Evaluation of the performance of Bread wheat genotypes (*Triticum aaestivum* L.) in central region of Iraq by using Selection technique

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Abstract
A field experiment was carried out at Abu Ghraib Research Station- Agricultural Research Department for the growing seasons 2014-2015 and 2015-2016 in order to evaluate the performance of eight introduced bread wheat genotypes from the University of Perth/ Australia Research Station and compare them with the two local varieties IPA 99 and Abu Ghraib 3. The experiment was implemented in randomized completely block design with (R.C.B.D.) with three replicates.

The results indicate statistically differences between genotypes for all studied characters. The introduced genotype M7 was superior to other genotypes for kernals.m^2 (492 kernals.m^2), 1000 seed weight (35.50 gm), grain yield (6.62 ton.ha^{-1}) and harvest index (41.68%), while the genotype M2 was superior in grain per spike (62 grain.spike^{-1}) and genotype M4 in total dry weight yield (17.78 ton.ha^{-1}).

Keywords: Yield, yield component, harvest index, bread wheat, *Triticum aaestivum L.*

Introduction

Bread wheat (*Triticum aestivum* L.) is one of the most important and most productive cereal crops in the world with more than one-third of the world's population dependent on it, which is a basic source of daily energy that man needs, which plays a major role in achieving food security. The world's population is projected to reach 10 billion by 2050, which means that we have to produce a large amount of food to meet the need for continued population growth[6].

The breeding programs of the international research centers focus on the introduction of genetic materials as a necessary step in improving the field and crop productivity of the crops. Although Iraq is one of the most important centre of origin of wheat in the world, the yield per unit area is still low compared to the yield regionally and globally. The increase in production is not keeping pace with domestic demand and the need to narrow the gap between increasing demand and low production is becoming increasingly urgent. This may be due to a lack of variation among the certified genotypes[15]. The differences in genetic structure and heterogeneity of environmental conditions are the most important reasons for the variation in the characteristics of growth, yield components and total dry weight[12,13,17].

To obtain a significant increase in one or more of the major yield components in some introduced genotype, it is positively reflected in the increase of its yield as compared to local certified varieties[2, 15]. The objective of this study is to evaluate the performance of eight bread wheat genotypes introduced from the University of Perth/ Australia Research Station with the certified local varieties in Iraq.

Material and Methods

A field experiment was carried out at Abu Ghraib Research Station- Agricultural Research Department for the growing seasons 2014-2015 and 2015-2016 in order to evaluate the performance of eight introduced bread wheat genotypes from the University of Perth/ Australia Research Station (Table 1) and compare them with the two local varieties IPA 99 and Abu Ghraib 3. The experiment was implemented in randomized completely block design with R.C.B.D. with three replicates.

The size of experimental unit (2 × 4 m) consisted of 6 lines with a length of 4 meters per line and a distance of 30 cm between line and another. Planting dates were on 25/11 for both seasons. Fertilizers were added as follows: urea fertilizer (N 46%) at 200 kg N. ha^{-1} in three equal doses during planting, When the second node appears and at booting stage[1], seeding rate was 120 kg.ha[1]. Cultural practices such as irrigation, weed control and hoeing are needed. The experiment was harvested when the plants reached full maturity at moisture content less than 14% on Ma, 19th for both seasons. The characters studied were as follows:

1. The number of harvested spikes per m^2.
2. The number of grains.Spike^{-1}: Calculated as the average number of grains per ten spikes per experimental unit.
3. The weight of 1000 seed (gm.): A random sample of the harvested grain was selected and 1000 grains were taken and then weighed by electronic balances.
4. Seed yield ton.ha^{-1}: calculated from harvesting of the four intermediate lines of each experimental unit and converted to ton.ha^{-1}.
5. Total dry weight yield (ton.ha^{-1}): Estimated from weight of harvested plant from middle 4 rows for each experimental unit and then converted to ton.ha^{-1}.
6. Harvest Index (%): calculated as follow:

HI= (Seed yield/ total dry weight yield) × 100

Table 1
Genotypes, their pedigree and origin

Genotype	Pedigree	Breeding Program	Origin
M1	Zippy	Introduced	Research Station/ Perth Uni./ Australia
M2	Endure	Introduced	Research Station/ Perth Uni./ Australia
M3	Wyalkatchem	Introduced	Research Station/ Perth Uni./ Australia
M4	Westonia	Introduced	Research Station/ Perth Uni./ Australia
M5	Fortune	Introduced	Research Station/ Perth Uni./ Australia
M6	Magenta	Introduced	Research Station/ Perth Uni./ Australia
M7	Bumper	Introduced	Research Station/ Perth Uni./ Australia
M8	King Rock	Introduced	Research Station/ Perth Uni./ Australia
IPA 99	Ures/Bows’’3”/3/jup/Bi y”S”ures	Selection	Iraq
Abu Ghraib 3	Mexico 24 XInia XAjeeba	Hybridization	Iraq

Statistical Analysis: After the data collection, the statistical analysis was conducted for each season separately. The combined analysis of the two seasons was carried out according to the RCBD design. Means were compared using the least significant difference (L.S.D.) at probability of 0.05[19].

Results and Discussion

Spike. m^{-2}: This characteristic is one of the major yield components, which has a significant effect on the grain yield and the plant breeders were interested in this character in selections because they are determined in the early stages of plant growth[16]. The results showed that there were significant differences between genotypes for the two seasons in the number of spikes.m^2 (Table 2). The M7 genotype has a higher average mean of 492.00 Spike.m^{-2} which did not differ significantly with the M1 genotype which gave 480.50 spike.m^{-2} whereas the local genotype IPA99 was the lowest mean average of 298.17 spikes.m^{-2} and that may be due to the differences in genetic makeup of these genotypes[2,20].

The same table indicates a significant interaction between genotypes and the growing seasons. M7 has the highest mean rate of 475.00 and 509.00 for both seasons respectively and significantly different from the rest of the genotypes in the two growing seasons.

Number of grains.Spike^{-1}: This is one of the three important components having a direct effect on the grain yield, which is influenced by the genetic nature of the plant as well as the environmental factor influencing the increase in the number of spike grains[9].

The results indicate that there are significant differences between the genotypes mean in the number of grains.spike^{-1} for the two seasons (Table 2). The genotype M2 was the highest average of 62.00 grains. Spike^{-1}, all the genotypes were significantly higher in this character than the local variety Abu Ghraib, which gave 37.26 grains.spike^{-1}. This is probably due to variation of genetic constitution of their parents.

This finding is consistent with Salman and Mehdi's findings[5,11,14] in presence of the significant differences between the genotypes in the number of grains per spike and they attributed that to differences in the genetic constitution that affected this character. The results also indicate significant interaction between genotypes and growing season. The genotype M2 recorded the highest average of 62.5 and 61.5 grain.spike^{-1} for the two seasons respectively while the lowest grain.spike^{-1} was the genotype IPA99 in first season and Abu-Ghraib 3 in second season with 37.52 and 36.0 grain.spike^{-1} respectively.

1000 Seed weight (gm.): This character expresses the degree of seed fill which depends on power of the sink (grain) as a receiver of photosynthesis products and the extent and strength of the sources to distribute the products of photosynthesis[9]. The weight of 1000 seed was significantly affected by genotypes for both seasons.

Average over seasons, the genotype M7 was significantly higher than other genotypes with 35.50 gm.1000seed^{-1} whereas the lowest seed weight was recorded by local variety Abu-Ghraib 3 (28.54 gm.). It may be due to the difference of genotypes on what is provided of nutrients to the grain from the source (leaf-products of photosynthesis) during the fertilization stage to maturity and this depends on the genetic constitution of genotypes and the internal factors of the same genetic constitution and its ability to invest growth factors.

This result is consistent with what Youssef et al[10] found a significant difference in the style and philosophy and methods of breeding and genetic improvement and its reflection on the yield components and the difference in genetic structure of the genotypes under study because of difference in their genetic pedigree and their environmental susceptibility.

The yield components are often related to each other by an inverse relationship. The increase in the number of spikes in the plant, for example, results in the distribution of photosynthetic products to the largest number of spikes, which reduces the share of the single spike. The increase in the number of grains reduces the amount of photosynthesis products processed per grain if it does not correspond to the increase in the amount of the photosynthetic products. The yield increase may come from the increase of one component with the other components remaining fixed or decrease or increase by a small percentage does not correspond to the proportion of increase in the first component[8]. These results are consistent with Al-Haidari[3] who stated that weights of 1000 grains are negatively correlated with the number of grains per spike. Interaction was insignificant between genotypes and growing seasons.

Yield of dry weight (ton.ha^{-1}): The results revealed that there are significant differences genotypes for both seasons. The genotype M4 possess the highest dry weight yield (17.78 ton.ha-1) while the local control genotype IPA99 possess the lowest dry weight (13.74 ton.ha-1), which did not differ significantly from the wheat variety Abu Ghraib 3 which recorded a total dry weight of 13.88 ton.ha^{-1}. This is due to the variation of genotypes in their efficiency in photosynthesis and nutrient transport. The interaction between genotypes and growing season was significant with highest dry weight yield produced by M4 genotype (18.78 ton.ha^{-1}), so the genotype M2 possesses the highest dry weight of 18.60 ton.ha^{-1} in the first season.

Grain yield (ton.ha^{-1}): It is the result of several factors including traits associated with yield, genetic factors that control the trait, as well as environmental factors that affect the growth of the plant.

The results showed that there were significant differences between the genotypes in this trait (Table 3). The genotype M7 was superior in grain yield with the highest mean of 6.62 ton.ha^{-1}, which was not significantly different from the M6 genotype (6.46 ton.ha^{-1}), the superiority of theses genotypes is due to distinction of these genotypes in some of yield components such as spike.m^2 and 1000 grain weight (Table 2). The difference in the genetic composition of the bread mixture M7 in the grain yield is to distinguish the class in some components of the product, such as the number of Spike.m^{-2} and the weight of 1000 gm. (Table 2) which reflected positively on the increase in the grain, which is reflected positively on the increase in grain yield These results are consistent with the findings of Daoudi[4], Obeidi[7] and Parveen et al[18], while the comparison class Abu Ghraib gave a score of 3.72 tons.

There was a significant interaction between the genotypes and the growing seasons. The highest grain yield was achieved by M7 genotype with 6.76 and 6.49 ton.ha^{-1} for the two seasons respectively whereas the lowest grain yield was recorded with local variety Abu-Ghraib 3 with 3.45 and 3.76 ton.ha^{-1} for the two seasons respectively.

Harvest Index %: The results indicated that there were significant differences between the genotypes in harvest index for the two seasons (Table 3). The genotype M7 was superior in the harvest index with the highest mean of 41.68%, while the local variety Abu- Ghraib 3 recorded the lowest harvest index of 27.07%. This confirms that the genotypes with a high grain yield and total dry weight have achieved higher efficiency in the distribution of dry matter and converted to grain.

Table 2
Spike per m^2, grain per spike and 1000 grain weight for genotypes grown in 2014-2015 and 2015-2016 seasons

Genotypes		Spike.m^2			Grain.spike^{-1}			1000 grain weight (gm)		
		1st Season	2nd season	Mean	1st Season	2nd season	Mean	1st Season	2nd season	Mean
M1		465.00	496.00	480.50	50.00	50.00	50.00	32.95	32.00	32.47
M2		354.50	468.00	411.25	62.50	61.50	62.00	31.00	31.00	31.00
M3		333.00	486.00	409.50	43.00	48.50	45.75	30.50	30.50	30.50
M4		367.00	402.50	384.75	46.50	50.50	48.50	33.50	34.50	34.00
M5		339.50	396.50	368.00	54.00	55.00	54.50	31.00	29.50	30.25
M6		434.50	446.50	440.50	52.00	54.00	53.00	32.00	33.50	32.75
M7		475.00	509.00	492.00	56.85	55.50	56.17	35.50	35.50	35.50
M8		390.00	383.00	386.50	48.35	48.85	48.60	34.00	35.00	34.50
IPA99		297.00	299.33	298.17	37.52	37.00	37.26	29.09	28.00	28.54
Abu-Graib3		306.67	305.00	305.83	38.56	36.00	37.28	28.09	27.33	27.71
Mean		376.22	419.18		48.93	49.69		31.76	31.68	
L.S.D5%	Genotypes	28.26	73.903		3.014	3.973		1.474	3.696	
	Combine	Genotypes	Season	Interaction	Geno-types	Season	Interaction	Geno-types	Season	Interaction
		38.190	11.862	51.878	2.407	N.S	3.391	1.920	N.S	N.S

Table 3
Total dry weight yield, grain yield and harvest index for genotypes grown in 2014-2015 and 2015-2016 seasons

Genotypes		Total Dry Weight (ton.ha^{-1})			Grain Yield (ton.ha^{-1})			Harvest Index%		
		1st Season	2nd season	Mean	1st Season	2nd season	Mean	1st Season	2nd season	Mean
M1		15.76	16.79	16.27	6.24	5.65	5.94	39.65	33.62	36.63
M2		15.87	18.60	17.23	4.95	4.51	4.73	31.23	24.10	27.67
M3		16.32	16.67	16.50	5.19	6.34	5.76	31.82	38.01	34.92
M4		16.85	18.72	17.78	6.72	5.63	6.17	39.91	30.06	34.99
M5		16.75	15.74	16.25	5.99	5.18	5.59	35.76	32.71	34.24
M6		17.27	15.95	15.89	6.45	6.47	6.46	37.34	40.56	38.95
M7		16.72	15.06	16.61	6.76	6.49	6.62	40.24	43.12	41.68
M8		16.83	13.97	15.40	5.65	4.38	5.08	33.59	31.45	32.52
IPA99		13.65	13.83	13.74	3.92	3.53	3.72	28.66	25.48	27.07
Abu-Graib3		14.16	13.60	13.88	3.45	3.76	3.61	24.39	28.34	26.37
Mean		16.02	15.89		5.53	5.19		34.26	32.75	
L.S.D5%		Genotypes	Season	Interaction	Genotypes	Season	Interaction	Genotypes	Season	Interaction
	Combine	1.648	N.S	2.326	0.561	N.S	o.935	2.801	N.S	4.012

The interaction between the genotypes and the growing seasons was significant, the M7 genotype showed the highest harvest index of 40.24% and 43.12% for the two seasons respectively, compared with Abu Ghraib 3 which gave a lower harvest index of 28.66% and 25.48% for both seasons respectively.

Conclusion

We conclude from the above results that introduced genotypes were well adapted to central part of Iraq and the genotype M7 was superior in number and weight of 1000 grain, which was reflected positively in the increase of the total grain yield compared to the two local control varieties IPA 99 and Abu Ghraib 3.

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