International Journal of Biological, Life and Agricultural Sciences
ISSN: 2415-6612
Vol:9, No:3, 2015

Some Yield Parameters of Wheat Genotypes

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***Abstract*—**To study the effect of the cross direction in bead wheat, three hybrid combinations (Babyle 113, Iratome), (Sawa, Tamose2) and (Al Hashymya, Al Iraq) were tested for plant height, spike and awn length, number of grains per spike, 1000-grain weight, number of tillers/m and grain yield. The results revealed that the direction of the crosses significantly effect on the number of grains/spike, number of tillers/m and grain yields. Grain yield was positively and significantly correlated with 1000-grain weight, number of grains per spike and tillers. Depend on the results of heritability and genetic advance it was suggested that 1000-grain weight, number of grains per spike and tillers should be given emphasis for future wheat yield improvement programs.

***Keywords*—**Correlation, Genetic Advance, Heritability, Wheat, Yield Traits.

I. Introduction

WHEAT (*Triticum aestivum* L.) being the most valuable staple food and among all wheat traits, yield is one of the most complex and economically important character. The changed climatic conditions and environmental stresses such as salinity, drought, insect and pest attack and some other diseases are adversely affecting the wheat production. Wheat production can be enhanced through development of improved genotypes capable of producing better yield under various agroclimatic conditions and stresses [1]. The evolution of new genotypes by continued genetic recombination is the need of the day. Genotypic correlation is important in determining the degree to which various yield contributing characters are associated. Several researchers have reported their findings regarding the correlation studies. Chowdhry et al. [2] reported that there was a positive genotypic correlation of grain yield with number of tillers per plant, plant height, 1000-grain weight and spike length. Saleem et al. [3] observed that grain yield was positively correlated with productive tillers, spike length, and 1000-grain weight but non-significantly correlated with plant height. Reference [4] concluded that yield components like number of grains per spike, plant height and 1000- grain weight are main contributors to grain yield in wheat.

Heritability with value of genetic advance helps the plant breeder to predict the gain under selection. Firouzian [5] tested many crosses of wheat plant and he observed high heritability (more than 85%) coupled with a maximum value (8.85) of genetic advance and concluded that this trait would prove effective and efficient during earlier generations. Memon et al. [6] founded that heritability ranged from 47.6 to 93.8% and 0.3 to 82.6% for number of tillers/plant and grain/spike respectively, genetic advance ranged from 2.7 to 11.5 and 0.1 to 29.2 for number of tillers/plant and grain/spike respectively in seven F3 progenies developed through different cross combinations of 8 parental lines of bread wheat. Reference [7] evaluated a set of 42 winter wheat genotypes and founded that tillers/plant exhibited high heritability (71.54%) with high genetic advance of 8.75, while 1000-grain weight exhibited heritability of 61.32% with genetic advance (4.72).

Now plant breeders in Iraq are making efforts to develop high yielding wheat genotypes which are superior and adaptive to a wide range of agro-climatic conditions. The present study was initiated to investigate the relationship of yield components and the grain yield. This information could be exploited in devising further breeding strategies and selection procedures to develop new varieties of wheat capable of high productivity.

II. Materials and Methods

Studies were conducted in F4 progenies [three hybrid combinations (Babyle 113, Iratome), (Sawa, Tamose2) and (Al Hashymya, Al Iraq)] of 6 wheat varieties (Babyle 113, Al Hashymya, Tamose2, Al Iraq, Iratome, and Sawa).Genotypes were planted in Randomized Complete Block Design (RCBD) with three replications at Al Latefeya Research Field, Agricultural Research Directorate, Ministry of Science & Technology, Iraq. Normal agronomic and cultural practices were applied to the experiment throughout the growing season. At maturity data on plant height (of the main tiller from the base of the stem up to the apex excluding spike), spike length (excluding awn), awn length, number of grains per spike, 1000-grain weight and grain yield. One meter area of central row from each plot was marked to study the number of tillers/m. The data was statistically analyzed using method of [8]. Genotypic correlation coefficients between traits were determined according to [9].

Heritability (%) estimates in broad sense were computed using:

$$h^2 = [\text{var. F2} - \sqrt{(\text{Vp1} \times \text{Vp2})} / \text{var. F2}] \times 100$$

where: h^2 = heritability. p1 = parent 1, p2 = parent 2, var. F4 = variance of F4, Vp1 = variance of p1, Vp2 = variance of p2.

Genetic advance (GA) at 10% selection intensity was calculated according to:

$$GA = SD \times h \times i$$

where: SD = standard deviation, h = heritability, i = constant value that reflects the selection intensity. The value for i (1.76) in this study was used in 10% selection intensity

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III. Results and Discussion

The results (Table I) revealed no significant differences among hybrids (Babyle 113 x Iratome and Iratome x Babyle113) and their parents Babyle 113 and Iratome varieties for plant height, spike length, awn length and 1000- grain weight, while significant differences were observed for number of grain/spike, number of tillers/m and grain yields in hybrids Babyle 113 x Iratome and Iratome x Babyle 113 compared with their parents. The highest grain yield in two hybrids could be due to more number of grain/spike and tillers.

The direction of the cross has significant effect only on number of tillers/m (147) when Iratome was used as female parent in the cross (Iratome x Babyle 113).

TABLE I
Effects of Reciprocal Cross of Babyle 113 and Iratome Varieties on Different Traits

Parent/Cross	Plant Height (cm)	Spike Length (cm)	Awn Length (cm)	1000- Grain Weight (gm)	No.Grains/Spike	No.Tillers/m	Yield (Kg/ha)
Babyle 113	86.33a	9.67a	5.33a	43.67a	56.67b	98.00a	3758.68b
Iratome	91.00a	10.00a	5.33a	38.00a	39.33a	106.00a	2926.68a
Babyle 113 x Iratome	88.33a	12.33a	5.00a	41.33a	62.33bc	120.00b	4306.68c
Iratome x Babyle 113	88.33a	9.00a	5.00a	42.33a	65.00c	147.00c	4393.32c

Different letters show significant differences at P≤0.05 (Duncan).

The mean of parents Sawa and Tamose2 and their hybrids for different traits were presented in Table II. No significant differences revealed among genotypes in plant height, spike length and 1000- grain weight. Sawa variety had the highest awn length (6.67 cm). Hybrid Tamose2 x Sawa surpassed significantly hybrid Sawa x Tamose2 in grain number/spike which reached 69.33 and 58.67 respectively and also this hybrid surpassed significantly hybrid Sawa x Tamose2 and the two parental inbred in number of tiller/m (145.33) and grain yields (5100 kg/ha). The result showed that when Tamose2 was used as female parent in the cross (Tamose2 x Sawa), the number of grain/spike, tillers/m and grain yields were significantly increased.

TABLE II
Effects of Reciprocal Cross of Sawa and Tamose2 Varieties on Different Traits

Parent/Cross	Plant Height (cm)	Spike Length (cm)	Awn Length (cm)	1000- Grain Weight (gm)	No.Grains/Spike	No.Tillers/m	Yield (Kg/ha)
Sawa	94.00a	10.00a	6.67b	38.67a	67.67b	124.00b	4233.32a
Tamose2	91.00a	9.67a	5.00a	38.00a	61.67ab	104.67a	4200.00a
Sawa x Tamose2	88.00a	8.67a	5.00a	43.00a	58.67a	125.67b	3840.00a
Tamose2 x Sawa	84.33a	8.00a	5.00a	36.33a	69.33b	145.33c	5100.00b

Different letters show significant differences at P≤0.05 (Duncan).

Hybrids showed no significant differences from their parents Al Hashymya and Al Iraq in plant height and awn length (Table III). Al Iraq x Al Hashymya had the lowest spike length (8.33), 1000- grain weight (32.33 gm) and grain yields (3826.68 kg/ha) compared with hybrid Al Hashymya x Al Iraq and the two parents. 1000- grain weight and number of tillers/m traits were affected by the direction of the cross, since the utilization of Al Iraq as female parent in the cross (Al Iraq x Al Hashymya) decreased 1000- grain weight (32.33 gm) and increased the number of tillers/m (147).

TABLE III
Effects of Reciprocal Cross of Al Hashymya and Al Iraq Varieties on Different Traits

Parent/Cross	Plant Height (cm)	Spike Length (cm)	Awn Length (cm)	1000- Grain Weight (gm)	No.Grains/Spike	No.Tillers/m	Yield (Kg/ha)
Al Hashymya	88.67a	10.00c	5.00a	42.67b	64.00b	127.67ab	5137.32b
Al Iraq	92.00a	9.00ab	5.00a	44.00b	54.00a	121.67a	4393.32ab
Al Hashymya x Al Iraq	88.00a	10.33c	5.33a	40.67b	60.67ab	116.00a	4706.68ab
Al Iraq x Al Hashymya	81.67a	8.33a	5.00a	32.33a	67.67b	147.00b	3826.68a

Different letters show significant differences at P≤0.05 (Duncan).

Significant differences among the genotypes for grain yield and related characters in different sets of material of bread wheat were observed [10], [11]. Increased yield of crops is the goal of plant breeders who have been utilizing the available genetic resources to modify the existing crop varieties to meet the ever-changing requirements. The effect of the direction of cross was clearly identified for many traits [12], [13].

Correlation coefficients of grain yields with all characters of parents' varieties with their hybrids are presented in Table IV. Significant positive correlation was observed of yield with 1000- grain weight (0.597), grain/spike (0.773) and number of tillers/m (0.657) in the set Babyle 113, Iratome and their hybrids. In genotypes Sawa, Tamose2 and their hybrids significant negative correlation was observed between yield and plant height, while significant positive correlation was observed between yield and number of grain/spike (0.631) and tillers/m (0.622). Grain yields expressed significant positive correlation with spike length (0.679) and 1000- grain weight

(0.551) in the set contained Hashymya, Al Iraq and their hybrids.

Correlation is an essential tool for successful selection, especially the association between yield and its components which has successfully exploited for identifying high yielding genotypes

Saleem et al. [3] stated that grain yield was positive and significantly correlated with spike length, number of tillers and 1000 -grain weight. Hussain et al. [11] founded that grain yield had significant positive correlation with 1000- grain weight and grain/spike.

The association of number of tillers per plant with grain yield are supported with [1] who generally reported that number of tillers is an important yield contributing. Significant negative correlation between yield and plant height is in accordance with the results obtained by [14], the preference of short stature plants may be due to lodging resistance and positive response to fertilizers.

TABLE IV
CORRELATION COEFFICIENT BETWEEN GRAIN YIELDS AND ITS COMPONENTS IN WHEAT GENOTYPES

Genotypes	Plant Height (cm)	Spike Length (cm)	Awn Length (cm)	1000- Grain Weight (gm)	No.Grains/Spike	No.Tillers/m
Babyle 113 , Iratome and their hybrids	-0.137	-0.073	-0.352	0.597*	0.773**	0.657*
Sawa,Tamose2 and their hybrids	-0.543*	-0.424	-0.112	-0.344	0.631*	0.622*
Hashymya ,Al Iraq and their hybrids	-0.009	0.679**	-0.058	0.551*	0.224	-0.409

*,**significant at 5% and 1% level, respectively

Depend on the result of correlation we focused on the heritability and genetic advance of the traits 1000 - grain weight, number of grain/spike and tillers/m (Table V). Heritability estimates can be categorized as low (0- 30%), moderate (30-60%) and high (60% and above).

TABLE V
HERITABILITY ESTIMATES AND GENETIC ADVANCE VALUES FOR TRAITS IN SIX WHEAT CROSSES

Crosses	Heritability and Genetic Advance	1000- Grain Weight (gm)	No.Grains /Spike	No.Tillers/m
Babyle 113 x Iratome	h^2	50.00	49.00	63.00
	GA	4.80	2.61	19.81
Iratome x Babyle 113	h^2	6.00	28.00	35.00
	GA	0.44	2.00	6.27
Sawa x Tamose2	h^2	86.00	12.00	31.00
	GA	9.40	1.08	5.08
Tamose2 x Sawa	h^2	13.00	34.00	3.00
	GA	0.58	2.12	0.17
Al Hashymya x Al Iraq	h^2	48.00	57.00	83.00
	GA	2.25	6.09	27.92
Al Iraq x Al Hashymya	h^2	17.00	9.00	35.00
	GA	0.62	0.68	6.20

h^2 = heritability, GA = genetic advance

A.1000- Grain Weight

The highest value of heritability (86 %) was recorded for cross Sawa x Tamose2 having high genetic advance (9.40), this result indicates that 1000- grain weight is governed by additive gene action and offered the possibility of the improvement through selection in early generations. Moderate heritability with an average of 50% associated with genetic advance at 4.80 was observed for the cross Babyle 113 x Iratome which infers that selection needs to be delayed. Cross Al Hashymya x Al Iraq had moderate heritability (48) and genetic advance at 2.25 which indicated non - additive type of gene action controlling this character, so selection might be useful if delayed. The rest crosses had low heritability ranged from 6 to17% and low genetic advance (0.44-0.62) indicating slow progress through selection for this trait.

B. No. Grain/Spike

Moderate heritability (57%) and genetic advance with an average of 6.09 were recorded for cross AlHashymya x Al Iraq which is indicative of additive with partial dominance type of gene action suggesting the possibility of selection. Moderate values of heritability were found for cross Babyle 113 x Iratome (49%) followed by Tamose2 x Sawa (34%), associated with genetic advance values of 2.61 and 2.12 respectively

Low heritability with low genetic advance values were found for crosses Sawa x Tamose2 and Al Iraq x Al Hashymya, indicated non-additive gene action and less amenable for selection

C. No.Tillers/m

The crosses Babyle 113 x Iratome and Al Hashymya x Al Iraq showing high heritability coupled with high genetic advance that mean tillers character in those crosses was less influenced by environmental and can easily be fixed with simple selection resulting in quick progress

Iratome x Babyle 113, Sawa x Tamose2 and Al Iraq x Al Hashymya revealed moderate heritability ranged from 31 to 35% along with genetic advance ranged from 5.08 to 6.27 which result in intermediate expression for both additive and dominance gene effect.

Tamose2 x Sawa had low heritability (3%) with low genetic advance (0.17) that means care must be taken while breeding for this trait as it may be influenced by environmental factors.

Our results are in agreement with those of [5]-[7]. Heritability is the good parameter and plays an important role for designing selection procedure in plant breeding. Heritability along with genetic advances (the expected response to selection) is usually more useful and help breeder to determine how much of the phenotype would be passed on the next generation [15]-[17].

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