtha location ranked the lowest. The site means were 11228.8, 7988.9 and 1783.9 kg/ha respectively.

Ramtha is the driest location from rain fall point view. In January and February the temperature was below zero °C for 22 days in Ramtha. Also the maximum temperature during these month were not high for growth, so that vegetative growth rate was slow. After mid March the temperature started to increase during the day which accelarated flowering. In addition to that the flag leaves rolled the spikes which may have reduced assimilates production and then reduced total dry matter production.

At Mushaquar the weather was better than other locations although the amount of rainfall was less than Jubeiha location but was better in distribution . The mean maximum temperature during vegetative growth period was higher than Jubeiha and the minimum temperature during the neight was lower, so we expected more assimilates production during days and less assimilates lost during the night.

Straw Yield

Straw yield at Ramtha location showed littel differences among genotypes studied. Although genotype HNXSt. 3 , HNXST 6 and 8 were the highest , whereas genotype HNXSt. 2 and 9 were the lowest . Hourani produced more straw yield than stork even though the difference between them was not significant (Table 9)

At Jubeiha location, genotype HNXST. 12 ranked the first whereas genotype HNXSt. 3 ranked the lowest even though without significant difference among most

Table (9). Mean values of straw yield (kg/ha) for 16 wheat genotypes grown under dry land conditions at the three locations in 1988/1989 growing season.

Genotype	Location			
	Ramtha	Jubeiha	Mushauar	Mean
Stork	1211.	4419.	7276.	4302.
Hourani	1265.	5577.	8171.	5004.
Jubeiha	1141.	5979.	7040.	4720.
HNXST. 1	1225.	4540.	7969.	4578.
HNXST. 2	1139.	7112.	7662.	5304.
HNXST. 3	1424.	4130.	7193.	4249.
HNXST. 4	1323.	5257.	6720.	4433.
HNXST . 5	1292.	4955.	6672.	4307.
HNXST. 6	1421.	5028.	6790.	4413.
HNXST. 7	1413.	5982.	8223.	5208.
HNXST. 8	1421.	5685.	7393.	4833.
HNXST. 9	1138.	4822.	6212.	4057.
HNXST. 10	1192.	5922.	6849.	4654.
HNXST. 11	1267.	5937.	7617.	4940.
HNXST. 12	1380.	7662.	7581.	5541.
HNXST. 13	1387.	5003.	7400.	5497.
Mean	1290.	5498.	7300.	4696.
$L.S.D._{0.05}$	361.	2099.	1551.	996.

of other genotypes. (Table 9) At Mushaqar location, genotypes HNXSt. 7, Hourani and HNXSt 1 were the highest. while genotype HNXSt. 9 ranked the last. (Table 9.) For the three locations, genotype HNXSt. 12 ranked the first while genotype HNXSt. 9 ranked the last among all genotypes .

The ranking of locations to straw yield showed that, Mushaquar location ranked the first and was followed by Jubeiha and then Ramtha with sites mean 7298, 5501 and 1290 kg/ha respectively.

1000-Kernel weight

Kernel weight is one of the yield component which gives an indication about the ability of plants to convert assimlates to kernels. Which affected by availability of water during seed filling period. Mean values of kernel weight at Ramtha location are presented in Table 10 . Genotype HNXST. 3 produced heaver kernels whereas Stork produced the lowest value for kernel weight among other genotypes.

At Jubeiha the mean values for kernel weight for all genotypes were higher than values at Ramtha. Genotypes Hourani and HNXST. 13, were the first in kernel weight whereas genotype HNXST. 1, Stork and HNXST.7 were the last among all other genotypes. (Table 10).

At Mushquar location genotypes HNXST. 5 and 6 produced heavier kernels whereas genotype HNXST. 7 was the lowest (Table 10.)

Hourani developed heavier kernels than Stork this may be due to adaptability of Hourani to dry land conditions than Stork genotype.

For all locations, Jubeiha and Mushaquer locations produced heavier kernels compared with Ramtha which was mainly due to availability of moisture to plants

Table (10). Mean values of 1000-kernel weight (g) for 16 wheat genotypes grown under dryland conditions at the three locations in 1988/1989 growing season.

Genotype	Location			
	Ramtha	Jubeiha	Mushaquar	Mean
Stork	28.27	39.93	40.80	36.33
Hourani	31.73	45.97	43.43	40.38
Jubeiha	32.27	43.93	46.80	41.00
HNXST. 1	31.30	39.53	39.10	36.64
HNXST. 2	30.97	43.07	39.47	37.83
HNXST. 3	35.37	44.13	39.53	39.68
HNXST. 4	32.77	42.97	46.53	40.76
HNXST. 5	30.63	44.87	48.53	41.34
HNXST. 6	30.90	43.90	48.13	40.98
HNXST. 7	30.97	39.97	36.80	35.91
HNXST. 8	33.73	44.90	46.43	41.69
HNXST. 9	32.03	45.63	41.27	39.64
HNXST. 10	32.50	42.17	40.07	38.24
HNXST. 11	31.47	44.37	43.67	39.83
HNXST. 12	30.40	41.90	44.43	38.91
HNXST. 13	31.73	45.87	43.17	40.26
Mean	31.69	43.32	43.01	39.34
$L.S.D._{0.05}$	3.60	3.551	4.79	2.08

during kernel filling period, so it will be expected to obtain heavier kernels at Jubeiha and Mushaquar locations compared to Ramtha (the driest site). The sites mean for kernel weight were 43.3, 43.0 and 31.7 g for Jubeiha, Mushaquar and Ramtha locations, respectively.

According to kernel weight we can classifying the locations in two groups : Ramtha location which produced the lowest mean kernel weight had highest stress intensity during the grain fill period and were classified as high stress environment for kernel weight. Jubeiha and Mushaquar locations produced the highest mean kernel weight were calssified as low stress environemnts for kernel weight. Average kernel weight was about 73% greater in the low stress environments.

Tillering capacity:

Tillering capacity is considered one of the yield components of the plant. Genotypes varied in tillering capacity across locations tested. This character is mainly controlled by environments and moisture availability the most important factor.

At Ramtha (the driest site) genotype HNXST. 13 ranked first in production of fertile tillers per plant, although no significant differnece among most of genotypes in case of production fertile tillers. (Table 11) The ability of genotype to produce more fertile tillers under dry conditions is considered as a mechanism for drought tolerance. Genotype HNXST. 2 ranked the last in fertile tillers production per plant. Hourani produced more fertile tillers than Stork, even though the difference between them was not significant.

At Mushaquar location genotype HNXST. 13 ranked first in production of fertile

Table (11). Mean values of fertile tillers/plant for 16 wheat genotypes grown under dryland conditions at the three locations in 1988/1989 growing season.

Genotype	Location			
	Ramtha	Jubeiha	Mushaquar	Mean
Stork	1.07	2.30	2.67	2.01
Hourani	1.27	1.80	2.77	1.94
Jubeiha	1.13	2.07	2.87	2.02
HNXST. 1	1.07	3.07	2.97	2.37
HNXST. 2	1.00	2.80	2.67	2.16
HNXST. 3	1.13	2.40	3.40	2.31
HNXST. 4	1.07	2.00	2.57	1.88
HNXST . 5	1.20	2.00	3.17	2.12
HNXST. 6	1.27	2.43	2.93	2.21
HNXST. 7	1.07	1.93	3.50	2.17
HNXST. 8	1.80	1.60	3.67	2.36
HNXST. 9	2.27	1.87	3.73	2.62
HNXST. 10	1.23	1.70	2.70	1.88
HNXST. 11	1.57	1.93	2.83	2.11
HNXST. 12	1.90	2.47	2.43	2.27
HNXST. 13	2.83	2.40	4.43	3.22
Mean	1.43	2.17	3.08	2.22
$L.S.D._{0.05}$	1.23	1.137	1.41	0.70

tillers per plant whereas genotype HNXST.12 ranked the last. (Table 11)

Hourani produced more fertile tillers than Stork even though no significant difference among them.

At Jubeiha location genotype HNXST. 1 ranked first and genotypes HNXST. 8 ranked the lowest in production of fertile tillers . Stork genotype produced more fertile tillers than Hourani, although the difference between them was not significant. (Table 11.)

For the three locations, genotype HNXST. 13 ranked the first in fertile tillers production, where in two locations ranked the first among all other genotypes, it could be considered as drought tolerance genotype due to his ability to maintain more fertile tillers at the end of the growing season.

The ranking in fertile tiller production among locations tested showed that Mushaquar location ranked the first followed by Jubeiha and then Ramtha locations. The sites mean were 3.1, 2.2 and 1.4 fertile tillers per plant, respectively. This ranking was expected because Mushaquar and Jubeiha locations were the wet sites compare with Ramtha location.

Plant height

Statistical analysis showed that genotypes differed in plant height. At Ramtha location Hourani and genotype HNXST. 12 were the tallest while genotypes HNXST.4 was the shortest .(Table 12).

At Jubeiha location genotype HNXST. 1 was the tallest , whereas genotype HNXST. 4 was the shortest. Hourani was taller than Stork although the difference between them was not significant at this location.(Table 12).

Table (12). Mean values of plant height (cm) for 16 wheat genotypes grown under dryland conditions at the three locations in 1988/1989 growing season.

Genotype	Location			
	Ramtha	Jubeiha	Mushaquar	Mean
Stork	42.8	77.9	88.7	69.
Hourani	48.5	88.0	112.7	83.1
Jubeiha	43.5	80.2	94.3	72.6
HNXST. 1	45.6	95.0	115.3	85.3
HNXST. 2	44.9	76.4	79.0	66.8
HNXST. 3	43.9	82.9	78.6	68.5
HNXST. 4	40.0	68.1	82.2	63.5
HNXST . 5	43.9	81.7	84.8	70.1
HNXST. 6	43.0	72.5	83.9	66.5
HNXST. 7	45.6	82.5	121.2	83.1
HNXST. 8	45.3	73.6	85.1	68.0
HNXST. 9	44.3	77.6	81.1	67.7
HNXST. 10	45.3	79.4	92.5	72.4
HNXST. 11	42.0	79.8	92.6	71.5
HNXST. 12	48.1	77.4	103.2	76.3
HNXST. 13	44.4	90.3	98.3	77.6
Mean	44.4	80.2	93.4	72.7
$L.S.D._{0.05}$	5.0	22.3	8.7	9.1

At Mushaquar location, genotypes HNXST. 7,1 and Hourani were the tallest whereas genotype HNXST. 3 and 2 were the shortest. Hourani significantly differ in height than Stork at this location. (Table 12.)

Ranking of locations according to plant height showed that, Mushaquar location ranked the first in plant height and was followed by Jubeiha and Ramtha location was the last. Sites mean for plant height were 93.4, 80.2 and 44.4 cm for Mushaquar, Jubeiha and Ramtha locations, respectively. At Mushaquar and Jubeiha, the environmental conditions (Rain, temperature) were better which lead to production of taller plants as compared to Ramtha site.

Heading date :

The difference between Hourani and Stork was not significant at Ramtha location for heading date, however two groups of heading date was observed. Five genotypes headed by six days later than the parents.

Genotypes HNXST. 8, 9, 10, 11, 12 and 13 headed later than other genotypes whereas genotypes HNXST. 3, 4, 2, 5 were the earliest among others significant where 9 days different between the earliest and latest cultivars. (Table 13.)

At Jubeiha location, the latest heading genotypes at Ramtha were the earliest at Jubeiha location, no significant differnce between Hourani and stork at this location was observed. Jubeiha genotype was the latest, there were seven days different between the earliest and latest genotypes. (Table 13.).

At Mushaquar location, genotypes HNXST. 9 and HNXST 7 were headed earlier than other genotypes while Hourani was late headed genotype , . Stork genotype headed with four days earlier than Hourani at this location., (Table 13) When

Table (13). Mean values of Heading date for 16 wheat genotypes grown under dryland conditions at the three locations in 1988/1989 growing season.

Genotype	Location			
	Ramtha	Jubeiha	Mushaquar	Mean
Stork	98	105	99	101
Hourani	99	106	102	102
Jubeiha	98	107	99	101
HNXST. 1	100	104	101	102
HNXST. 2	98	106	100	101
HNXST. 3	97	104	101	101
HNXST. 4	98	105	100	101
HNXST . 5	98	105	101	101
HNXST. 6	98	105	99	101
HNXST. 7	99	104	101	101
HNXST. 8	105	101	98	101
HNXST. 9	106	101	97	101
HNXST. 10	106	101	99	102
HNXST. 11	106	101	97	101
HNXST. 12	106	100	98	101
HNXST. 13	106	101	99	102
Mean	101.	104	99.	101.
$L.S.D._{0.05}$	2.1	2.5	2.6	1.7

statistical analysis were done for all locations, no significant differences was found, although Stork was early headed genotype whereas Hourani was late headed genotype with about two days difference.

Mushaquare location ranked the first in heading date where as Jubeiha ranked the last were about four days different between the two locations. Ramtha location was the intermediate location in heading.

Spike characters

Spike is the reproductive organ of the wheat plants. spike characters studied were; spike length, number of spikelets per spike, kernels per spikelets and awn length.

Spike length : Mean vlalues of spike length are presented in Table 14 . At Ramtha location genotype HNXST. 10 produced longer spikes whereas HNXST. 7 and 4 produced short spikes compared with other genotypes . Hourani did not significantly differ from Stork in spike length .

At Jubeiha location, Jubieha genotype produced longer spike, whereas Hourani genotype produced shortest spike with a significant difference from Stork genotype(Table14).

At Mushaquar location, Jubieha genotype ranked the first in spike length with a significant difference from other genotypes studied, also Hourani genotype ranked the last in spike length with a significantly difference from stork genotype. (Table 14.) The ranking of locations for spike length showed Mushaquare location being the first and was followed by Jubeiha and then Ramtha location with sites mean 6.26, 5.99 and 4.91 cm respectively. The availability of good conditions (moisture and

Table (14). Mean values of Spike length (cm) for 16 wheat genotypes grown under dry land conditions at the three locations in 1988/1989 growing season.

Genotype	Location			
	Ramtha	Jubeiha	Mushaquar	Mean
Stork	5.10	6.03	7.17	6.10
Hourani	5.17	4.97	5.00	5.04
Jubeiha	5.23	9.33	10.07	8.21
HNXST. 1	4.10	5.20	5.60	4.96
HNXST. 2	5.77	5.67	5.70	5.71
HNXST. 3	5.17	5.67	5.97	5.80
HNXST. 4	4.03	5.70	6.00	5.24
HNXST. 5	4.63	5.87	6.07	5.52
HNXST. 6	4.17	5.70	5.53	5.13
HNXST. 7	4.03	5.53	5.70	5.08
HNXST. 8	5.40	5.13	5.37	5.30
HNXST. 9	4.53	5.20	5.57	5.10
HNXST. 10	5.83	6.37	6.87	6.35
HNXST. 11	4.73	6.37	6.60	5.90
HNXST. 12	5.20	6.37	5.57	6.04
HNXST. 13	5.47	6.67	6.43	6.19
Mean	4.91	5.99	6.26	5.72
$L.S.D._{0.05}$	1.54	0.734	1.04	0.58

temperataure) during spike development at Mushaquar and Jubeiha locations compared to Ramtha (the driest) location could be the reason for the differences between locations for spike length .

Spikelets per spike:

Genotype HNXST. 8 ranked the first in production of spikelets per spike whereas genotypes HNXST. 4 ranked the last at Ramtha location. (Table 15) Stork genotype produced more spikelets per spike than Hourani, although the difference between them was not significant. This is known about the semidworf Mexican types.

At jubeiha location genotype HNXST. 13 ranked the first, whereas genotype HNXST. 1 ranked the last. (Table 15) Hourani genotype produced more spikelets per spike than Stork although the difference between them was not significant.

At Mushaquar location, genotype HNXST. 11 and 3 were the first in spikelets / spike whereas genotype HNXST. 1 ranked the lowest .(Table 15) Stork produced more spikelets per spike than Hourani at this location even though the difference between them was not significant.

According to spikelets per spike production, Jubeiha location ranked the first and was followed by Mushaquar and the Ramtha location was the last with sites mean 15.6, 15.2 and 9.6 spikelets per spike respectively.

Number of Kernels per spikelet

Mean values of kernels per spikelet for the genotypes grown at Ramtha are presented in Table 16 . Genotypes HNXST. 12 and 8 were in the top order whereas genotype HNXST.4 was in the lower order in production of kernels / spikelet . Hourani

Table (15). Mean values of spikelets/spike for 16 wheat genotypes grown under dry land conditions at the three locations in 1988/1989 growing season.

Genotype	Location			
	Ramtha	Jubeiha	Mushaquar	Mean
Stork	11.27	15.00	15.80	14.02
Hourani	10.60	16.67	14.87	14.04
Jubeiha	9.07	14.27	15.73	13.02
HNXST. 1	8.40	13.73	13.40	11.84
HNXST. 2	9.63	16.13	15.53	13.76
HNXST. 3	10.33	14.60	16.07	13.66
HNXST. 4	7.80	16.50	13.90	12.73
HNXST . 5	9.73	16.20	15.40	13.77
HNXST. 6	9.80	15.60	14.20	13.20
HNXST. 7	8.60	14.53	14.20	12.44
HNXST. 8	12.07	15.20	15.87	14.38
HNXST. 9	9.50	16.20	15.87	13.85
HNXST. 10	8.37	15.67	15.53	13.19
HNXST. 11	8.40	16.80	16.20	13.80
HNXST. 12	9.80	16.33	15.87	14.00
HNXST. 13	9.93	17.47	15.20	14.20
Mean	9.58	15.62	15.23	13.47
$L.S.D._{0.05}$	2.73	2.164	1.71	1.35

Table (16). Mean values of kernels per spikelet for 16 wheat genotypes grown under dry land conditions at the three locations in 1988/1989 growing season.

Genotype	Location			
	Ramtha	Jubeiha	Mushaquar	Mean
Stork	1.73	2.33	2.53	2.19
Hourani	1.87	2.20	1.93	2.00
Jubeiha	1.33	2.33	2.13	1.89
HNXST. 1	1.60	2.20	2.00	1.93
HNXST. 2	1.90	2.73	2.87	2.50
HNXST. 3	1.67	2.60	2.07	2.11
HNXST. 4	1.13	2.40	2.53	2.02
HNXST. 5	1.80	2.93	2.33	2.35
HNXST. 6	1.80	2.73	2.47	2.33
HNXST. 7	1.67	2.27	2.00	1.98
HNXST. 8	1.93	2.67	2.67	2.42
HNXST. 9	1.73	2.73	2.53	2.33
HNXST. 10	1.83	2.80	2.47	2.36
HNXST. 11	1.60	2.87	2.33	2.26
HNXST. 12	1.93	2.73	2.47	2.37
HNXST. 13	1.80	3.00	2.47	2.42
Mean	1.71	2.59	2.36	2.22
$L.S.D._{0.05}$	0.78	0.43	0.48	0.29

produced more kernels per spikelet than Stork although the difference between them was not significant.

At Jubeiha location, genotypes HNXST. 13 ranked the first whereas genotypes HNXST. 1 and Hourani were the lowest . Stork genotype produced more kernels per spikelet than Hourani even though no significant difference between them.

At Mushaquar location genotype HNXST. 2 ranked the first whereas Hourani ranked the last . A significant difference between Haurani and Stork were observed where Hourani produced less number of kernel per spikelet than Stork.

For the three locations, genotype HNXST. 2 ranked the first in production of kernels per spikelet, whereas Jubeiha ranked the last.

The ranking of locations occrding to production of kernels per spikelet showed that Jubeiha location ranked the first followed by Mushauar and then Ramtha with site means 2.59, 2.36 and 1.17 respectively.

Awn length:

At Ramtha location, genotype HNXST. 8 and 13 produced longer awns compared with othe genotypes whereas Jubeiha genotype produced short awns (Table 17.) Stork produced longer awns than Hourani at this location even though the difference between them was not significant.

At Jubeiha location, genotypes Hourani, HNXST. 8 produced longer awns whereas Jubeiha produced short awns . Hourani produced longer awns than Stork eventhough the difference between them was not significant.(Table 17.)

At Mushaquar location genotype HNXST. 9, 10 and 2 were in the top while Jubeiha was in the lower ~~or the~~ in awn length . Stork produced longer awns than Hourani, without significant differnces among them (Table 17.)

Table (17). Mean values of awn length (cm) for 16 wheat genotypes grown under dry land conditions at the three locations in 1988/1989 growing season.

Genotype	Location			
	Ramtha	Jubeiha	Mushaquar	Mean
Stork	8.43	10.80	9.37	9.53
Hourani	8.03	11.13	8.20	9.12
Jubeiha	6.57	7.43	6.73	6.91
HNXST. 1	7.40	9.43	9.67	8.83
HNXST. 2	8.10	10.73	11.47	10.10
HNXST. 3	7.90	9.50	11.20	9.53
HNXST. 4	7.93	10.10	10.90	9.64
HNXST . 5	8.80	10.70	10.70	10.06
HNXST. 6	8.53	10.27	9.47	9.42
HNXST. 7	7.43	10.23	9.17	8.94
HNXST. 8	10.27	11.10	10.40	10.59
HNXST. 9	9.40	10.63	12.17	10.73
HNXST. 10	8.33	10.90	11.60	10.27
HNXST. 11	9.63	10.13	9.30	9.68
HNXST. 12	9.73	10.57	10.77	10.35
HNXST. 13	10.00	10.27	10.60	10.29
Mean	8.53	10.24	10.11	9.62
$L.S.D._{0.05}$	3.44	1.22	3.03	1.84

The ranking of locations for awn length where Jubeiha location ranked the first and was followed by Mushaquare and Ramtha locations with sites mean of 10. 2, 10.1 and 8.53 cm respectively.

Peduncle length:

Mean values of the peduncle length for the genotypes are presented in Table 18. At Ramtha location, genotype HNXST. 9 produced longer peduncle whereas genotype HNXST. 4 produced short peduncle compared with othe genotypes .

Stork had longer peduncle than Hourani although the difference between them was not significant.

At Jubeiha, genotype HNXST. 7 produced longer peduncle whereas genotypes HNXST. 9, Jubeiha and HNXST. 5 produced short peduncles compared with other genotypes .(Table 18.)

Hourani produced longer peduncle than Stork, although no significant difference between them was found.

At Mushquar location Hourani produced longer peduncles, whereas Jubeiha produced short peduncles , (Table 18) also Hourani produced longer peduncle than Stork genotype at this location, even though the difference between them was not significant.

The ranking of locations for peduncle length were Mushquar location ranked the first and was followed by Jubeiha and then Ramtha locations with sites mean 13.61, 11.03 and 1.57 cm, respectively. At Ramtha location, the peduncles were protected by rolled flag leaf and incomplete spike emergence.

Table (18). Mean values of peduncle length (cm) for 16 wheat genotypes grown under dry land conditions at the three locations in 1988/1989 growing season.

Genotype	Location			
	Ramtha	Jubeiha	Mushaquar	Mean
Stork	1.30	10.27	13.87	8.48
Hourani	1.27	13.70	17.47	10.88
Jubeiha	1.47	7.13	11.03	6.54
HNXST. 1	1.83	17.00	16.57	11.80
HNXST. 2	0.93	9.83	13.73	8.16
HNXST. 3	2.20	9.37	12.63	8.06
HNXST. 4	0.53	7.70	12.33	6.85
HNXST . 5	1.93	7.27	13.17	7.45
HNXST. 6	1.13	14.80	13.47	9.80
HNXST. 7	1.33	19.87	12.23	11.13
HNXST. 8	1.87	9.73	11.80	7.80
HNXST. 9	3.37	6.87	12.77	767
HNXST. 10	1.00	10.13	14.07	8.40
HNXST. 11	2.10	10.70	13.27	8.69
HNXST. 12	1.63	9.67	14.60	8.63
HNXST. 13	1.23	12.40	14.73	9.45
Mean	1.57	11.03	13.61	8.73
$L.S.D._{0.05}$	2.82	6.14	3.25	2.7

Flag leaf blade area

Mean values of flag leaf blade area are presented in Table 19 . Genotype HNXST. 12 produced large flag leaf area compared with othe genotypes whereas genotypes HNXST. 1 and 2 produced small flag leaf area at Ramtha location. There was no significant difference between Hourani and Stork in flag leaf area even though Stork genotype had more falg leaf area.

At Jubeiha location genotypes Hourani HNXST. 5 and Jubeiha were in the first order whereas Stork genotype was the last in the flag leaf area . Hourani significantly differ from stork ion flag leaf area at this location was found . (Table 19).

At Mushaquar location genotypes HNXST. 9, 6 and 5 produced larg flag leaf area whereas genotype HNXST. 12 produced small flag leaf area among other genotypes . (Table 19) . Stork genotype had more flag leaf area than Hourani although without significant difference among them.

According to falg leaf blade area, Mushaquar location ranked the first followed by Jubeiha and then Ramtha location with sites mean 24.74, 19.90 and 8.49 cm^2 respectively. These results expected may be due to the present of better conditions (moisture and temperature) at Mushaquar and Jubeiha than Ramtha (the driest) location where the flag leaves rolled to avoid water losses at Ramtha location.

Table (19). Mean values of flag leaf blade area (cm^2) for 16 wheat genotypes grown under dryland conditions at the three locations in 1988/1989 growing season.

Genotype	Location			
	Ramtha	Jubeiha	Mushaquar	Mean
Stork	9.10	15.53	21.70	15.44
Hourani	7.97	23.57	20.33	17.29
Jubeiha	8.57	22.70	28.17	19.81
HNXST. 1	6.87	17.40	21.10	15.12
HNXST. 2	6.93	19.30	27.20	17.81
HNXST. 3	8.50	16.87	24.40	16.59
HNXST. 4	9.10	19.47	27.40	18.66
HNXST . 5	8.77	22.93	28.97	20.22
HNXST. 6	8.60	20.97	29.30	19.62
HNXST. 7	8.30	16.13	20.57	15.00
HNXST. 8	9.00	21.80	23.07	17.96
HNXST. 9	9.00	20.83	29.10	19.64
HNXST. 10	8.07	19.37	25.23	17.56
HNXST. 11	7.83	21.43	24.00	17.76
HNXST. 12	11.00	20.50	19.30	16.93
HNXST. 13	8.30	19.67	26.00	17.99
Mean	8.49	19.90	24.74	17.71
L.S.D.$_{0.05}$	2.84	4.34	7.68	3.23

Correlations among characters studied

Grain yield:

The coefficient of correlation between grain yield and other traits studied at Ramtha are presented in Table 20. Grian yield showed a highly significant correlation with biological yield (r=0.812**). This is expected where more assimilates available to grain development is associated with more vegetative growth. So, genotype HNXST. 3 produced more biological yield and more grain yield than other genotypes, and Jubeiha genotype produced both less biological and grain yield. Awn length associated secondary to grain yield (r=0.633*). This result agreed with many researches Evans (1972) ,Atkins and Norris, (1955) and Duwayri (1984) . They noted that awns are very important character in correlation with grain yield especially under dry conditions, because awns are photosynthesize and the last organ introduced to senscence process. The thired trait associated with grain yield (r=0.519*) was kernels per spikelet which is one of the spike yield components and so yield per plant.

Biological yield significantly associated with grain yield (r=0.519*) and kernels per spikelet also associated with grain yield (r=0.489*) at Mushaquar location . Table 20. Genotypes HNXST. 11 and 12 produced more biological yield and so more grain yield, Jubeiha genotype production low of both biological and grain yield. Genotype HNXST. 1 produced less spikelets per spike and kernels per spikelet. The association between grain yield and awns length at this location showed apositive but not significant correlation (r=0.412).

The correlation between grain yield and other traits studied at Jubeiha location

Table (20) Correlation coefficient (r) between grain yield and other agronamic characters of 16 wheat genotypes grown at Ramtha, Jubeiha and Mushaquar locations in 1988/1989 growing season.

Characters / Location	Ramtha	Jubeiha	Mushaquar
Biological Yield	0.812**	0.510*	0.519*
Straw yield	0.490*	0.147	0.354
Fertile tillers	0.405	0.464	-0.110
1000-Kernel-wt	0.265	-0.130	0.255
Plant height	0.086	-0.021	-0.342
Heading date	0.346	-0.174	-0.192
Spike length	0.196	-0.126	-0.293
Spikelets spike	0.198	-0.059	0.267
Kernels/spikelet	0.519*	-0.290	0.490*
Awn length	0.633**	0.242	0.412
Pedunde length	0.268	0.455	-0.051
Flag leaf area	0.241	-0.041	0.049

*, ** , Significant at 5% and 1% probability levels respectively

are presented in Table 20. Biological yield was the only trait significantly associated with grain yield at this location (r=0.510*). Genotype HNXST. 7 produced more biological yield and also more grain yield whereas genotypes HNXST. 9 and 1 produced less biological yield and so grain yield. Genotype HNXST. 3 ranked the lowest in biological yield and ranked intermediate in grain yield. This may be due to contribution of other yield components such as 1000-kernel weight.

Biological yield:

The coeffecient of correlation between biological yield and other traits studied at Ramtha location are presented in Table 21 Biological yield showed a positive correlations with straw yield (r=0.820) and with awn length (r=0.506*). At Mushaquar biological yield showed a positive and highly significant correlation with straw yield (r= 0.903) . This is expected because straw yield is a portion of biological yield . Also a positive but not significant correlation with plant height was found (r=0.457) and heading date negatively correlated with other trails studied. However at Jubeiha weak correlations were shown between biological yield and other traits studied except with straw yield (r=0.91) .(Table 21)

Straw yield:

The coeffecient of correlation between straw yield and other traits studied at Ramtha are presented in Table 22. Straw yield was significantly correlated with biological yield with r=0.82 ** and with grain yield r=0.49*.This is due to contribution of straw yield in total dry matter production. At Jubeiha straw yield was significantly correlated only with biological yield (r=0.910**). The other traits

Table (21) Correlation coefficient (r) between biological yield and other agronamic characters of 16 wheat genotypes grown at Ramtha, Jubeiha and Mushaquar locations in 1988/1989 growing season.

Characters / Location	Ramtha	Jubeiha	Mushaquar
Straw yield	0.820**	0.910**	0.903**
Fertile tillers	0.312	0.196	0.129
1000-Kernel-wt	0.304	-0.107	-0.247
Plant height	0.079	0.238	0.457
Heading date	0.175	-0.07	0.242
Spike length	-0.076	0.157	-0.330
Spikelets spike	0.264	0.204	-0.055
Kernels/spikelet	0.341	0.027	-0.103
Awn length	0.506*	0.178	0.134
Pedunde length	0.034	0.178	0.134
Flag leaf area	0.356	0.229	0.654**

*, ** , Significant at 5% and 1% probability levels respectively

Table (22) Correlation coefficient (r) between straw yield and other agronamic characters of 16 wheat genotypes grown at Ramtha, Jubeiha and Mushaquar locations in 1988/1989 growing season.

Characters / Location	Ramtha	Jubeiha	Mushaquar
Fertile tillers	0.370	-0.015	-0.020
1000-Kernel-wt	-0.043	0.175	-0.300
Plant height	0.334	-0.09	0.510*
Heading date	-0.103	-0.179	0.068
Spike length	0.244	0.208	-0.093
Spikelets spike	0.284	0.171	-0.027
Kernels/spikelet	0.224	0.296	-0.160
Awn length	0.330	0.136	-0.07
Pedunde length	0.043	0.003	0.216
Flag leaf area	0.423	0.270	-0.206

*, ** , Significant at 5% and 1% probability levels respectively

showed weak correlations with straw yield.(Table 22.)

Straw yield significantly correlated with biological yield and plant height with r=0.903 and 0.51 respectively at Mushaquar location(Table 22.)

Kernel weight:

The coeffecient of correlation between kernel weight and other traits at Ramtha are presented in Table 23. Weak correlations were obtained with kernel weight. Whereas at Jubieha, a strong correlation was found between Kernel weight and flag leaf blade area (r=0.747**) and was followed by spikelets per spike (r=549*) and Kernels per spikelet (r=0.501*). (Table 23) Importance of flag leaf in contribution for kernel weight is will known, since more flag leaf area contribute to more assimilates for kernels growth and development which will increase kernel weight.

However, flag leaf blade area showed positive but not significant correlation with kernel weight (r=0.454) at Mushaquar location. (Table 23.)

Fertile tillers:

The cooeffecient of correlation between fertile tillers and other traits studied at Ramtha location are presented in Table 24. Awn length and heading date showed highly significant correlation with fertile tillers capacity (r=0.766** and 0.764**) respectively . Confiriming the important of awns under dry conditions .

Whereas, weak correlations were obtained between fertile tillers and other traits at Mushaquar. (Table 24).However kernel weight and plant height gave positively association with fertile tillers but without significantly mannar at Jubeiha location (Table 24.)

Table (23) Correlation coefficient (r) between 1000-kernel weight and other agronamic characters of 16 wheat genotypes grown at Ramtha, Jubeiha and Mushaquar locations in 1988/1989 growing season.

Characters / Location	Ramtha	Jubeiha	Mushaquar
Plant height	-0.069	-0.076	-0.360
Heading date	0.076	-0.205	-0.214
Spike length	0.146	0.039	0.195
Spikelets spike	-0.013	0.546*	0.060
Kernels/spikelet	-0.196	0.501*	0.209
Awn length	-0.024	0.102	-0.224
Pedunde length	0.201	-0.463	-0.236
Flag leaf area	-0.094	0.747**	0.454

*, ** , Significant at 5% and 1% probability levels respectively

Table (24) Correlation coefficient (r) between fertile tillers and other agronamic characters of 16 wheat genotypes grown at Ramtha, Jubeiha and Mushaquar locations in 1988/1989 growing season.

Characters / Location	Ramtha	Jubeiha	Mushaquar
1000-Kernel-wt	0.077	-0.412	-0.097
Plant heisht	0.159	0.346	0.003
Heading date	0.764**	0.206	0.101
Spike length	0.217	-0.017	-0.197
Spikelets spike	0.225	-0.192	0.075
Kernels/spikelet	0.311	-0.095	-0.033
Awn length	0.766**	-0.256	0.195
Pedunde length	0.383	0.269	-0.167
Flag leaf area	0.319	0.418	0.176

Plant height:

The correlations between plant height and other traits studied at Ramtha are presented in Table 25. The heighest r value was obtained with kernels per spikelet (r=0.684**) and was followed by spike length (r=0.480). At Jubeiha, peduncle length showed a positive correlation with plant height (r=0.469) (Table 25)

Kernels per spikelet and flag leaf area negatively associated with plant hight at Mushaquar (Table 25.) Peduncle length showed a positive and significant correlation (r=0.507*) with plant height this is due to the contribution of peduncle length in the total plant height.

Heading date:

A highly significant correlation was found between heading date and awn length at Ramtha (Table 26) However negative correlations were obtained between heading date and spikelets/spike and kernels per spikelet at Mushaquar and Jubeiha (Table 26.) Confirming the importance of developing early heading cultivars for dry land conditions .

Spike length

The correlation between spike length and other traits studied at Ramtha are presented in Table 27. A weak correlation were observed between spike length and other traits except kernels per spikelet (r = 0.49*). Awn lenght negatively correlated with Spike length at Mushaqar and Jubeiha locations . A weak correlation was found between spike length and other traits studied at Jubeiha and Mushaquar locations. (Table 27.)

Table (25) Correlation coefficient (r) between plant height and other agronamic characters of 16 wheat genotypes grown at Ramtha, Jubeiha and Mushaquar locations in 1988/1989 growing season.

Characters / Location	Ramtha	Jubeiha	Mushaquar
Heading date	0.246	-0.066	0.340
Spike length	0.480	-0.019	-0.053
Spikelets spike	0.314	-0.250	-0.461
Kernels/spikelet	0.684**	-0.192	-0.668**
Awn length	0.090	-0.174	-0.482
Pedunde length	0.106	0.498*	0.507*
Flag leaf area	0.063	-0.124	-0.708**

*, ** , Significant at 5% and 1% probability levels respectively

Table (26) Correlation coefficient (r) between heading date and other agronamic characters of 16 wheat genotypes grown at Ramtha, Jubeiha and Mushaquar locations in 1988/1989 growing season.

Characters / Location	Ramtha	Jubeiha	Mushaquar
Spike length	0.300	0.154	-0.285
Spikelets/ spike	0.015	-0.527*	-0.567*
Kernels/spikelet	0.363	-0.638**	-0.599**
Awn length	0.750**	-0.403	-0.187
Pedunde length	0.369	0.075	-0.321
Flag leaf area	0.248	-0.040	-0.187

*, ** , Significant at 5% and 1% probability levels respectively

Table (27) Correlation coefficient (r) between spike length and other agronamic characters of 16 wheat genotypes grown at Ramtha, Jubeiha and Mushaquar locations in 1988/1989 growing season.

Characters / Location	Ramtha	Jubeiha	Mushaquar
Spikelets/ spike	0.429	0.055	0.322
Kernels/spikelet	0.490*	0.058	0.073
Awn length	0.247	-0.744**	-0.492*
Pedunde length	-0.123	-0.335	-0.411
Flag leaf area	-0.016	0.211	0.191

*, ** , Significant at 5% and 1% probability levels respectively

Table (28) Correlation coefficient (r) between spikelets per spike and other agronamic characters of 16 wheat genotypes grown at Ramtha, Jubeiha and Mushaquar locations in 1988/1989 growing season.

Characters / Location	Ramtha	Jubeiha	Mushaquar
Kernels/spikelet	0.596*	0.723**	0.322
Awn length	0.412	0.459	0.165
Pedunde length	0.179	-0.357	-0.319
Flag leaf area	0.273	0.371	0.070

*, ** , Significant at 5% and 1% probability levels respectively

Spikelets/spike

The correlations between spikelets per spike and other traits studied at Ramtha are presented in Table 28. A positive and significant correlation was found between spikelets per spike and kernels per spikelet (r= 0.596*) and was followed by awn length but not significantly correlated (r= 0.412). At Jubieha kerenls per spikelets also correlated significantly and in positive mannar with spikelets per spike with (r=0.723**), awn length correlated with spikelets per spike but without significantly mannar (r=0.459). (Table 28.) However weak correlations were observed between this character and other traits studied at Mushaquar location. (Table 28)

Kernels per spikelet:

The coeffecient of correlation between Kernels per spikelet and other traits studied at Ramtha are presented in Table 29. Awn length only trait correlated with kernels per spikelet positively and significantly with (r = 0.531*). At Jubieha weak correlations were found between kernels per spikelets and other traits.(Table 29). However awn length significantly correlated with Kernels per spikelets with (r=0.564*). At Mushaquar location(Table 29). The correlation between Kernels per spikelet and awn length significantly correlated at two locations this support the importance of awns for contribution of assimilates to kernels.

Awn length and Peduncle length:

The correlation between awn length and with peduncle length and flag leaf area are presented in Table 30. At three locations, a weak correlations were observed.

The correlation between peduncle length and flag leaf blade area showed a weak correlation at all locations.(Table 30.)

Table (29) Correlation coefficient (r) between kernels per spikelets and awn length, peduncle length and flag area of 16 wheat genotypes grown at Ramtha, Jubeiha and Mushaquar locations in 1988/1989 growing season.

Characters / Location	Ramtha	Jubeiha	Mushaquar
Awn length	0.531*	0.304	0.564*
Peduncle length	0.173	-0.399	-0.281
Flag leaf area	0.048	0.298	0.393

*, ** , Significant at 5% and 1% probability levels respectively

Table (30) Correlation coefficient (r) between awn length, peduncle length and flag leaf area 16 wheat genotypes grown at Ramtha, Jubeiha and Mushaquar locations in 1988/1989 growing season.

Location	Ramtha			Jubeiha			Mushaquar		
character	Awn length	Peduncle length	Flag leaf area	Awn length	Peduncle length	Flag leaf area	Awn length	Peduncle length	Flag leaf area
Awn length	1.000	0.320	0.394	1.000	0.076	0.004	1.000	-0.030	0.225
Peduncle length		1.000	0.127		1.000	-0.400		1.000	-0.479
Flag leaf area			1.000			1.000			1.000

Seedling Characters;

Seminal roots number

Statistical analysis for seminal roots number are presented in Table 31. Petra ranked the first with mean value (5.17) without significant difference from Hourani with mean value (4.89) whereas genotype HNXSt. 12 ranked the lowest. Hourani significantly differ from stork in porducing seminal roots number.

Average root length:

Genotype HNXSt. 12 produced longer seminal roots which was ranked the first. This is may be due to less simenal roots number which was ranking the last whereas Jubeiha genotype ranked the lowest. Stork has longer seminal roots than Hourani although the difference between them was not significant. (Table 31).

Total roots length:

Petra significantly differ from other genotypes which ranked the first among other genotypes. This is may be due to production of more simenal roots number, whereas Jubeiha genotype ranked the last whic was produced shorter seminal roots compared to other genotypes. The total roots length for Hourani is more than stork even though the difference between them was not significant (Table 31).

Coleoptile length:

Hourani produced longer coleoptile compared with other genotypes with mean value = 6.15 cm. genotypes HNXSt. 7 and 1were followed Hourani and they did not differ significanlty from them with the mean values 5.97 and 5.77 cm, respictively. Golan genotype ranked the lowest. Hourani produced longer coleoptile than stork and the difference between them was significant. This is could be reason for the adaptability of Hourani to dry land conditions.

Table (31). Mean values of seminal roots number, average roots length, total roots length and coleoptile length for 20 wheat genotypes tested in the laboratory, 1989/1990.

Genotype	Seminal roots number	average root length (cm)	total roots length (cm)	coleoptile length (cm)
Stork	3.85	5.62	21.63	3.81
Hourani	4.89	5.03	24.59	6.15
HNXST. 1	4.00	7.33	29.32	5.77
HNXST. 2	3.67	5.94	21.79	3.58
HNXST. 3	4.17	6.29	26.23	3.65
HNXST. 4	4.17	5.06	21.10	3.75
HNXST . 5	4.50	6.53	29.38	4.53
HNXST. 6	4.67	6.29	29.37	4.70
HNXST. 7	3.67	7.68	24.84	5.97
HNXST. 8	3.67	6.77	24.84	4.20
HNXST. 9	3.67	5.70	20.92	3.90
HNXST. 10	4.17	5.14	21.43	3.57
HNXST. 11	3.67	5.98	21.94	3.55
HNXST. 12	3.17	7.79	24.70	3.50
HNXST. 13	4.17	5.94	24.76	3.92
Jubeiha	3.67	4.20	15.41	4.88
Maru	4.67	6.04	28.20	4.10
Golan	4.17	4.68	19.51	3.17
om-Rabi-14	4.83	4.63	22.36	4.28
Petra	5.17	7.16	37.01	4.58
Mean	4.12	5.99	24.46	4.27
$L.S.D._{0.05}$	0.86	1.69	6.14	0.52

EXPERIMENT II

Biological Yield:

Data on biological yield of the two treatments and the different genotypes are presented in Table 32. Average biological yield for T1 was 36.1 g as compared to 29.7 g, the average biological yield for T2. The difference between the two treatments was significant. This trend of results in agreement with the results obtained by Frank et al. 1977; Fischer and Maurer, 1968; and Duwayri, 1984 who reported higher biological yields at more favorable conditions.

The highest biological yield (48.1 g) at T1 was obtained by Golan whereas the highest for T2 (42.1 g) was for Om-Rabi-14. The highest mean for both treatment (42.1 g) was for Om-Rabi-14. Hourani was among the genotypes giving the highest values at both treatments and only one of HN X ST progenies studied gave higher values than Hourani for this character.

The interactions between the irrigation treatments and genotypes studied were significant only for biological yield, straw yield, plant height, flag leaf area and heading date.

Grain Yield:

The results of the grain yield in the Table 32 showed that there were no significant difference between irrigation treatments. However there were significant differences among genotypes studied.

The mean values 6.8 and 6.4 g/pot were obtained for two irrigation treatments T1 and T2, respectively (Table 32), though this difference was not significant. The genotypes Petra, Golan, Jubeiha and HN X ST,6 produced the highest grain yield over the two treatments and were higher than Hourani by almost 100%. The high biological and grain yield of HN X ST 6 is of importance since it was stable over the two treatments.

Straw Yield:

Significant difference between the two treatments for straw yield was found. The means were 29.2 and 22.3 g/pot for T1 and T2, respectively (LSD 0.05=6.71 g/pot) which agreed with Singh et al. 1971, and Duwayri; 1984 where straw yield was associated with more moisture available to plants during growing season.

Mean values of straw yield at the two treatments for all genotypes are presented in Table 32. At T1, Om-Rabi-14 ranked the first while Stork ranked the last. Om-Rabi-14 also ranked the first at T2 while Jubeiha ranked the last. The high ranking of Om-Rabi-14 is due to the low grain yield which resulted from the late heading.

Harvest Index:

The harvest index for the field capacity treatment (T1) was 0.18 as compared to 0.24 for the 1/3 available water treatment (T2). The harvest index is higher at the less favorable moisture conditions. The highest value at T1 was 0.28 for both Petra and Stork. At T2, the highest value (0.39) was for HN X ST 11, HN X ST 3, HN X ST 6, HN X ST 10. Golan and Petra gave higher harvest index at this treatment (Table 32).

Number of Spikes per pot:

Significant difference between the two treatments in spikes per pot was

Table (32). Mean values of Biological yield (g/pot) grain yield (g/pot), straw yield (g/pot), and harvest index of 20 wheat genotypes grown at two irrigation treatments (T1,T2)*, under glass house condition in 1989/1990.

Genotype	Biological yield g/pot			Grain yield g/pot			Straw yield g/pot			Harvest index		
	T1	T2	Mean	T1	T2	Mean	T1	T2	Mean	T1	T2	Mean
Stork	22.4	24.2	23.3	6.1	5.3	5.7	16.3	18.9	17.6	0.28	0.22	0.25
Hourani	45.3	32.8	39.1	4.3	7.1	5.7	40.0	25.7	32.8	0.10	0.21	0.15
HNXST. 1	41.1	29.4	35.3	3.8	3.4	3.6	37.3	26.0	31.6	0.10	0.11	0.10
HNXST. 2	31.9	28.9	30.4	7.4	7.4	7.4	24.5	21.5	23.0	0.23	0.25	0.24
HNXST. 3	33.1	25.0	29.0	8.8	8.8	8.8	24.3	16.2	20.2	0.26	0.35	0.30
HNXST. 4	28.1	29.7	28.9	6.2	6.2	6.2	21.9	23.5	22.7	0.22	0.20	0.21
HNXST. 5	28.3	31.3	29.8	4.3	4.3	4.3	24.0	27.0	25.5	0.15	0.14	0.14
HNXST. 6	46.1	34.6	40.3	10.8	11.3	11.1	35.3	23.3	29.3	0.23	0.33	0.28
HNXST. 7	33.9	37.8	35.9	4.5	2.5	3.5	29.4	35.3	32.4	0.13	0.06	0.10
HNXST. 8	37.8	28.1	33.0	6.4	5.6	6.0	31.4	22.5	26.9	0.17	0.2	0.18
HNXST. 9	41.0	30.0	35.5	3.4	5.0	4.2	37.6	25.0	31.3	0.08	0.11	0.10
HNXST. 10	30.7	22.2	26.4	8.2	8.2	8.2	22.5	14.0	18.2	0.27	0.37	0.32
HNXST. 11	33.6	23.9	28.7	9.3	9.3	9.3	24.3	14.6	19.4	0.27	0.39	0.33
HNXST. 12	27.4	27.2	27.3	3.9	3.9	3.9	23.5	23.3	23.4	0.14	0.14	0.14
HNXST. 13	28.3	29.7	29.0	5.5	5.5	5.5	22.8	24.2	23.5	0.19	0.18	0.18
Jubeiha	45.8	24.1	35.0	12.1	12.1	12.1	33.7	12.0	22.8	0.26	0.5	0.38
Maru	35.9	29.4	32.6	8.1	8.1	8.1	27.8	21.3	24.6	0.22	0.27	0.24
Golan	48.1	31.4	39.8	11.0	11.0	11.0	37.1	20.4	28.7	0.22	0.35	0.28
Om-Rabi-14	41.6	42.6	42.1	0.2	0.2	0.2	41.4	42.4	41.9	0.004	0.005	0.004
Petra	42.1	32.5	37.3	12.0	12.0	12.0	30.1	20.5	25.3	0.28	0.37	0.32
Mean	36.1	29.7	32.9	6.8	6.4	6.8	29.3	22.9	26.1	0.18	0.24	0.21

Character	LSD 0.05 for irrigation treatments means	LSD 0.05 for wheat genotypes means	LSD 0.05 for interaction
Biological yield	6.0	7.0	9.9
Grain yield	NS	3.6	NS
Straw yield	6.7	7.2	10.2
Harvest index	0.05	0.12	NS

T_1 = Field capacity treatment, T_2=1/3 available water treatment

found. Treatments means were 7.1 and 5.6 spikes per pot (LSD 0.05 = 1.31). Mean values of number of spikes per pot are presented in Table 33.

At T1, Jubeiha ranked the first whereas genotype HN X ST 1 ranked the last. No significant difference between Hourani and Stork in spikes per pot was found. At T2, Jubeiha also ranked the first while Hourani and Om-Rabi-14 ranked the last without significant difference from Stork (Table 33).

Spike length:

The results of spike length showed no significant difference between the two treatments was found. Mean values of spike length are presented in Table 33. At T1, Golan and Jubeiha genotypes produced longer spikes while genotypes HN X ST 12 and 2 were among the last. At T2, Jubeiha, HN X ST 13 and Golan genotypes produced longer spikes whereas genotypes HN X ST 3 produced short ones. No significant differences between Hourani and Stork in spike length was found at the two treatments.

Spikelets per spike:

The mean values for the treatments T1 and T2 were 15.2 and 14.2, respectively. Though no significant difference between the two treatments was found (Table 33). At T1, genotypes Golan and HN X ST 7 produced more spikelets per spike whereas genotype HN X ST 10 produced this number of spikelets per spike. At T2, genotype Golan ranked the first while HN X ST 3 ranked the last. No significant difference between Hourani and Stork at the two treatments for spikelets per spike was found. The high values of spikelets per spike for bread wheat genotypes could be due to production longer spikes compared with durum genotypes.

Number of Kernels per pot:

Water treatments did not result in significant differeces for number of kernels per pot. At T1, Golan ranked the first in kernels per pot while Om-Rabi-14 ranked the last (Table 33). Stork produced more kernels than Hourani eventhough no significant difference between them. At T2, Golan also ranked the first and Om-Rabi -14 ranked the last. The ranking of Om-Rabi-14 in the last at the two treatments is due to late heading of Om-Rabi-14 compared with other genotypes which was resulted in exposed late heading genotypes to high temperature in the green house lead to fail of spikes to produced fertile spikelets.

Plant Height:

Statistical analysis for plant height showed no significant difference between the two treatments was found. The mean values for genotypes studied are presented in Table 34. HN X ST 7 genotype is taller than any of its parents at both treatments. HN X ST 3 is shorter than any parents at both treatments. At T1 Hourani significantly differed from Stork in plant height. At T2, also genotype HN X ST 7 was the tallest whereas genotypes HN X ST 3 and 2 where the shortest. Hourani differed significantly from Stork in plant height also.

Peduncle length:

Significant difference between the two treatments means was found where the values were 14.2 and 12.6 cm for the T1 and T2, respectively ($L.S.D_{0.05}$ =0.87 cm). Mean values for genotypes are presented in Table 34. At (T1), Jubeiha produced longer peduncle while genotype HN X ST. 3 produced short peduncles. Stork gave

Table (33). Mean values number of Spikes/pot, spike length (cm), spikelets/spike, Kernels/pot. for 20 wheat genotypes at two irrigation treatments (T1,T2)*, grown under glass house condition in 1989/1990.

Genotype	Spike/pot			Spike length (cm)			Spikelets/spike			number of Kernels /pot		
	T1	T2	Mean	T1	T2	Mean	T1	T2	Mean	T1	T2	Mean
Stork	5	4	4.5	6.0	5.2	5.6	16.1	13.2	14.6	157	135	146
Hourani	5	3	4.0	6.0	5.9	6.0	15.7	16.5	16.1	81	169	125
HNXST. 1	4	4	4.0	6.0	5.0	5.5	17.1	14.0	15.6	89	83	86
HNXST. 2	8	6	7.0	5.0	5.2	5.1	13.7	12.0	12.8	192	192	192
HNXST. 3	9	6	7.5	5.2	4.9	5.0	13.7	11.8	12.7	220	220	220
HNXST. 4	7	7	7.0	5.2	5.6	5.4	13.9	14.6	14.2	161	160	161
HNXST . 5	4	6	5.0	5.6	5.7	5.6	15.4	14.7	15.0	114	114	114
HNXST. 6	9	7	8.0	5.3	5.4	5.4	15.9	14.0	14.9	244	261	253
HNXST. 7	5	4	4.5	6.8	5.6	6.2	18.1	13.2	15.6	124	78	101
HNXST. 8	7	5	6.0	6.4	6.3	6.4	16.7	16.3	16.5	153	138	146
HNXST. 9	6	5	5.5	5.7	6.5	6.1	16.6	16.1	16.3	94	141	118
HNXST. 10	9	5	7.0	5.5	5.7	5.6	12.4	14.5	13.4	208	208	208
HNXST. 11	9	5	7.0	5.5	5.7	5.6	13.6	13.0	13.3	241	241	241
HNXST. 12	6	6	6.0	4.9	5.8	5.4	13.7	14.5	14.1	108	108	108
HNXST. 13	6	6	6.0	5.8	8.7	7.3	13.1	12.6	12.8	141	141	141
Jubeiha	12	8	10.0	8.8	8.9	8.9	15.1	13.4	14.2	27.4	274	274
Maru	7	7	7.0	6.1	6.2	6.2	15.8	14.4	15.1	213	213	213
Golan	9	6	7.5	9.3	8.3	8.8	18.3	17.5	17.9	367	367	367
om-Rabi-14	4	3	3.5	5.3	5.4	5.4	13.2	13.4	13.3	4	5	5
Petra	9	6	7.5	5.9	6.0	6.0	16.2	15.6	15.9	298	298	298
Mean	7.1	5.6	6.3	6.0	6.1	6.0	15.2	14.2	14.7	174	177	175

Character	LSD 0.05 for irrigation treatments means	LSD 0.05 for wheat genotypes means	LSD 0.05 for interaction
Number of spikes/pot	1.3	2.7	NS
Spike length	NS	1.1	NS
Spikelets/spike	NS	2.3	NS
Number of kernels/pot	NS	86.6	NS

T_1 = Field capacity treatment, T_2=1/3 available water treatment

longer peduncle than Hourani although the difference between them was not significant. At (T2), Golan ranked the first in peduncle whereas genotype HNXST. 7 ranked the last, also Stork had longer peduncle than Hourani even though the difference between them was not significant.

Awn length:

Statistical analysis for awn length showed no significant difference between the two treatments was found. Mean values of awn length at two treatments are presented in Table 34. Maru produced longer awns while Golan produced short awns copmared with other genotypes at the two treatments, Golan and Jubeiha are bread wheat genotypes and have shorter awns. No significant difference between Hourani and Stork at both treatments in awn length was found.

Flag leaf blade area :

The difference between the two treatment was not significant for the flag leaf area with treatments mean 27.7 and 24.67 cm^2 (L.S. $D_{0.05} = 4.3$ cm^2). Mwan values for flag leaf area are presented in Table 34.

At (T1), genotype om-Rabi-14 ranked the first in flag leaf area whereas HNXST. 12 ranked the last. Hourani significantly differed from Stork at this treatment. At (T2), genotype Golan ranked the first while genotypes HNXST. 2, Maru , HNXST. 3 and 4 were in the lower order. No significant difference between Hourani and Stork in flag leaf area at T2 was found.

Table (34). Mean values of Plant height (cm), Peduncle length (cm), Awn length (cm) and Flag leaf blade area (cm^2) for 20 wheat genotypes grown at two irrigation treatments (T1,T2)*, grown under glass house condition in 1989/1990.

Genotype	Plant height (cm)			Peduncle length (cm)			Awn length (cm)			Flag leaf area $(cm)^2$		
	T1	T2	Mean	T1	T2	Mean	T1	T2	Mean	T1	T2	Mean
Stork	61.0	61.0	61.0	13.0	15	14.0	10.1	9.9	10.0	23.4	22.7	23.0
Hourani	87.0	85.0	86.0	12.0	13.0	12.5	10.5	10.0	10.2	32.0	23.0	27.5
HNXST. 1	104.0	79.0	91.5	17.0	8.0	12.5	11.1	11.0	11.0	31.5	26.3	28.9
HNXST. 2	49.0	53.0	51.0	13.0	11.0	12.0	10.4	9.5	10.0	20.2	20.4	20.3
HNXST. 3	49.0	50.0	50.0	11.0	14.0	12.5	10.5	10.1	10.3	23.1	20.5	21.8
HNXST. 4	53.0	61.0	57.0	12.0	11.8	11.9	9.8	10.9	10.4	25.5	20.9	23.2
HNXST. 5	58.0	59.0	590	13.0	12.0	12.5	8.7	10.4	9.6	27.3	23.8	25.6
HNXST. 6	66.0	56.0	61.0	12.0	11.0	11.5	9.5	10.4	10.0	29.3	22.3	25.8
HNXST. 7	107.0	103.0	105.0	17.0	7.0	12.0	11.4	11.1	11.2	27.7	27.7	27.5
HNXST. 8	58.0	59.0	59.0	13.0	11.0	12.0	10.5	10.7	10.6	35.7	23.2	29.5
HNXST. 9	60.0	56.0	58.0	13.0	11.0	12.0	10.4	8.9	9.6	31.2	22.3	26.7
HNXST. 10	60.0	64.0	62.0	18.0	15.0	16.5	9.8	9.4	9.6	19.8	23.9	21.8
HNXST. 11	61.0	57.0	59.0	17.0	17.0	17.0	9.9	9.1	9.5	21.5	21.7	21.6
HNXST. 12	53.0	59.0	56.0	14.0	14.0	14.0	9.7	9.4	9.5	16.5	27.2	21.8
HNXST. 13	54.0	59.0	56.5	15.0	13.0	14.0	11.4	9.6	10.5	22.5	27.7	25.1
Jubeiha	75.0	76.0	76.0	21.0	16.0	18.5	6.8	7.7	7.2	36.7	31.3	34.0
Maru	65.0	60.0	63.0	12.0	13.0	12.5	12.1	11.8	12.0	28.3	20.5	24.4
Golan	84.0	77.0	80.5	18.0	18.0	18.0	6.4	6.7	6.5	37.2	35.9	36.6
om-Rabi-14	67.0	60.0	63.5	11.0	9.0	10.0	10.3	10.0	10.1	39.5	29.8	34.6
Petra	62.0	63.0	63.0	12.0	14.0	13.0	11.7	10.1	10.9	24.8	24.5	24.6
Mean	66.7	64.9	65.8	14.2	12.6	13.4	10.1	9.8	9.9	27.7	24.7	26.2

Character	LSD 0.05 for irrigation treatments means	LSD 0.05 for wheat genotypes means	LSD 0.05 for interaction
Plant height	NS	7.4	10.5
Peduncle length	0.8	3.8	NS
Awn length	NS	1.4	NS
Flag leaf area	NS	5.4	7.7

T_1 = Field capacity treatment, T_2=1/3 available water treatment

Heading date:

Significant difference between the means of the two treatments for heading date was found, where reduction of irrigation water resulted in earliess of two days as compared with the field capacity treatment ($L.S.D_{0.05}$ = 0.73) . The mean values of heading date for the genotypes studied are presented in Table 35.

At (T1), HNXSt. 4 and 11 genotypes were the earliest (52 days), while Om-Rabi-14 was the latest (113 days). Stork headed earlier than Hourani with difference being significant. At (T2), genotypes HNXST. 10 was the earliest while Om-Rabi-14 was the latest Stork also headed earlier than Hourani although the difference between them was not significant.

Maturity date:

Statistical analysis showed significant difference between the two treatments for maturity date was found with treatments mean 110.0 and 105.4 days for (T1) and (T2), respectively ($L.S\ D_{0.05}$=3.9 days). Mean values of maturity dates for the genotypes studied are presented in Table 35. At (T1), genotypes HNXST.4 and 10 matured earlier than other genotypes where as Om-Rabi-14 was the latest maturity genotype. At (T2) , genotypes HNXST. 10 and 11 were the earliest while Om-Rabi-14 was the latest genotype. Significant difference between Hourani and Stork for maturity date was found at both treatments. Stork matured about 47 and 25 days earlier than Hourani at T1, and T2, respectively.

Roots weight:

The mean values of roots weight for T1 and T2 are 7.6 and 6.5 g, for the two

Table (35). Mean values of heading date and maturity date (days) for 20 wheat genotypes grown at two irrigation treatments (T1,T2)* under glass house conditions in 1989/1990.

Genotype	Heading date (days) T1	T2	Mean	Maturity date (days) T1	T2	Mean
Stork (P1)	61	56	59	97	92	95
Hourani	101	72	87	144	117	131
HNXST. 1	88	101	95	116	140	128
HNXST. 2	62	55	59	97	91	94
HNXST. 3	54	55	55	94	89	92
HNXST. 4	52	52	52	88	89	89
HNXST. 5	60	60	60	100	101	101
HNXST. 6	93	69	81	128	120	124
HNXST. 7	76	92	84	115	130	123
HNXST. 8	92	90	91	135	126	131
HNXST. 9	71	72	72	115	108	112
HNXST. 10	55	51	53	92	88	90
HNXST. 11	52	54	53	101	88	95
HNXST. 12	62	52	57	103	89	96
HNXST. 13	53	52	53	102	89	96
Jubeiha	59	58	59	105	97	101
Maru	64	57	61	106	97	102
Golan	61	66	64	105	94	100
om-Rabi-14	113	113	113	165	165	165
Petra	59	59	59	96	95	96
Mean	69.0	67.0	68.0	110	105	108

Character	LSD 0.05 for irrigation treatments means	LSD 0.05 for wheat genotypes means	LSD 0.05 for interaction
Heading date	0.7	7.7	10.9
Maturity date	3.9	12.9	NS

Target, T_1 = Field capacity treatment, T_2=1/3 available water treatment treatments, respectively. However the difference between these two means was not significant (LSD 0.05= 3.3 g/pot).

Hourani with a mean values of 19.6 and 13.8 g/pot at T1 and T2, respectively was the highest in root weight (Table 36). This could be an important factor for Hourani adaptation to rainfed conditions and should be utilized as a source of root weight and length in breeding programs.

At (T1), HNXST 7 genotype gave 13.1 g/pot and was second to Hourani. However, Om-Rabi-14 was second to Hourani at T2 and was followed by HNXST 7 genotype. Furthermore, Stork was inferior to Hourani in this respect and four of the 13 HNXST progenies were inferior to Stork in this trait.

Water use effeciency :

Significant difference between the two treatments was found where treatment means were 3.45 and 4.58 g dry matter/kg water for (T1) and (T2), respectively ($L.S.D_{0.05}$ =0.34). These findings agreed with Mehrota et al (1976) and Singh et al (1979a) where water use effeciency decreased by increasing number of irrigations and water availability. Mean values of water use effeciency for the genotypes are presented in Table 37.

At (T1) genotype HNXST. 13 significantly differed from all genotypes tested while Om-Rabi-14 ranked the last, this may be due to late heading and maturity of Om-Rabi-14 which consumed more water during growing season compared with total dry mater produced per uint of water transpired and also a negative correlation was found between water use effeciency and maturity date. There was no significant difference between Hourani and Stork for water use effeciency was

Table (36). Mean values of weight of roots of 20 wheat genotypes grown at the two irrigation treatments (T1, T2) under glass house condition in 1989/1990.

Genotype	Roots weight g/pot T1	T2	Mean
Stork	6.3	3.8	5.1
Hourani	19.6	13.8	16.7
HNXST. 1	10.8	5.1	8.0
HNXST. 2	4.2	6.3	5.3
HNXST. 3	4.9	4.4	4.7
HNXST. 4	4.9	4.5	4.7
HNXST. 5	4.8	6.3	5.6
HNXST. 6	9.5	6.3	7.9
HNXST. 7	13.1	8.4	10.8
HNXST. 8	7.7	4.4	6.1
HNXST. 9	8.3	5.0	6.7
HNXST. 10	5.5	3.7	4.6
HNXST. 11	4.2	4.6	4.4
HNXST. 12	5.0	5.4	5.2
HNXST. 13	5.3	6.5	5.9
Jubeiha	10.2	7.6	8.9
Maru	7.1	7.0	7.1
Golan	7.1	6.8	7.0
Om-Rabi-14	6.5	12.6	9.6
Petra	6.5	6.6	6.6
Mean	7.6	6.5	7.1

LSD 0.05 for irrigation treatments means	LSD0.05 for wheat genotypes means	LSD0.05 for interaction
NS	3.1	NS

T_1= Field capacity treatment, T_2=1/3 available water treatment

Table (37). Mean values of biological yield g/pot, total water transpired kg/pot, and water use effeciency for 20 wheat genotypes at two irrigation treatments (T1,T2) grown under glass house condition in 1989/1990.

Plant height (cm) Genotype	Biological yield (g/pot) T1	T2	Mean	Total water transpired (kg/pot) T1	T2	Mean	Water use effeciency** (WUE) T1	T2	Mean
Stork	22.4	24.2	23.3	8.72	4.43	6.57	2.6	5.5	4.1
Hourani	45.3	32.8	39.0	20.37	9.75	15.06	2.2	3.7	3.0
HNXST. 1	41.1	29.4	35.3	14.43	7.15	10.79	2.8	4.1	3.5
HNXST. 2	31.9	28.9	30.4	9.38	4.97	7.17	3.4	5.8	4.6
HNXST. 3	33.1	25.0	29.0	8.58	5.00	6.79	3.9	5.0	4.5
HNXST. 4	28.1	29.7	28.9	7.80	6.42	6.81	3.9	4.6	4.3
HNXST . 5	28.3	31.3	29.8	10.11	8.36	9.23	2.8	3.7	3.3
HNXST. 6	46.1	34.6	40.4	13.90	7.57	10.73	3.3	4.6	4.0
HNXST. 7	33.9	37.8	35.9	8.46	10.93	9.69	4.0	3.5	3.8
HNXST. 8	37.8	28.1	33.0	12.93	5.08	9.00	2.9	5.5	4.2
HNXST. 9	41.0	30.0	35.5	12.75	7.00	9.87	3.2	4.3	3.8
HNXST. 10	30.6	22.2	26.4	7.55	4.25	5.90	4.4	5.2	4.7
HNXST. 11	33.6	23.9	28.7	9.88	5.46	7.67	3.4	4.4	3.9
HNXST. 12	27.4	27.2	27.3	9.21	5.43	7.32	3.0	5.0	4.0
HNXST. 13	28.3	29.7	29.0	5.39	6.73	6.06	5.2	4.4	4.8
Jubeiha	45.8	24.1	35.0	12.78	8.81	10.79	3.6	2.7	3.2
Sham 1	35.9	29.4	32.7	10.37	7.49	8.93	3.5	3.9	3.7
Golan	48.1	31.4	39.8	13.07	7.12	10.09	3.7	4.4	4.1
om-Rabi-14	41.6	42.6	42.1	19.31	17.39	18.53	2.2	2.4	2.3
Korfila	42.1	32.5	37.3	11.46	7.51	9.48	3.7	4.3	4.0
Mean	36.12	29.74	32.93	11.29	7.34	9.31	3.37	4.35	3.86

Character	LSD 0.05 for irrigation treatments means	LSD 0.05 for wheat genotypes means	LSD 0.05 for interaction
Biological yield	6.0	7.0	9.0
Total water transpired	2.9	3.1	4.4
Water use efficency	0.34	1.4	NS

Target,* T_1 = Field capacity treatment, T_2=1/3 available water treatment

**, WVE = biological yield/total water transpired.

found. At (T2) genotypes HNXST. 2 and Stork ranked the first while Om-Rabi-14 ranked the last, no significant difference between Hourani and Stork was found.

Correlation among the traits studied:

The coeffecients of correlation between the traits studied are presented in Table 38. At (T1), grain yield significantly and positively correlated with biological yield, number of Kernels, number of spikes per pot, spike length peduncle length, harvest index and water use effeciency, but was negatively correlated with both heading and maturity dates. At (T2), grain yield was positively and significantly correlated with number of kernels per pot, spike length, harvest index, and peduncle length but was negatively correlated with straw yeild , heading and maturity dates. These findings agreed with (Fischer and Wood, 1979; El-Ajlauni, 1986 and Ghoshed, 1989).

At (T1) straw yield was positively and significantly correlated with biological yield, plant height, spikelets per spike heading and maturity dates, flag leaf area, weight of roots and water use effeciency, whereas it was negatively correlated with harvest index. At (T2) straw yield was correlated positively and significantly with biological yield, number of spikes per pot, heading and maturity dates, weight of root and was negatively with number of kernels and harvest index.

At (T1) biological yield significantly and positively correlated with number of kernels , plant height, number of spikes per pot, spike length, spikelets per spike, heading and maturity dates and roots weight and was negatively correlated with harvest index. At (T2), biological yield was significantly and positively correlated with number of spikes per pot, heading and maturity dates and roots weight and negatively correlated with harvest index.

Number of kernels was significantly correlated with number of spikes, spike length, peduncle length, harvest index and water use effeciency and negatively correlated with heading and maturity dates at (T1). At (T2), number of kernels was positively and significantly correlated with peduncle length and harvest index while was negatively correlated with heading and maturity dates.

Plant height significantly correlated with peduncle length, spike length, spikelets per spike, heading and maturity dates, flag leaf area and roots weight At (T1) However, it was significantly correlated with heading date, flag leaf area and roots weight at T2.

Peduncle length was correlated significantly with spike length but weakly correlated with other traits studied under T1 treatment. It was negatively correlated with heading and maturity dates at T2 treatment.

At T1, number of spike per pot was significantly correlated with harvest index but weakly correlated with other traits. At T2, heading and maturity dates were negatively and significantly correlated with number of spikes per pot whearas the other traits were weakly correlated with number of spikes.

At T1, spike length was significantly correlated with spikelets per spike and flag leaf area. At T2, spike length was significantly correlated with spikelets per spike whereas it was weakly correlated with other traits.

At T1, spikelets per spike was significantly correlated with flag leaf area and weight of roots, while weak correlations were found between spikelets per spike and other traits at T2.

At T1, awn length was significantly correlated with flag area whereas a weak correlation was found with other traits. At T2, weak correlation between awn length and other traits were found.

At T1, heading date was positively and significantly correlated with maturity date, flag leaf area and weight of roots whereas it was negatively correlated with harvest index and water use effeciency. At T2, heading date was significantly correlated with maturiy date and roots weight while was negatively correlated with harvest index.

At T1, maturity date was significantly and positively correlated with flag leaf area and weight of roots whereas it was negatively correlated with harvest index and water use effeciency. At T2, maturity date was positively and significantly correlated with roots weight and was negatively correlated with harvest index.

At T1, flag leaf area was significantly correlated with roots weight and harvest index while was negatively correalted with water use effeciency. At T2, weak correlations were found between flag leaf area and other traits.

At T1, weight of roots was significantly correlated with water use effeciency while at T2 a weak correlation was found.

At T1, number of kernels and harvest index were positively and significantly correlated with water use effeciency whereas heading and maturity dates, flag leaf area and straw yield were negatively correlated with water use effeciency. At T2, weak correlations were found between traits studied and water use effeciency.

Table (38) : Coefficient of correlation (r) among agronomic characters of 20 wheat genotypes grown at field capacity treatment (T1) and 1/3 available water (T2) under green house condition i 1989/1990.

Character	Tretm.	G.Y	St.wt	Bio	K.N.	H.t	P.L	S.N	S.L	SKt.N	A.L	H.D.	M.D.	F.L	R.wt	H.I.	W.U.E
GY	T1	1.00	-0.21	0.41**	0.96**	-0.05	0.26*	0.82**	0.40**	0.10	-0.14	-0.39**	-0.42**	-0.14	-0.05	0.87**	0.29*
	T2	1.00	-0.58**	-0.23	0.96**	-0.09	0.34**	0.17	0.28*	0.12	-0.22	-0.45**	-0.45**	-0.12	-0.13	0.85**	-0.02
St.wt	T1		1.00	0.90**	-0.05	0.47**	0.02	0.09	0.28*	0.44**	-0.02	0.62**	0.67**	0.70**	0.54**	-0.45**	0.36**
	T2		1.00	0.78**	-0.55**	0.12	-0.29*	0.37**	-0.13	0.001	0.14	0.55**	0.60**	0.08	0.40**	-0.74**	-0.16
Bio	T1			1.00	0.36**	0.41**	0.14	0.44**	0.43**	0.45**	-0.09	-0.40**	0.45**	0.57**	0.47**	-0.04	-0.19
	T2			1.00	-0.22	0.24	-0.13	0.47**	-0.09	0.02	0.01	0.46**	0.52**	0.009	0.60**	-0.47**	-0.25
K.N.	T1				1.00	-0.04	0.30*	0.77**	0.47**	0.14	-0.19	-0.46**	-0.45**	-0.13	-0.14	0.83**	0.33*
	T2				1.00	-0.05	0.41**	0.15	0.29*	0.16	0.28*	-0.46**	-0.48**	-0.04	-0.14	0.82**	0.001
H.t	T1					1.00	0.39**	-0.20	0.44**	0.49**	-0.02	0.40**	0.31*	0.42**	0.57**	-0.26*	-0.14
	T2					1.00	-0.08	-0.23	0.13	0.12	0.04	0.34**	0.28*	0.32*	0.37**	-0.12	0.28*
P.L	T1						1.00	0.19	0.52**	0.14	-0.30*	-0.22	-0.23	0.02	-0.007	0.17	0.19
	T2						1.00	0.28*	0.11	-0.01	-0.26*	-0.53**	-0.51**	-0.11	-0.12	0.27*	0.03
S.N.	T1							1.00	0.29*	-0.06	-0.12	-0.32*	-0.25	-0.11	-0.02	0.67**	0.25
	T2							1.00	0.07	-0.16	-0.13	-0.11	-0.08	-0.21	0.10	-0.08	-0.17
S.L.	T1								1.00	0.51**	-0.46**	-0.11	-0.06	0.48**	0.21	0.18	0.10
	T2								1.00	0.33*	-0.19	-0.16	-0.18	[illegible]	0.04	0.15	-0.23
Skt.N	T1									1.00	0.03	0.15	0.17	0.42**	0.33*	-0.08	-0.21

Character	Tretm.	G.Y	St.wt	Bio	K.N.	H.t	P.L	S.N	S.L	SKt.N	A.L.	H.D.	M.D.	F.L	R.wt.	H.I.	WUE
	T2									1.00	0.001	0.04	0.04	0.17	0.10	-0.07	-0.22
A.L	T1										1.00	0.06	0.02	-0.30*	0.004	-0.08	0.05
	T2										1.00	0.10	0.15	-0.21	0.01	-0.22	0.03
H.D	T1											1.00	0.87**	0.59**	0.50**	-0.56**	-0.49**
	T2											1.00	0.93**	0.19	-0.37**	-0.45**	-0.14
M.D	T1												1.00	0.65**	0.42**	-0.63**	-0.43**
	T2												1.00	0.17	0.48**	-0.47**	-0.22
F.L	T1													1.00	0.38**	0.43**	-0.36**
	T2													1.00	0.23	-0.02	-0.29*
R.wt	T1														1.00	-0.23	-0.22
	T2														1.00	-0.23	-0.38**
H.I	T1															1.00	0.35**
	T2															1.00	0.04

*,** Significant at 5% and 1% probability levels respectively.

GY= grain yeild , St.wt= straw weight, Bio= biological yield, K.N= number of kernels /pot, H.t= plant height, P.L= peduncle length, S.N= number of spikes/pot, S.L= spike length,

SKt.N= spikelets/spike, A.L.= awn length, H.D= heading date, M.D=maturity date, F.L.=flag leaf area, R.wt= weight of roots, H.I= harvest index, WUE=water use effeciency.

SUMMARY AND CONCLUSIONS

Two experiments (field and greenhouse) were conducted during 1988/1989 and 1989/1990 growing season to evaluate several wheat genotypes under different environment or simulated moisture condition.

I. Field Experiment :

The study was carried out to evaluate yield performance and some agronomical traits of sixteen wheat genotypes at three locations during 1988/1989 growing season. The locations were Ramtha Agricultural Research Station, Jubeiha Station (Jordan University Campus) and Mushaqar Agricultural Research Station The genotypes studied were Hourani land race locally adapted genotype, Stork, and 13 advanced progeny lines of Hourani X Stork cross and Jubeiha a bread wheat line. Total rainfall was 147.0, 530.7 and 326.1 mm for Ramtha, Jubeiha and Mushaqar, respectively.

The experiment was laid out in randomized complete block design with three replications was used at each location. The character studied were : Biological, grain and straw yields, harvest index,1000-kernels weight, plant height, heading date, spike length, spikelets/spike, kernels/ spikelets, awn length, peduncle length, flag leaf blade area, and fertile tiller/plant. The most important results may be summarized in the following points :

1 - Genotypes grown at the three locations varied in their grain and biological yields, genotypes ranked first at Ramtha were ranked intermediate at Jubeiha and Mushaqar locations. This indicates the necessity to practice selection in the target environment. For all locations, the genotypes were HNXST 7 and HNXST 10 out

yielded Hourani whereas the other genotypes yielded less than Hourani.

2 - For biological yield, genotypes grown at Jubeiha and Mushaqar locations produced more dry matter than at Ramtha due to high rainfall in Jubeiha and Mushaqar compared to Ramtha (thedrier location). Genotype HNXST 12 ranked first in Jubeiha and second at Mushaqar and ranked third at Ramtha, while over all locations it ranked the first. It ranked first for straw yield, but last in harvest index where more dry matter with less grain yield was produced.

3 - Association between grain yield and other traits showd that biological yield was positively significantly associated with grain yield at the three locations tested. Awn length was associated with grain yield and biological yield at the drier location (Ramtha) whereas weakly correlated with biological and grain yields at wetter sites (Jubeiha and Mushaqar).

4 - Genotypes grown at Jubeiha and Mushaqar locations produced kernels heavier than Ramtha location. 1000 kernels weight values at Ramtha ranged from 28.3 to 35.4, whereas from 39.5 to 46.0 g at Jubeiha and 36.8 to 48.5 g at Mushaqar location.

5 - Flag leaf area was associated with 1000 kernels weight at wetted sites while weakly correlated with kernel weight at Ramtha (drier site).

6 - Genotypes grown at Mushaqar location produced more fertile tiller than other locations. Genotype HNXST 13 ranked first in fertile tillers production for all locations and ranked first in Ramtha and Jubeiha locations. According to keine and kronstad (1981), this genotype would be classifed as drought tolerance due to the ability of this genotype to maintain a high number of grain-bearing tillers.

7 - Awn length showed highly significant corelation with fertile tillers at the drier location (Ramtha) whereas it was weakly correlated with fertile tillers at

Jubeiha and Mushaqar locations.

8 - For plant height, genotypes grown at Ramtha location were stunted compare with other locations. Genotypes Hourani, HNXST 1 and HNXST 7 were the tallest genotypes at the three locations, whereas genotype HNXST 4 was the shorter for all locations. Peduncle length showed positive and significant correlation with plant height at Mushaqar and Jubeiha locations where as weakly correlated with plant height at Ramtha location where the peduncle was rolled by flag leaf and incomplete spike emergence.

9 - For spike characters, genotypes grown at Ramtha location produced short spikes with less number of spikelets/spike, less kernels number/spikelet and short awns compared with Jubeiha and Mushaqar locations.

10 - Weak correlations were found spike characters and other traits except the association between spikelets/spike and kernels/spikelets at Ramtha, awn length and kernels per spikelets at Ramtha and Mushaqar locations which support the importance of awns in contribution assimilates to kernels.

11 - For seedling characters, Hourani and Petra had more seminal roots number, Petra ranked first in total roots length whereas Hourani ranked intermediate. Hourani had long coleoptile length among all other genotypes.

II. Greenhouse Experiment:

The experiment was carried out at glasshouse in the Jordan University Campus in 1989/1990 growing season. Experiment was laid out split-plot design with three replications was used where irrigation treatments were main plot and genotypes sub-plot.

Genotypes studied were Hourani, Stork, 13 advanced progeny lines derived from Hourani X Stork corss, Jubeiha, Maru, Golan, Om-Rabi-14 and Petra.

Two irrigation treatments were applied :

1 - Field capacity treatment (T1) : MOisture contnet maintained around the field capacity within the range between 2/3 of the available water (lower limit) and field capacity (upper limit), the moisture percentage at the two limit were 29.2% and 32.8%, respectively. Pots were weighted daily to maintain this range.

2- One-third available water treatment (T2) : Moisture contnet was maintained around the one-third available water within the range between permenant wilting point (lower limit) and one-third available water (upper limit), the moisture percentage at the two limits were 22.0% and 25.6%, respectively. Pots were weighed daily to maintained this range.

The following parameters were taken : plant height, heading and maturity dates, flag leaf blade area, peduncle length, number of spikes/pot, spike length, number of spikelets/spike, number of kernels/spikelets, awn length, oven dried roots weight, number of kernels per pot, kernels weight/pot (grain yield), straw weight, harvest index, total dry matter (biological yield) and water use effeciency determined by : $\frac{\text{Total dry matter weight (g/pot)}}{\text{Total water transpired (kg/pot)}}$

The most important results may be summarized in the following ones :

1 - The interaction was not significant between irrigation treatments and genotypes for all studied characters except for biological yield, straw yield, plant height, flag leaf area and heading date. These results indicated that each factor was acting independently.

2 - Significant differences were obtained among irrigation treatments for biological and straw yields, peduncle length, number of spikes per pot, heading and maturity dates and water use effeciency whereas no significant difference were obtained among them for other traits studied.

3 - Om-Rabi-14 ranked the last among genotypes for grain yield at the two treatment due to production of few kernels per pot. The reason is that genotypes that headed later was exposed to high temperature during heading in glasshouse resulted in failure of spikes to produce fertile spikelets.

4 - Biological yield, number of kernels per pot, number of spikes per pot, spike length and harvest index were positively and significantly associated with grain yield at T1 treatment, whereas number of kernels per pot, harvest index and peduncle length were assocaition with grain yield at T2. Heading and matuirity dates were negatively and significantly associated with grain yield at both treatments.

5 - Biological yield and Straw yield, at T1 were higher than at T2. Number of kernels per pot, plant height, number of spikes per pot, psike length, number of spikelets per spike, heading and maturity dates, flag leaf area and weight of roots were significantly and positively associated with biological yield at T1, and with number of spikes per pot, heading and maturity dates and roots weight at T2. Harvest index was negatively correlated with biological yield at T2.

6 - .Number of Kernels per pot at the two treatments was positively correlated with peduncle length and harvest index whereas was negativiely correlated with heading and maturity dates.

7 - Plant height was significantly and positively correlated with heading date, flag leaf area and roots weight at both treatments. Bread wheat produced longer

peduncles at the two treatments comparedwith durum types, where Jubeiha and Golan were the top at the two treatments.

8 - Peduncle length was positively correlated with spike length at T1 while was negatively correlated with heading and maturity dates at T2 treatments.

9 - Number of spikes per pot was negatively correated with heading and maturity dates at T2. This may be due to exposure of late heading genotypes to high temperatures in glasshouse during heading which resulted in fail tillers to produce fertile spikes although later genotypes produced spikes but with few or without kernels.

10- Irrigation treatments did not showed significantly different values among them for spike length, spikelets/spike and awn length. Bread wheat genotypes produced longer spike and more spikelets/spike and shorter awns as compared with durum types. Spike length was positively and significantly correlated with spikelets/spike at both treatments. Flag leaf area was significantly and positively correlated with spike length whereas weak correlations were found at T2.

11- Significantly difference among treatments were found for heading and maturity dates where genotypes receiving T2 headed and matured earlier compared with T1. Heading and maturity dates were positively coreelated with flag leaf area and root weight but was negatively correlated with harvest index and water use effeciency at T1. At T2, heading and maturity dates were positively correlated with weight of roots and were negatively correlated harvest index.

12- Flag leaf area was correlated positively with weight of roots and harvest index while was negatively correlated with water use effeciency at T1.

13- Hourani significanlty differed from all genotypes in roots weight at both treatments which ranked first with significantly difference from Stork. This may be the reason for adaptability of Hourani to dry Jordanian conditions. Weight of roots was significantly correlated with water use effeciency at T1 but weak correlation was found at T2.

Genotypes receiving T2 were more effecient for water use as compare with T1.

In conclusion few genotypes of Hourani x Stork cross, were found to be superior to Hourani in Ramtha, the dry site and also at T2, where the plants were subjected to stress as compared to T1 treatment.

ARABIC SUMMARY الملخص العربي

يعتبر محصول القمح من أهم المحاصيل الحقليه الشتويه التي تزرع في العالم بشكل عام وفي الاردن بشكل خاص . حيث يمكن زراعته في المناطق المطريه التي يتراوح فيها معدل سقوط الامطار بين ٢٥٠-٥٠٠ ملم. بلغت معدل المساحه المزروعه في القمح في الفتره ما بين ١٩٨٠-١٩٨٨ حوالي (٥٦ الف هكتار) في حين كان معدل الانتاج لنفس الفتره حوالي (٤٨ الف طن) بمعدل ٨٤ر. طن/هكتار (دائره الاحصاءات العامه ١٩٨٩) .

يعتبر معدل سقوط الامطار وتوزيعها خلال موسم النمو من العوامل الرئيسيه التي تحدد انتاجية وأقلمة القمح تحت ظروف الزراعه المطريه . لذلك فإن تطوير وتربية اصناف لها المقدره على تحمل الجفاف وتأقلم هذه الاصناف على مدى واسع من ظروف الرطوبه المتذبذبه من موسم لآخر ومن موقع لآخر يعتبر من أهم اهداف برنامج تربية نبات القمح في الأردن .

هدفت هذه الدراسه الى تقيم بعض الصفات المحصوليه لعدد من اصناف القمح تحت ظروف الزراعه الحقلية وتحت ظروف معاملتين من الرطوبة الأرضية في البيت الزجاجي .

دراسة الاصناف تحت ظروف الحقل :

اجريت التجربه في ثلاث مناطق في الاردن خلال موسم النمو ١٩٨٨/١٩٨٩م وهذه المناطق هي محطة الرمثا الزراعيه ، محطة المشقر الزراعيه ، محطة الجبيهه (حقل الحرم الجامعي) . كانت الأصناف حوراني (صنف محلي) ، ستورك (صنف مدخل من المكسيك) جبيهه (قمح طري) وثلاثة عشر صنفاً انتخبت من نهجين صنفي حوراني × ستورك .

كانت معدلات الامطار خلال موسم النمو ١٤٧ ملم في محطة الرمثا ٣٢٦ ملم في محطة المشقر ٥٣٠٫٧ في محطة الجبيهه . استخدم نظام القطع العشوائيه الكامل بثلاث مكررات في تنفيذ التجربه في كل من المحطات الثلاث . لقد تم دراسة الخائص المحصولية التاليه :

الانتاج الكلي من الماده الجافه ، انتاج الحبوب ، انتاج القش ، معدل عدد الاشطاء الحامله للسنابل / نبات ، طول النبات ، وزن ١٠٠٠ حبه ، تاريخ التبسيل ، دليل الحصاد ، طول السنبله ،

عدد السنيبلات / سنبله ، عدد الحبوب / سنيبله ، طول السفا ، طول حامل السنبله ومساحة الورقه العلم .

وكانت أهم النتائج المحصّل عليها كالآتي:

١- كان هناك تباين في معدل انتاج الماده الجافه وانتاج الحبوب بين المواقع الثلاثه وبين الاصناف نفسها في الموقع الواحد . فهذا مؤشر على تطبيق نظام الانتخاب في كل موقع على حده . تفوق هجينين على صنف حوراني في كل المواقع وهما حوراني × ستورك ٧ وحوراني × ستورك ١. بينما تدنت بقية الهجن على حوراني في المواقع الثلاث .

٢- ارتبط الانتاج الحبي ارتباطاً ايجابياً مع الانتاج الكلي من الماده الجافه في المواقع الثلاث . ارتبط الانتاج الحبي مع طول السفا ارتباطاً ايجابياً وقوياً في الموقع الجاف (الرمثا) ولكنه كان ضعيفاً في المواقع الماطره (الجبيهه والمشقر) مما يتيح المجال لاعتماد صفه طول السفا كدليل على الانتاجيه العاليه خاصه في الظروف المطريه المتدنيه .

٣- ارتبط وزن الـ ١٠٠٠ حبه ارتباطاً وثيقاً مع مساحة الورقه العلم في المناطق الماطره (الجبيهه والمشقر) بينما كان الارتباط ضعيفاً في الموقع الجاف (الرمثا) مما يؤكد اهمية الورقه العلم في عملية التمثيل الضوئي تحت الظروف المناخيه المناسبه .

٤- ارتبطت القدره الاشطائيه ارتباطاً قوياً مع تاريخ التبسيل وطول السفا في الموقع الجاف (الرمثا) بينما كان ضعيفاً في المناطق الماطره (المشقر والجبيهه) .

٥- ارتبط طول النبات ارتباطاً وثيقاً مع طول حامل السنبله في المواقع الماطره (الجبيهه والمشقر) بينما كان الارتباط ضعيفاً في الموقع الجاف (الرمثا) .

٦- اعطى الموقع الجاف (الرمثا) سنابل قصيره وعدد سنيبلات قليله / سنبله وعدد قليل من الحبوب / سنيبله وسفا قصير مقارنه بموقعي المشقر والجبيهه . ارتبط عدد السنيبلات/سنبله ارتباطاً وثيقاً مع عدد الحبوب /سنيبله في موقعي الرمثا والجبيهه بينما ارتبط طول السفا وعدد الحبوب / سنيبله ارتباطاً وثيقاً في موقعي الرمثا والمشقر .

٧- في تجربه صفات البادرات ، اظهر صنفي حوراني وبترا (كورفيلا) تفوقاً في عدد الجذور

البدائيه وتفوق حوراني في طول الرويشه على بقية الاصناف المدروسه ويمكن ان يكون هذا سبب في ملائمة صنف حوراني لظروف الزراعه المطريه .

دراسة الاصناف تحت ظروف البيت الزجاجي:

أجريت التجربه داخل البيت الزجاجي في موقع كلية الزراعه في الجامعة الأردنية في موسم ١٩٨٩/١٩٩٠م وذلك لتقييم ودراسة الخصائص المحصوليه لعدد من أصناف القمح تحت معاملتين من الرطوبه الارضيه ، الاولى السعه الحقليه والثانيه ثلث الرطوبه المستساغه وقد تم المحافظه على هذه المستويات ثابته وذلك عن طريق التعويض اليومي لكميات المياه المفقودة عن طريق النتح من النبات . وقد تم تغطية القوارير بورق الالمنيوم وذلك لمنع عمليات فقد المياه عن طريق التبخر من سطح القوارير . كانت الاصناف التي درست هي حوراني (صنف محلي) ستورك ، ثلاثه عشر هجيناً اشتقت من الاباء حوراني وستورك ، جبيهه (قمح طري) مرو (شام ١) بترا (كورفيلا) ، ام ربيع -١٤ وجولان (قمح طري) . استخدم في تنفيذ التجربه تصميم القطع المنشقه في ثلاثة مكررات حيث شغلت معاملات الري القطع الرئيسية ووزعت الاصناف العشرون عشوائياً في القطع الثانويه . ولقد استخدم جهاز Thermohydrograph لتسجيل درجات الحراره والرطوبة النسبية .

لقد تم دراسة الخصائص التاليه للقوار الواحد . الانتاج الكلي من الماده الجافه ، وزن الحبوب، وزن القش ، عدد الاشطاء (السنابل) المخصبه ، عدد الحبوب ، طول النبات ، تاريخ التسبيل ، تاريخ النضج الفسيولوجي ، طول حامل السنبله ، مساحة الورقه العلم ، طول السنبله، عدد السنيبلات/سنبلة، طول السفا ، وزن الجذور الجاف ، مؤشر الحصاد وكفاءة استخدام المياه (وقد قدرت على اساس معدل الانتاج الكلي من الماده الجافه/كمية المياه المفقودة عن طريق النتح) .

١- لم تظهر النتائج تفاعل معنوي بين معاملات الري والأصناف للخصائص التي درست باستثناء الإنتاج الكلي من المادة الجافة ، وزن القش ، طول النبات ، مساحة الورقة العلم وتاريخ التسبيل . هذه النتائج تشير الى أن معاملات الري والأصناف تصرفت غير معتمدة على بعضها .

٢- لقد أظهرت المعاملات فروقاً معنويه في الانتاج الكلي من الماده الجافه ، انتاج القش ، عدد السنابل / قوار ، تاريخ التسبيل ، تاريخ النضج الفسيولوجي طول حامل السنبله ، ومعدل كفاءة استخدام المياه ، ولكنها لم تظهر فروقاً معنوية في باقي الخصائص الأخرى .

٣- أدى التأخر في موعد التسبيل الى تعرض الاصناف المتأخره في التسبيل الى درجات حراره مرتفعه خلال مرحلة التسبيل ومرحلة إمتلاء البذور مما ادى الى فشل الاشطاء في حمل سنابل مخصبه وبالتالي ادى الى نقص عدد السنابل المخصه وعدد الحبوب الناتجه وبالتالي الى تقليل انتاج الكلي للقوار وهذا يؤكد اهمية التبكير في التبسيل كطريقة للهروب من تعرض النباتات الى نقص الرطوبه ووضع النباتات تحت شد رطوبي ارضي عالي في الحقل في مرحلة التبسيل وامتلاء الحبوب من جهة والى تعرضها الى درجات حراره مرتفعه من جهة اخرى مما يؤدي الى نقص الانتاج الحبي سواءاً بانتاج اشطاء غير مخصبه أو انتاج حبوب ضعيفه منكمشه وهذا كله يؤدي الى تدني انتاجية القمح تحت ظروف الزراعه المطريه ، اما بالنسبه لهذه التجربه فتعرض النباتات المتأخره التسبيل الى درجات حراره مرتفعه داخل البيت الزجاجي ادى الى فشل السنيبلات على انتاج حبوب على الرغم من انتاج السنابل .

٤- ارتبط انتاج الحبوب ارتباطاً ايجابياً مع الانتاج الكلي من الماده الجافه ، عدد السنابل المخصبه / قوار ، عدد الحبوب / قوار ، طول السنبله ، مؤشر الحصاد تحت ظروف المعامله الأولى ، بينما اتبط مع عدد الحبوب/قوار ، مؤشر الحصاد ، وطول حامل السنبله تحت ظروف المعامله الثانيه ، ارتبط تاريخ التسبيل وتاريخ النضج الفسيولوجي سلبياً مع انتاج الحبوب كماً ووزناً تحت ظروف المعاملتين .

٥- ارتبط طول النبات ايجابياً مع تاريخ التسبيل ومساحة الورقه العلم ووزن الجذور تحت ظروف المعامتلين . ارتبط عدد السنابل / قوار سلبياً مع تاريخ التسبيل والنضج الفسيولوجي تحت ظروف المعامله الثانيه .

٦- امتازت اصناف القمح الطري بسنابل طويله ، وعدد سنيبلات / سنبله اكثر ولكن بسفا قصير مقارنه باصناف القمح القاسي .

٧- ارتبطت مساحة الورقه العلم ايجابياً مع طول السنبله ، عدد السيبلات / سنبله وطول السفا تحت ظروف المعامله الأولى ولكن كان الارتباط ضعيفاً تحت ظروف المعامله الثانيه .

٨- كان هناك فرقاً معنوياً من حيث تاريخ التسبيل والنضج الفسيولوجي بين المعاملتين حيث أدت المعامله الثانيه الى تبكير الاصناف في التسبيل والنضج مقارنة بالمعامله الأولى .

٩- ارتبط تاريخ التسبيل والنضج الفسيولوجي ايجابياً مع مساحة الورقه العلم ووزن الجذور وسلبياً مع مؤشر الحصاد وكفاءة استخدام المياه تحت ظروف المعامله الأولى بينما ارتبط تاريخ التسبيل والنضج الفسيولوجي ايجابياً مع وزن الجذور وسلبياً مع مؤشر الحصاد تحت ظروف المعامله الثانيه .

١٠- ارتبطت مساحة الورقه العلم ايجابياً مع وزن الجذور وسلبياً مع كفاءة استخدام المياه تحت ظروف المعامله الأولى بينما كان الارتباط ضعيفاً تحت ظروف المعامله الثانية . تفوق صنف حوراني في وزن الجذور واختلف معنوياً عن بقية الاصناف تحت ظروف المعاملتين . ويمكن أن يكون هذا سبباً في تأقلم صنف حوراني الى ظروف الزراعه المطريه هذا كما اظهرت النتائج ان أحد الهجن حوراني × ستورك قد اعطى جذوراً قريبه من صنف حوراني.

١١- كان هناك ارتباطاً وثيقاً ايجابياً بين وزن الجذور وكفاءة استخدام المياه تحت ظروف المعامله الأولى ولكن كان الارتباط ضعيفاً تحت ظروف المعامله الثانيه . أظهرت المعامله الثانيه (ثلث الرطوبة المستساغه) تفوقاً على المعامله الأولى من حيث كفاءة استخدام المياه .

ويمكن الاستنتاج من هذه التجارب أن هناك أصنافاً من هجن حوراني × ستورك أعطت تفوقاً على صنف حوراني تحت ظروف الزراعه القاسيه سواء كانت في محطة الرمثا الزراعيه لموسم ١٩٨٨/١٩٨٩ أو تحت ظروف البيوت الزجاجيه في الحرم الجامعي ، مما يعطي الأمل في انتاج اصناف عالية الانتاج وذات صفات محصولية جيدة بالإضافة الى مزايا صنف حوراني .

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Appendix 1 : Mean Monthly rainfall average (mm) for Ramtha, Mushaquar and Jubeiha for several years. *

Month	Ramtha for the period 1976-1987	Mushaquar for the period 1973-1987	Jubeiha for the period 1938-1987
January	37.4	83.5	110.5
February	46.4	72.8	98.7
March	46.7	69.4	87.6
April	11.7	18.4	25.2
May	4.1	4.8	5.5
June	0.0	0.0	0.0
July	0.0	0.0	0.0
August	0.0	0.0	0.0
September	0.2	0.2	0.2
October	8.9	5.2	10.1
November	28.4	39.9	48.3
December	37.5	64.2	90.0
Total	221.3	358.4	476.1

*Source : Ministry of Agriculture. Directorate of Agricultural economics and planning division of statistics. Amman 1989.

Appendix 2. Wheat planted area and production in Jordan for the period of 1980-1989.*

Year	Area (ha)	Production (Mt)
1980-1981	10607.2	59687.0
1981/1982	75990.1	29100.0
1982/1983	11065.9	11561.3
1983/1984	43002.1	24983.0
1984/1985	94355.6	62827.0
1985/1986	59435.5	30842.0
1986/1987	84319.3	79805.6
1987/1988	70176.8	78772.7
Average	56119.06	47197.3

* Source : Annual report of statistics. Department of statistics. Amman-Jordan 1988.

Appendix 3. Mean maximum, mean minimum of temperatures and relative humidity of the glass house in 1989/1990.

Month	Temperature mean Max.	Temperature mean Min.	Relative humidity mean Max.	Relative humidity mean Min.
December	25.6	10.3	75.2	50.5
January	29.7	13.2	57.0	36.0
February	35.4	14.5	60.2	31.9
March	41.9	10.8	74.0	28.2
April	43.6	8.7	84.8	20.7
May	44.1	7.9	60.6	18.7

LIST OF ABBREVIATIONS

Word or sentence	Abbreviation
And others	et al
Centimeter	cm
Correlation coefficient	r
Grams	gm
Hectar..	ha
Kilogram	kg
Metric tons	MT
Millimeter	mm
Per	/
Percent	%