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VARIABILITY IN 19 VARIETAL WHEAT BLENDS AND GENOTYPIC AND PHENOTYPIC CORRELATIONS FOR MORPHOLOGICAL AND YIELD CHARACTERS

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Abstract

Cultivar mixtures have been suggested to increase the yielding ability and control crop diseases, but little information is available on how to choose component varieties for cultivar mixtures. A two year-study was directed to test the ability of two and four component wheat mixtures to increase yield and yield components. All of the 19 possible two and four variety mixtures of six Egyptian wheat varieties (*Triticum aesetivum* L.) and their counterparts were evaluated in the two seasons, 1992-1993 and 1993-1994. The performance of a blend can be evaluated by its yield per unit area and by its compensatory response for yield. Four of the two variety mixtures were superior in seed yield than the highest component of the mixture. The increase in yield above the high component varied from 0.11 ton/acre for the blend Sakha 61 with Giza 157 to 0.90 ton/acre for Sakha 61 with Sakha 69 in the two growing seasons. For each of the yield components, some blends were superior relative to either its higher counterpart or the mean of parents in pure stand. The mixtures with yield advantage comprised genotypes that were more diverse in height and relative maturity .

Some of the most important aspects to the wheat breeder are the number of spikelets per spike, weight of kernel and kernels weight per spike, which contribute significantly to grain yield. In most cases, genotypic correlations were higher than phenotypic correlations.

INTRODUCTION

Numerous studies discussed the theoretical advantages of diversity and the rational blending of individual lines has been recommended since the nineteenth century. Even So, there are surprisingly few comparisons between the productivity of genetically uniform and genetically diverse populations in self-pollinated crops. Recent studies of several different crops have suggested blending or mixing of crop cultivars within or among species to stabilize and perhaps to maximize production.

Allard (1961) found a relationship between the genetic diversity and consistency of performance in different environments and that pure-line populations were less stable than mixtures in producivity. Mixtures appear to be insured against low yields, but the genetic and ecological forces that produce stability in production do not endow mixtures with high average productive capacity.

Gustafsson (1953) found that mixtures of three barley cultivars were somewhat superior in number of spikes, number of kernels, total kernel weight and 1000 kernel weight than the three component cultivars .

Frey and Uriel Maldonado (1967) reported that a mixture of oat cultivars, when grown under a stress environment, actually yielded more than the mean of component cultivars. This occurred because, in a mixture plants that were not damaged by heat increased their productivity by utilizing nutrients and moisture, which the damaged plants could no longer use. Gbpaut (1970) found that a mixture of four wheat varieties produced more grain than their pure stand.

Perkoister *et al.* (1989) observed through the study of spring barley multilines that the advantage of mixtures increased with increasing mean level of resistance in the components isolines. Grain yield in both multilines and isolines increased with mean level of resitance, with most resistance multilines producing higher grain yield than yield predicted by the mean level of the components in pure stands. The results indicated that components with higher level of resistance gained the most benefit from being utilized in a multiline mixture.

Jensen (1954) pointed out that diversification is particularly suited to risk situations in oat production, which have been created primarily by plant pathogens, principally those causing crown and stem rust, which move freely between oat fields. He stated that, it may be possible to produce a satisfactory multiline variety through a blend of multiple pure lines, each of which is of a different genotype. Such a variety would be composed of pure lines chosen from the oat breeding programme for uniformity of appearance particularly height and matrity, resistance to disease and other characteristics essential for a basic desirable agronomic type. Each line used should contribute additional desirable genetic factors without affecting the phenotypic uniformity of the composite.

Correlations of agronomic and morphological characters with yield in different crops have been reported by several workers (Singh, 1989; Gibrel; 1990; Talukdar & Bans, 1982; Lebsock and Amaya, 1969; Fiuzat & atkins, 1953). These estimates are very helpful in determining the component of a complex trait such as yield, which is greatly affected by environmental variations. Consequently, selection based on seed yield itself is not always effective because of the confounding effects of the environment. Another approach towards improvement of yield may be to emphasize selection for its components. The three components of wheat grain yield are number of plants/m^2, number of spikes per plant and seed yield per spike.

MATERIALS AND METHODS

Six Egyptian bread wheat (*Triticum aestivum* L.) varieties with wide variations in their morphological and physiological growth rhythms and included types adapted to the different environmental regions in Egypt, were selected for the present study. The varieties were Sakha 61 (C1) Sakha 69 (C2), Sakha 92 (C3), Giza 157 (C4), Giza 160 (C5), and Giza 164 (C6). The pedigree and year of release for these varieties are presented in the following Table:

Variety	Pedigree *	Year of release
Sakha 61 (C1)	Inia/RL 4220//7C Yr "S"	1980
Sakha 69 (C2)	Inia/RL 4220//7C Yr "S"	1980
Sakha 92 (C3)	Napo 63 / Inia 66//Wern "S"	1987
Giza 157 (C4)	Giza 155// Pit 62/LR 64/3/Tzpp/Knot	1977
Giza 160 (C5)	Chenab 70/G. 155	1982
Giza 164 (C6)	Kvz / Buho "S" //Kal / Bb = veery "S"	1987

* Source : Wheat Research Dept., Field Crops Research Institute, ARC.

Two-component blends :

Fifteen mixtures were formed from the pervious six varieties on the basis of kernel weight seeds of each variety were mixed to produce approximately equal number of seeds for each blend in all possible two component mixtures .

Four component blends :

Four varieties from the above mentioned genotypes were mixed to achieve four different blends, each having a ratio of 3:1:1:1.

Twenty five wheat enteries (6 varieties in pure stand and 19 mixtures) were evaluated in the two growing seasons 1992/93 and 1993/1994. Each experiment was layed out as a partially balanced lattice design (Steel and Torrie, 1990) with six replications and three-row plots. Rows were 3.5 m long and 20 cm apart. The experiments were conducted at the Agricultural Experiment Station, Faculty of Agriculure, Cairo University, Giza. The sowing dates were on November 15 and 21 in the first and second seasons, respectively. However, the experiments were harvested in mid May in each season. The seeding rate was 60 kg / acre for each entry in pure stand or mixture. At heading, a representative sample of 50 flag leaves were used to estimated leaf area. At harvest, 30 plants each of one tiller were taken randomly from the inner row to estimate the plant and spike characters. Grain yield per unit area was determined by harvesting the inner row. The studied variables were :

1- Plant height (from soil surface to the ear base)
2- Spike length
3- Leaf area
4- Number of spikelets per spike
5- Number of kernels per spike
6- Number of spikes in one meter
7- Kernels weight per spike
8- 100 kernel weight
9- Grain yield/acre

Statistical procedures :

Analysis of variance :

A regular analysis of variance of partially balanced lattic designs with six replications for each year was carried out on plot means to compute variance and least significance difference among entries for each variable .

Phynotypic and genotypic correlation :

The covariance components from analysis of covariance were used to compute genotypic and phenotypic correlations between character pairs on a line means basis as follows :

Genotypic r = α (g 1.2) / {(α^2 91). (α^2 92)}$^{1/2}$

Where σg 1.2 is the genetic covariance between trait 1 and 2 ,α^2 g1 is the genetic variance of the first trait and α^2 g2 is the genetic variance of the second trait.

Phenotypic r = α (ph 1.2) / {(α^2 ph1). (α^2 ph2}$^{1/2}$

Where $_\alpha$ ph 1.2 is the phenotypic covariance of line means between the two traits and $_\alpha 2$ ph1 and $_\alpha 2$ ph2 are the phenotypic variances of line means for each trait, Miller *et al.* (1958).

RESULTS AND DISCUSSION

1- Mean performance :

a) Morphological characters :

The mean performance and mean squares of the varieties and their blends for morphological characters are presented in Table 1. In the first season, the varieties in pure stands did not differ significantly in plant height and number of spikelets per spike while the differences were significant in leaf area in the first season, and in plant height and number of spikelets per spike in the second season. Since the mixtures were made up of varieties that could not be easily separated morphologically, it was important to investigate the relationship between genetic diversity and productivity. Therefore, comparison between mixtures and their components in pure stand was undertaken .

1- Plant height :

As shown in Table 1, the pure stand varieties varied significantly in both seasons and ranged from 83.3 and 59.9 cm for Sakha 61 (C1) to 98.6 and 79.0 cm for Giza 164 (C6) in first and second seasons, respectively. Because of the heigh estimate for Giza 164, the highest mixture was Giza 164 with Sakha 92 (98.6 cm) and Giza 164 with Giza 157 (78.3 cm) in first and second seasons, respectively. Significant differences among mixtures in both seasons were indicated. In the first season,

Table 1. Mean performance and mean square for morphological characters of six wheat cultivars and its 1:1 two and 3:1:1:1 four component blends in 1992/1993 (S1) and 1993/1994 (S2)

Genotypes	Plant height (Cm)		Spike length (Cm)		Leaf area Cm2		Number of sip-kelets per spike	
	S1	S2	S1	S2	S1	S2	S1	S2
Sakha 61 (C1)	38.38	59.9	9.90	9.81	26.8	50.7	19.26	18.81
Sakha 69 (C2)	87.5	72.0	10.05	11.06	26.8	47.3	19.60	21.31
Sakha 92 (C3)	85.9	67.0	10.01	9.61	31.8	41.9	20.43	20.41
Giza 157 (C4)	85.3	74.3	10.25	9.98	34.1	52.1	19.41	18.71
Giza 160 (C5)	88.4	73.8	10.25	8.56	28.6	45.7	19.50	18.26
Giza 164 (C6)	98.6	79.0	10.56	10.41	34.3	48.0	20.28	19.16
Mean	88.16	71.0	10.17	9.90	30.40	47.61	19.74	19.44
1 : 1 Two Component blends								
C1 : C2	90.1	65.3	10.28	10.51	27.0	47.7	19.25	20.63
C1 : C3	85.1	62.1	9.73	10.16	30.5	45.9	18.61	19.36
C1 : C4	95.3	72.5	10.06	10.73	34.7	51.2	20.26	20.51
C1 : C5	91.4	65.8	9.90	9.91	27.6	48.5	20.03	19.46
C1 : C6	77.4	70.8	9.66	9.93	31.5	47.3	17.88	18.48
C2 : C3	91.5	72.7	10.23	10.66	32.9	48.2	21.08	20.63
C2 : C4	84.4	74.2	10.61	10.23	28.2	50.1	19.76	20.28
C2 : C5	92.6	75.7	10.08	10.46	27.5	49.2	20.16	21.40
C2 : C6	91.0	75.7	10.11	10.71	32.9	46.0	19.00	20.56
C3 : C4	89.6	71.0	11.15	10.88	33.8	46.5	21.16	20.08
C3 : C5	91.2	72.1	10.18	9.65	26.5	44.5	19.11	20.53
C3 : C6	98.6	73.0	10.81	10.41	34.1	48.9	21.10	19.98
C4 : C5	92.0	75.7	11.03	10.26	30.5	46.5	20.90	20.20
C4 : C6	90.4	78.3	10.30	9.80	35.9	48.8	20.15	18.75
C5 : C6	93.0	77.5	9.86	10.35	33.2	51.0	20.28	20.66
Mean	90.2	72.1	10.26	10.31	31.12	48.02	19.91	20.10
3 : 1 : 1 : 1 Four component blends								
C1:(C3:C5:C6)	85.4	67.8	10.08	9.60	33.6	46.3	19.10	19.04
C3:(C1:C5:C6)	85.6	71.0	10.12	9.60	28.6	43.9	20.50	19.56
C5:(C1:C3:C6)	94.2	70.7	10.15	9.25	27.0	45.9	19.50	18.85
C6:(C1:C3:C5)	89.5	74.7	10.30	9.86	31.3	45.3	19.65	19.13
Mean	88.6	71.0	10.16	9.57	30.12	45.35	19.65	19.14
Mean square	139.39	130.12	0.940	1.500	24.401	37.780	3.988	4.422
L.S.D.	7.8	12.5	0.131	1.270			3.40	2.10

the mixture C1: C4 had the longest plants while C4 : C6 was the longest blend in the second season.

The plants in the second season were shorter than in the first season. This could be due to the number of insufficient irrigations in the second season .

2- Spike length :

Data in Table 1 show that Giza 164 had the longest spike (10.6 cm) which differed significantly from all other varieties in both seasons except of Sakha 69 in the second season. The varietal mixtures differed significantly only in the first season and ranged from 9.7 cm for Sakha 92 or Giza 164 with Sakha 61 to 11.2 cm for Sakha 92 with Giza 157. In the second season spike length of pure stands ranged form 8.9 cm for Giza 160 (C5) to 11.1 cm for Sakha 69 (C2). For mixtures, it ranged from 9.3 cm for the four-component mixture (C5) : (C1 : C3 : C6) to 10.9 cm for the two-components blend (C3 : C4).

3- Leaf area :

For both seasons the differences in leaf area among all mixtures and their counterparts where not significant. Leaf area in the second season was larger than in the first season due to longer time between irrigations in the second season .

4- Number of spikelets per spike :

At the first season, the cultivar with the greatest number of spikelets per spike was Giza 164 (C6), producing 20.3 spikelets per spike. The three mixtures , Sakha 69 - Sakha 92 - Giza 157 and Sakha 92 - Giza 164 were singificantly higher than Giza 164. The maximum in number of spiklets advantage (6%) was for the mixture Sakha 92 - Giza 157. In contrast, in the second sowing season only one mixture (C2 : C5) gave more spikelets per spike with slight advantage, but there were eleven and ten blends having higher spikelets per spike than the mean of their counterparts in the first and second seasons, respectively .

b- Grain yield and yield components :

The components of grain yield in cereal crops are determined at different stages in the ontogeny of plants. Cannell (1969) showed that barely tillers, appearing after the main axis having five leaves failed to survive to head emergence. The number of spikelets in wheat is determined at the time of floral initiation, but variation in number of florets per spikelet can occur later. Since yield components are determined at different times, they are differentially affected by variation in environment. Thorne (1966) reported that low temperature between spikelet initaion and anthesis reduced tiller number, and that short days during the same period reduced kernel weight.

1- Number of kernels per spike :

The number of kernels per spike was estimated only in one season (S2) and is presented in Table 2. There was slight increase in this character when the cultivars were mixed. However the differences among all studied genotypes were significant. The number of kernels per spike of pure stands ranged from 37.05 in Giza 160 to 48.31 (Sakha 92), and from 29.45 for the blends Sakha 61 and Giza 160 to 53.65 for Sakha 61 and Giza 157 probably because of the large number of kernels of Giza 157 .

2- Number of spikes in one meter :

Table 2 presents the number of spikes in one meter which significantly varied among genotypes. This may be due to variation in the tillering ability. However, Giza 160 (C5) and Giza 157 (C4) showed the highest density in the first and second seasons, respectively. The blend (C2 : C5) had the highest number of spikes in both seasons .

3- Kernels weight per spike :

There was a slight difference in kernels weight per spike in both seasons. For pure stand varieties, Giza 160, and Giza 164 and Sakha 92 had the heaviest kernels in first and second seasons, respecively .

Two blends gave higher kernel weight than their counterparts, but they did not differ significantly from the other blends. However, kernels weight per spike ranged from 1.11 for C3 : C5 to 2.03 gm for C1 : C2 and from 1.08 for C2: C4 to 2.00 gm for C2 : C6 in the first and second seasons, respectively.

4- 100 kernel weight :

The differences among the pure stand varieties in the first season were significant only in the second season. However, in the first season, the pure stand varieties ranged from 2.90 for Giza 160 (C5) to 3.72 gm For Giza 157 (C4). In the

Table 2. Mean performance and mean square for grain yield and yield characters of six wheat cultivars and their 1:1 and 3:1:1:1 component blends in 1992/1993 (S1) and 1993/1994 (S2)

Genotypes	Number of kenels per spike	No of Spikes in one meter		Kernels weight per spike (gm)		100 kernel weight (gm)		Grain yield Ton/Acre	
	S1	S2	S1	S2	S1	S2	S1	S2	S1
Sakha 61 (C_1)	38.38	71	64	1.16	1.11	3.02	2.58	1.905	1.865
Sakha 69 (C_2)	42.36	80	68	1.43	1.28	3.56	3.28	2.175	1.905
Sakha 92 (C_3)	48.31	74	70	1.26	1.48	2.98	2.98	2.055	1.997
Giza 157 (C_4)	45.58	68	89	1.06	1.29	3.72	3.70	1.695	1.602
Giza 160 (C_5)	37.05	85	87	1.81	1.07	2.90	2.53	2.986	2.053
Giza 164 (C_6)	41.73	72	66	1.50	1.48	3.42	3.48	2.430	2.034
Mean	42.23	75	74	1.37	1.28	3.26	3.09	2.208	1.909
1 : 1 Two Component blends									
$C_1 : C_2$	41.11	75	70	2.03	1.25	3.61	3.30	3.071	2.244
$C_1 : C_3$	37.75	59	59	1.81	1.06	3.13	2.80	1.515	1.373
$C_1 : C_4$	53.65	81	82	1.33	1.73	3.53	3.16	2.610	1.919
$C_1 : C_5$	29.45	86	59	1.61	1.10	3.27	2.86	2.265	1.500
$C_1 : C_6$	40.61	62	64	1.20	1.33	3.32	3.20	1.710	1.496
$C_2 : C_3$	40.85	64	88	1.40	1.31	3.01	3.00	1.845	1.779
$C_2 : C_4$	41.76	64	77	1.81	1.08	2.66	3.46	1.635	1.497
$C_2 : C_5$	46.95	82	86	1.53	1.30	3.89	2.93	2.016	1.703
$C_2 : C_6$	49.93	62	68	1.15	2.00	3.27	3.50	1.785	1.940
$C_3 : C_4$	48.06	65	75	1.43	1.73	2.25	2.98	2.190	2.220
$C_3 : C_5$	44.71	73	85	1.11	1.45	2.83	3.28	1.890	2.030
$C_3 : C_6$	50.91	86	60	1.63	1.80	2.98	3.96	2.145	1.785
$C_4 : C_5$	50.50	75	75	1.48	1.51	2.84	3.06	2.520	2.16
$C_4 : C_6$	44.66	76	73	1.61	1.33	3.29	3.30	2.490	1.979
$C_5 : C_6$	39.21	79	67	1.65	1.29	3.16	3.06	2.190	1.756
Mean	44.00	73	73	1.47	1.41	3.13	3.12	2.125	1.829
3 : 1 : 1 : 1 Four component blends									
C1:(C3:C5:C6)	40.37	70	83	1.28	1.22	3.30	2.82	1.965	1.649
C3:(C1:C5:C6)	43.68	77	73	1.33	1.35	3.18	3.03	1.965	1.806
C5:(C1:C3:C6)	39.92	75	84	1.55	1.21	3.44	2.81	1.995	1.684
C6:(C1:C3:C5)	41.48	84	80	1.44	1.35	3.92	3.12	2.265	1.972
Mean	41.36	77	80	1.40	1.28	3.46	2.94	2.045	1.777
Mean square	207.18	48	522.60	0.340	0.444	0.890	0.419	46.94	42.431
L.S.D.	10.72	28.0	23.0	1.33	0.097	0.138	0.133	1.030	0.590

second season they ranged from 2-53 for C5 to 3.70 gm for C4. The mixtures differed significantly in the two seasons and the four and two counterparts blends C6: (C1 : C3 :C5) and (C3 : C5) had the highest weight of 100 kernels in the first and second seasons, respectively. This may indicate that the variety Giza 160 stimulated the increase of kernel weight in the blend in which it was involved .

5- Grain yield per acre :

The performance of six component varieties in pure stand is compared with the respective two and four components mixtures for seed yield and the results are given in Table 2. The differences in grain yield per acre among genotypes were significant in both seasons . The mean grain yield for each of the three genotypes in the first season was higher than its respective in second season. There were few significant differences between genotypes in each group. When growing in pure stand, Giza 160 was significantly higher in yield than the other varieties in both seasons.

Three mixtures, vis. Sakha 61- Sakha 69, Sakha 61-Giza 157 and Giza 157-Giza 164 in the first season and Sakha 61-Sakha 69 and Sakha 92-Giza 157 or Giza 160 in the second season outyielded both their components grown in pure-stand. Also Jokinen (1991) found that some mixtures produced higher relative yield than monocultures but the differences were not significant.

Sage (1971) suggested that yields of wheat mixtures tend toward the yield of the higher yielding component and that in sepecific cases mixtures can have a significant yield advantage over pure stands. Dziomba and Styk (1992) found that the highest barley grain yield were from some of pure stands and their blends. Hartleb and Skadow (1992) reported that the percentage of the area under spring barley where variety mixtures were grown has increased from 10% in 1984 to 92% in 1990. Manthey and Fehrmann (1993) found that cultivar mixtures in wheat decreased disease development and gave higher yields than pure stands in field trials over seasons and also the varietal mixtures gave a higher profit than the respective pure stands .

II - Phenotypic and genotypic correlation :

All possible phenotypic and genotypic correlations between 8 characters were computed from the combined analyses of three genotype populations for two seasons. A number of interesting relationships can be observed from Table 3. Some of the most important relations to the wheat breeder are grain yield, and number of spikelets per spike, weight of kernel per plot and kernels weight per spike, and those had highly positive significant phenotypic correlation coeficients, which agrees with Salem *et al.* (1976) and Herbert *et al.* (1955). Significant positive phenotypic correlation with 100 kernel weight (Salem *et al.* 1976, Singh 1986, Talukdar & Bans 1982 and Mikheev, 1993). These correlation coefficients were high enough to encourage selection for these traits as criteria for yield improvement .

Other highly significant positive correlations worthy of attention are those between grain yield and plant height (0.42) and spike length (0.32). Chaudhary and Singh (1993) found similar results. In most instances the genotypic correlations were higher than the phenotypic correlations (Table 3). This pattern of genotypic association is in harmony with the findgins of other investigators (Herbert et al, (1955); Sidwell *et al.* (1976; Salem *et al.* 1976 and Weber and Moorthy 1952). Also, Nachit and Jarrah (1986) and Johnson et al. (1966) found that some genotypic correlation values exceeded unity. These anomalous values obviously resulted from the differences in magnitude and sign of the environmental, genotypic, phenotypic covariances which introduced a bias into the estimation of genotypic covariance. Similar interpretation for the genotypic correlations which exceeded unity was given by Abo El-Zahab et al, (1992).

The correlations presented in Table 3 indicate that grain yield was positively correlated genetically with plant height, spike length and number of spikelets per spike. The genotypic correlations of other traits with grain yield were negligible. In general, these estimates suggest that early selection for morphological characters such as plant height, spike length and number of spikelets per spike could improve grain yield. Hovever, Singh (1989) reported that in most instances, grain yield had slight negative correlation with plant height. Gibrel (1990) observed that grain yield / spike and plant height were significantly positively correlated with grain yield.

The phenotypic correlations between 100 kernel weight and plant height and kernels weight per spike were highly significant and positive (0.40 and 0.25, respectively). The correlation coefficient between 100 kernel weight and spike length was however significant and negative (-0.22). Talukdar and Bans (1982) found positive correlation between these traits. The other studied characters had moderate and low phenotypic correlation with 100 kernel weight. Exception of positive genotypic correlation coefficients for 100 kernel weight with plant height and spike length, the other genotypic correlation coefficient of 100 kernel weight with other studied characters were negligible. However, Lebsock and Amaya (1969) reported

Table 3. Phenotypic and genotypic correlation between all pairs of 8 characters means measured in pure and mixed stand of six wheat cultivars.

		Spike Length (cm)	Leaf Area	Number of Spikelets Per spike	Weight of Kernels per plot	Kernels weight per spike	100 kernerl weight (gm)	Grain Yield
Plantheigh	(Ph)	0.3915**	0.3321**	0.5032**	0.4293**	0.4162**	0.4010**	0.4231**
	(g)	1.8501**	0.5556**	0.9187**	0.0000	0.0000	1.0740**	1.3903
Spike length	(Ph)		0.1639	0.5798**	0.3273**	0.3273**	-0.2200*	0.3181**
	(g)	-	0.7743**	0.9335**	0.0000	0.0000	-0.5669*	1.3403*
Leaf Area	(Ph)			-0.0690	-0.1359	0.0593	0.1217	-0.1879
	(g)			0.1444	0.0000	0.0000	-0.2878	-3.3507
Number of spikelets per sipke	(Ph)				0.4713**	0.3768**	-0.1050	0.3970**
	(g)				0.0000	0.0000	-0.2878	1.8415**
Weight of kernels per plant	(Ph)					0.7593**	0.2146	0.8877**
	(g)					0.0000	0.0000	0.0000
Kernels weight per spike	(Ph)						0.2462**	0.7195**
	(g)						0.0000	0.0000
100 - kernel weight	(Ph)							0.1992*
	(g)							-1.5658

*,** Significant at 0.05 and 0.01 levels of probability, respectively

that 100 kernel weight was correlated significantly and positively with plant height in durum wheat crosses. They also found that genotypic correlation coefficients were generally similar in sign to the corresponding phenotypic coefficients and were often larger than phenotypic values .

Kernels weight per spike was highly significant and positively related to plant height, spike length, number of spikelets per spike and weight of kernels plant. It is worth to mention that from the breeders point of view, selection for imprvoing plant height, spike length, number of spikelets per spike and weight of kernels per plant will improve in kernels weight per spike. Similar interrelationships between wheat characters reported herein were found by several authors (Fiuzat and Atkins, 1953 and Fischer 1976). Another correlation worthy of attention is that between weight of kernel per plot and plant height, spike length and number of spikelets per spike, which had high positive significant correlation coefficients of 0.43, 0.33 and 0.47, respectively. Similar results were found by Sidwell (1976), Salem *et al.* (1976) and Nachit and Jarrah (1986).

All possible associations among the three studied morphological characters i.e, spikelets per spike, spike length and leaf area had high significant positive phenotypic correlation coefficients. The corresponding genotypic correlation coefficients were generally positive and were often larger than the phenotypic values .

The simple correlation for leaf area was highly significant only with plant height. The insignificant correlation between leaf area and other studied traits may be due to the fact that the studied materials were mixtures from different cultivars having characters related with total leave area, such as plant height and number of leaves per plant.

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التباين فى تسعة عشر خليطا من القمح والإرتباط الوراثى والمظهرى للصفات المظهرية والمحصولية

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تستخدم مخاليط الاصناف لزيادة القدرة الانتاجية ومجابهة النقص الناجم عن الأصابة بالامراض ولكن نظرا لقلة المعلومات المتاحة عن مخاليط أصناف القمح المصرية وصعوبة اختيار الآباء الملائمة للخلط فقد تم اجراء هذه الدراسة خلال الموسمين الزراعيين ١٩٩٢ / ١٩٩٣ – ١٩٩٣ / ١٩٩٤، واستخدم فيها ستة أصناف مصرية من القمح وهى سخا ٦١ ، سخا ٦٩ ، سخا ٩٢ ، جيزة ١٥٧ ، جيزة ١٦٠ وجيزة ١٦٤ وكذلك خمسة عشر من المخاليط الثنائية (صنفين) وأربعة من المخاليط الرباعية (أربعة أصناف) وأوضحت النتائج تفوق أربعة من المخاليط الثنائية وهى سخا ٦١ مع سخا ٦٩ ، سخا ٦١ مع جيزة ١٥٧ ، سخا ٩٢ مع جيزة ١٥٧ مع جيزة ١٦٠ فى محصول الحبوب عن الأب الأعلى المكون فى كل منهما وكانت تلك الزيادة تتراوح من ١١, طن / ايكر للخليط سخا ٦١ مع جيزة ١٥٧ الى ٩٥, طن / ايكر للخليط سخا ٦١ مع سخا ٦٩ ، أما بالنسبة لكل من مكونات المحصول كانت هناك مخاليط متفوقة إما على الأب الأعلى أو على متوسط الصنفين المشاركين فى الخليط.

من أهم العلاقات الأرتباطية بين الصفات التى تهم مربى النبات تلك الموجودة بين المحصول ومكوناته ، وقد وجد ارتباط موجب ومعنوى بين محصول الحبوب وكل من عدد السنيبلات فى السنبلة ووزن حبوب القطعة ووزن حبوب السنبلة وكذلك مع كل من طول النبات وطول السنبلة كما لوحظ فى معظم الحالات زيادة الارتباط الوراثى عن نظيره المظهرى بين الصفات.