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STUDIES OF CORRELATION AND PATH COEFFICIENT ANALYSIS FOR SOME YIELD ATTRIBUTES IN SOME BREAD WHEAT GENOTYPES UNDER TWO ENVIRONMENTS.

Tammam, A. M., E. A. M. EL-Sayed and M. B. Tawfelis
Wheat Research Program, Field Crops Research Institute, ARC, Egypt.

ABSTRACT

This study was conducted at Res. farm of Shandaweel Agric. Res. station, Agric. Res. Cen. (ARC) Egypt, during the period of 2001/2002 – 2003/2004 seasons, to estimates of phenotypic, genotypic correlations and path coefficient analysis in five bread wheat genotypes, F_1 hybrids and three F_2 populations under two treatments of irrigation (normal and drought stress).

The results showed that grain yield/plant had positive and significant correlations with each of number of spikes / plant, 100 kernel weight, plant height and days to maturity under the two treatments of irrigation in the parents and F_1 hybrids for both magnitudes of correlations. Meanwhile, in the F_2 populations grain yield / plant showed varied values of correlations from positive and significant to insignificant in both phenotypic and genotypic correlations according to cross with previous traits. Similarly, phenotypic and genotypic correlations between grain yield / plant and each of number of kernels / spike and days to heading were negative in the parents only under normal irrigation, while the relationships of these traits was positive in the F_1 hybrids under the two treatments of irrigation.

Also, the results revealed that number of spikes / plant had positive and significant correlation with each of 100 kernel weight and days to maturity in the parents under the two irrigation treatments and positive insignificant correlations with each of plant height and days to heading in all studied genotypes under the irrigation treatments, while it showed negative and significant correlations with number of kernels / spike in the parents and in the F_2 populations of crosses No 2 (p_2 x p_3) and No 3 (p_4 x p_5) .

The phenotypic and genotypic correlations were positive and significant between number of kernels / spike and each of kernel weight and number of days to heading in the parents under normal irrigation and in the F_1 hybrids with kernel weight and plant height. Meanwhile, in the F_2 generations the relationships differed from positive to negative correlations according to population.

Also, the relationships between 100 kernel weight and each of plant height, days to heading and days to maturity varied from positive to negative significant or insignificant according to genotypes and irrigation treatments. Plant height revealed positive correlations with days to heading in the parents and F_1 hybrids under the two irrigation treatments and cross No 1 (P_1 x P_2) in the F_2 generation under drought stress only.

Days to heading showed negative correlations with days to maturity in the parents and in the F_1 hybrids under normal irrigation, while had positive and significant correlations under drought stress with all studied generations.

Path coefficient analysis under normal irrigation showed that grain yield was directly affected by number of kernels / spike in all studied generations and number of spikes / plant in the (F_1hybrids and cross No3 in F2 population). Meanwhile, under drought stress , grain yield was affected directly by number of spikes / plant in the parents and in the F_2 population of cross No3, number of kernels / spike in the in the

F_2 populations of crosses No 1 and 2 and 100 kernel weight in the parents and in F_2 population of cross No 2.

These results revealed that selection for lines having high number of spikes, number of kernels / spike and heavy kernel weight will result in lines having high yielding ability.

INTRODUCTION

Grain yield in wheat (*Triticum aestivum* L.) is a complex quantitative character. It is the final expression and contributions of its components. Yield or some of its components (number of spikes / plant, number of kernels / spike and kernel weight) can't be used as criteria for selection since their heritability values are low and display wide fluctuations as a result of their interaction with the environmental conditions (Grafius 1956 and Paroda and Joshi 1970).

Many investigators studied phenotypic and genotypic correlations using path coefficient analysis. Fonseca and Patterson (1968), revealed that grain yield had a positive simple correlation with each of number of spikes, kernels/spike and kernel weight with values 0.708, 0.178 and 0.400, respectively. The direct effect of number of spikes on grain yield was positive and highly significant (0.976), while, the indirect effect via number of kernels / spike was negative (-0.347). The direct effect for number of kernels/spike was positive and significant (0.718), but the indirect effect via number of spikes was negative (-0.470). The direct effect for kernel weight on yield was positive and non-significant (0.314), as the indirect effect via number of spikes was positive (0.230), being small and negative effect via number of kernels/spike.

Paroda and Joshi (1970) reported that 1000 kernel weight was genetically associated with grain yield / plant, whereas number of kernels / spike and number of spikes / plant were negatively associated with all studied characters at genotypic level. Path coefficient analysis revealed high direct and positive effect of all yield components except, number of kernels / spike which showed negative direct effect. Meanwhile, Yunus and Parada (1982), Kumar and Chowdhury (1986), El-Sayed (1990) and Eissa and Awad (1994), concluded that number of spikes / plant, number of kernels / spike and 1000 kernel weight were the most important components of wheat grain yield.

Joshi *et. al.* (1982), Kamboj and Mani (1983) Loffler *et. al.* (1985) and Zakria (2004) showed that genotypic and phenotypic correlation between plant height and grain yield per plant were negative and non-significant. On the other hand, Sinha and Sharma (1979) recorded positive and significant correlation between grain yield and plant height. The correlation coefficients between plant height and each of number of effective tillers, number of grains per spike and 1000 grain weight were positive and significant. Although Karrar (1980) showed that the phenotypic and genotypic correlations between plant height and each of grain yield, number of kernels per spike and 1000 kernel weight were negative and significant, grain yield had positive and significant phenotypic and genotypic correlations with each of number of spikes / plant, number of kernels /spike, 1000 kernel weight and days to heading. Moreover, Ehadaie and Waines (1989), Busch and Rauch (1993) and Tammam *et. al.* (2000) reported that grain yield had positive correlation with each of days to heading, number of spikes / plant, number of kernels / spike in the F_1 and only for genotypic level in the parents and F_2 populations, and with 1000 kernel weight in the parents and for genotypic correlation in the F_2 populations. Mitkees *et. al.* (1992) and El-Banna and Basha (1994) found that the direct effect of number of spikes on grain yield was (0.797), however the indirect effect via kernels /spike or via kernel weight were relatively low. The direct effect of number of kernels/spike was (0.301) and the indirect effect via 1000 kernel weight was low (0.094), compared with that via number of spikes / m^2 (0.580). Meanwhile, 1000 kernel weight showed low direct effect (0.180) and the indirect effect via number of spikes / m^2 was (0.218) and via kernels/ spike was (0.263). Also, the results of Tammam *et. al.* (2000) indicated that the path coefficient analysis showed that grain yield was affected directly by number of spikes /plant, number of kernels / spike and 1000 kernel weight in both phenotypic and genotypic correlations.

The present investigation devoted to estimate the relationships between grain yield / plant and each of number of spikes / plant, number of kernels / spike, kernel weight, plant height, days to heading and days maturity under two water regimes. In addition, the relationships would be partitioned to the direct and indirect effect for number of spikes / plant, number of kernels / spikes, kernel weight and plant height on yield. The study involved parents, F_1's and three F_2 populations.

MATERIALS AND METHODS

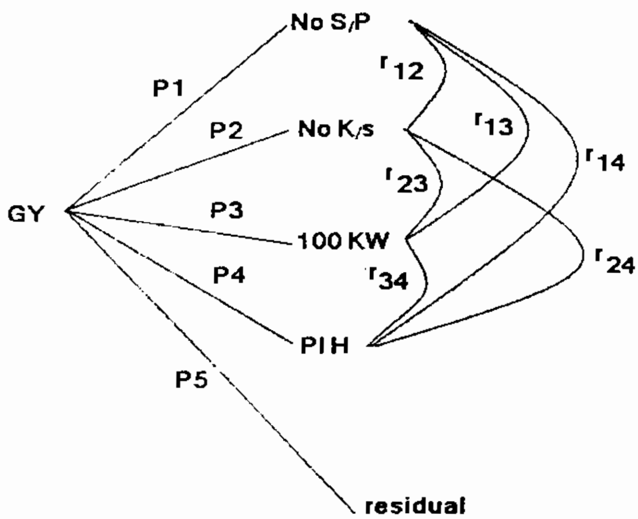
The field work of this study was conducted at Shandaweel Agricultural Research station, Agricultural Research Center (ARC), Egypt. Five different bread wheat genotypes representing a wide range of genetic variability were used during the three successive growing seasons (2001/2002, 2002/2003 and 2003 / 2004). Name and pedigree of the five parental genotypes are presented in Table (1).

Table (1): Name and pedigree of the five tested parental genotypes.

NO	Name and pedigree
P1	T. aest / kal. Bb (cno. Chr / OM / Gall s / Sa 42.
P2	Yacora Rojo.
P3	Sakha 69.
P4	Fto (W711) Imuris.
P5	HD 2501.

In 2001/2002 season, crosses were made to produce three hybrids namely P_1x P_2, P_3 x P_4 and P_4 x P_5. In 2002/2003, each of the parents and the three F_1 hybrids were grown in one row 1m long and 30 cm. a part, to produce F_2 generations and at the same time, the three F_1's were reconstructed. In 2003/2004, the parents and their respective F_1 and F_2 generations were grown in a randomized complete block design (RCBD) with four replications according to Steel and Torrie (1980), under two different water regimes, i.e. normal irrigation (6 irrigation), and water stress (3 irrigations). Each genotype of the parents and the 3 F_1 hybrids were sown in one row, while each of the 3 F_2 crosses were seeded in six rows in each replicate. The row was 3.0 m long and 10 cm between plants and the rows were 30 cm. apart. Data were collected on ten random competitive plants of parents and F_1 hybrids and from F_2 generations forty plants from each replicate to determine number of days to heading (HD), number of days to physiological maturity (MD), plant height (PL.H), number of spikes/plant (No.S/P), number of kernels / spike (No.K/s), 100 kernel weight (100 K.wt) and grain yield /plant (G.y/pl.). To perform statistical analysis, 5 parents and 3 F_1 hybrids were analyzed together while the three F_2 populations were separately analyzed. The analysis of variance and covariance of the seven traits and their combinations were calculated as reported by Steel and Torrie (1980), aiming to estimate phenotypic and genotypic correlations (r_p and r_g), respectively for every population under the two water regimes.

Path coefficient analyses were performed according to Wright(1934) and similarly to those applied by Dewey and Lu (1959), Durate and Adams (1972) and Sidwell et al (1976).



Figure(1): illustrates a flow chart representing the path coefficients and correlations between grain yield / plant and each of number of spikes / plant, number of kernels / spike,100 kernel weight and plant height.

Finally assuming one unit variance, the following equation was used to compute coefficient of determination of the suggested modal to evaluate the relative importance of yield components, the interaction and the non-estimated factors P_0 (Residual value) deviates components of variation due to one estimated factors

$P_1^2+P_2^2+P_3^2+P_4^2+2r12P_1P_2+2r13P_1P_3+2r14P_1P_4+2r23P_2P_3+2r24P_2P_4+2r34P_3P_4+P_0=1$

RESULTS AND DISCUSSION

1-Correlation studies:-

In order to detect the suitable plant characters that can be used by breeders as criteria for selection under normal and water stress conditions, the phenotypic and genotypic correlation coefficients among various characters were estimated on parents, F_1 hybrids and F_2 populations (Table 2 and 3). The significant relationships (correlations) among yield components can illustrate the influence of its genetic make up (Yunus and Paroda 1982).

Phenotypic and genotypic correlation coefficients between grain yield and number of spikes / plant (Tables 2 and 3) was significantly positive under the two irrigation treatments for parents, F_1 and the three F_2 populations except for the phenotypic correlation of F2 population of cross No. 3 under water stress condition. The genotypic correlation under normal condition for population derived from cross No.3 (P_4x P_5) couldn't reach the significant level (r_g= 0.02), while, it was significantly negative under water stress conditions (r_g= -0.70*). similar results were obtained by Zakria (2004).

The phenotypic and genotypic correlation coefficients between grain yield and number kernels /spike under normal irrigation (Table 2) were positive and significant for 3 crosses in the F_2 and F_1 and they were negative in the parents and significant in the genotypic level only. On the other hand, under drought treatment they were significantly positive for parents and for the F_2 population derived from cross No.1 . Genotypic correlation between grain yield /plant and kernel weight was significant for the parents under the two irrigations treatment , F_1 hybrids, cross No. 2 and cross No.3 under drought irrigation. On the other hand, phenotypic correlation for the two traits was positive and significant for the parents, negative and significant for F_1 crosses under two level of irrigation and positive and significant for cross No2 and negative and significant under drought treatment only. The phenotypic and genotypic correlation between grain yield / plant and plant height was significant and positive under two level of irrigations for parents, F_1 and cross No.3 in the F_2 population under normal irrigation and cross No.2 under drought irrigation (Table 3). Also the genotypic correlation between grain yield / plant and plant height was significant with cross No.1 under drought and cross No.2 under normal irrigation. Phenotypic correlation was significant and positive between grain yield/ plant and heading date for F_1, cross No.1 in F_2 population under drought stress, and cross No.3 under normal irrigation. Meanwhile, the genotypic correlation for the two traits was significant and positive for

F_1 under two level of irrigation treatments, negative and significant for cross No.2 under drought stress and positive and significant for cross No.3 under normal irrigation.

The genotypic and phenotypic between grain yield / plant and maturity date were positive and significant under two treatments of irrigation for parents, F_1 hybrids . On the other hand, the crosses in the F_2 generations showed positive and significant phenotypic correlation. Also in the F_2 generation crosses No. 1, 2 and 3 showed positive and significant genotypic correlation under drought stress and crosses 2 and 3 under normal irrigation treatment. These results are in agreement with those reported by Fonseca and patterson (1968), Paroda and Joshi (1970), Yunus and Paroda (1980), El.Sayed (1990), Tammam *et. al*. (2000) and Zakria (2004).

Number of spikes / plant showed negative and significant phenotypic and genotypic correlation with number kernels / spike in the most genotypes under two level of irrigations, except with F_1 hybrids under normal irrigation (Table 2). The phenotypic and genotypic correlation coefficients between number of spikes / plant and kernel weigh was positive and significant in all generations except in the F_1 hybrids under normal treatment of irrigation.

The correlation between number of spike / plant and heading date revealed insignificant values under normal treatment of irrigations except the genotypic magnitude in the crosses No 1 and 3. The phenotypic and genotypic correlation coefficient between number of spikes / plant and maturity date was significant and positive for parents, F_1 and genotypic for cross No.3 under normal irrigation. While the genotypic correlation was positive and significant for parents, F_1 hybrids and crosses No. 2 and 3 under drought treatment irrigation (Tables 2 and 3). These results are in agreement with those obtained by Fonseca and Patterson (1968),Tammam *et. al.* (2000) and Zakria (2004).

Study the phenotypic and genotypic correlations under normal and drought treatments irrigation, (Tables 2 and 3), respectively, for number of kernels / spike and kernel weight were positive and significant for parents in normal and drought treatments irrigation, negative and significant for cross No.2 under drought treatment irrigation, positive and significant for F_1 and negative and significant for cross No.3 in the F_2 generation under normal irrigation. The correlations coefficient between number of kernels / spike and plant height under two treatments of irrigation were nonsignificant for parents, and significant for F_1 hybrids and ranged from r_g = - 0.18 in the cross No. 2 to r_g = 0.30 in the crosses No. 2 and 3 under normal treatment irrigation (Table 2).Meanwhile its had quite values in the 3 crosses of the F_2 populations but had positive and significant values in the parents and F_1 hybrids under drought stress. The most values of correlation coefficients between number of kernels / spike and heading date were positive or negative and non-significant except genotypic values for parents under drought treatment irrigation was positive and significant, phenotypic and genotypic correlation for cross No.2 were negative and significant under drought treatment. On the other hand, parents, F_1 hybrids, crosses No.2 and No.3 in the F_2 generations under drought treatment recorded positive or negative phenotypic and genotypic correlation coefficient for number of kernels/ spike and maturity date. Fonseca and Paterson(1968), El-Sayed (1990) and Tammam *et. al.* (2000) showed the same results.

The phenotypic and genotypic correlation coefficients between 100-kernel weight and plant height under normal treatment the F_1 hybrids, cross No.1 and cross No.2 in the F_2 generations showed negative and significant phenotypic and genotypic correlation. On the other hand, it were positive or negative significant in the most values of correlation under drought treatment. The correlation coefficient between 100- kernel weight and heading date under normal irrigation for parents was negative and significant as will as positive and significant for F_1 and cross No.2 in the F_2 generation (genotypic correlation) and negative and significant phenotypic correlation for cross No.1 in the F_2 generations but it were mostly insignificant except genotypic correlation for F_1 hybrids and cross No.3 under drought treatment irrigation were negative and significant. The phenotypic and genotypic correlations between 100 - kernel weight and maturity date were positive and significant in the parents, F_1 and cross No.1 in the F_2 generations under drought treatment and parents and cross No.3 in the F_2 generation under the normal irrigation. Also the F_1 hybrids and cross No.2 in the F_2 generations showed negatives and significant phenotypic and genotypic correlation between 100- kernel weight and maturity date under normal irrigation. This result is agreement with those obtained by Kumar and Chowdhury (1986),and Sinha and Sharma (1979).

The phenotypic and genotypic correlation coefficient between plant height and heading date were significant and positive in the most case studied under drought treatment. On the other hand, the same two traits don't show significant under normal irrigation except F_1. Meanwhile the genotypic correlation between plant height and maturity date were positive and significant for parents under two levels of irrigations, cross No.1 and F_1 hybrids under drought treatment. This result in the same obtained by Sinha and Sharma (1979) El-Sayed (1990) and Tammam *et. al.* (2000).

The phenotypic and genotypic correlation were significant and positive between plant height and heading date in the F_1 hybrids under both treatments of irrigation and cross No.1 under drought stress. While it was positive and insignificant in the parents under two levels of irrigation except genotypic magnitude was significant for drought stress. As well as, in the F_2 populations it were negative and insignificant in the crosses No.1 and 3 (normal irrigation), crosses No.2 and 3 (drought stress). The relationship between plant height and days to maturity was positive and significant in all studied genotypes under normal irrigation except crosses No. 1 and 3 of the F_2 generations (Tables 2 & 3).

The phenotypic and genotypic correlation coefficients between heading date and maturity date under normal irrigation (Table 2), the genotypic correlation was negative and significant in the F_1, positive and significant in the cross No.1 in the F_2 generation but the phenotypic correlation was positive and significant in the cross No.1 and cross No.3 in the F_2 generation (Table 2). On the other hand, it were positive and significant for all populations studied under drought treatment irrigation (Table 3). These results are in line with those obtained by Sinha and Sharma (1979) El-Sayed (1990) and Tammam *et. al.* (2000).

2-Path coefficients study:-

Results of the partitioning of simple correlation coefficients into the direct and indirect effect under normal and drought treatment irrigations are shown in Table 4 and 5, respectively. The highest direct phenotypic correlation effect on grain yield under normal irrigations was number of kernels /spike for parents, F_1 and three crosses in the F_2 generations, On the other hand, the highest direct phenotypic effect on grain yield under drought treatment irrigations were found with number of spikes per plant for parents,

F_1 and cross No.3 in the F_2 generations and number of kernels / spike for cross No.1 and No .2 in the F_2 generations. Meanwhile the highest direct genotypic correlation effect on grain yield under normal irrigation was number of spikes/plant for F_1 and cross No.3 in the F_2 and number of kernels /spike for cross No.1 in the F_2. normal irrigation was number of spikes/plant for F_1 and cross No.3 in the F_2 and number of kernels /spike for cross No.1 in the F_2 population, but under drought treatment irrigations was 100-kernel weight for parents, F_1 hybrids, cross No.2 in the F_2 and number of kernels /spike for cross No.1 in the F_2 population. These results indicate that selection for grain yield must be have great number of spikes /plant fowled by number of kernels /spike and heavy kernels may be gave lines which have high yielding ability. These results were confirmed by Fonseca and Patterson (1968), Ehdaite and Waines (1989), Yunus and paroda (1989), El-Sayed (1990), Mitkees *et. al.* (1992) as well as Eissa and Awaad (1994).

Table(2): Phenotypic (ph) and genotypic (g)correlation coefficients among some studied characters under normal condition.

Source of variation	Parents		F_1 hybrids		F_2 population					
					Cross No1		Cross No2		Cross No3	
	Ph	G	Ph	G	Ph	G	Ph	G	Ph	G
G.Y/PL x No.S/PL	0.72*	0.79*	0.90*	0.92*	0.36*	0.28*	0.46*	0.55*	0.35*	0.02
G.Y/PL x No.K/S	-0.27	-0.50*	0.90*	0.92*	0.55*	0.68*	0.26*	0.35*	0.36*	0.62*
G.Y/PL x100 KW	0.51*	0.81*	-0.56*	-0.95*	0.11	0.28*	0.09	0.10	0 23	-0.25
G.Y/PL x PLH	0.61*	0.80*	0.94*	0.98*	0.07	0.12	0.09	0.10	0.47*	0.96*
G.Y/PL x H.D.	-0.05	-0.11	0.25	0.44*	-0.04	0.04	0.04	0.01	0.27*	0.69*
G.Y/PL x M.D.	0.50*	0.87*	0.65*	0.83*	-0.07	0.10	-0.11	-0.17*	-0.21*	-0.45*
No.S/PLx No.K/S	-0.69*	-0.90*	0.79*	0.98*	-0.01	-0.31*	-0.29*	-0.19*	-0.28*	-0.55*
No.S/PLx 100 KW	0.71*	0.86*	-0.68*	-1.00*	0.17*	0.46*	0.05	-0.03	0.11	0.36*
No.S/PLx PLH	0.29	0.32	0.81*	0.96*	0.06	0.20*	0.16*	0.22*	0.18*	0.41*
No.S/PLx H.D.	0.04	0.12	0.30	0.32	-0.08	-0.18*	-0.20	-0.16	0.13	0.28*
No.S/PLx M.D.	0.60*	0.98*	0.65*	0.89*	-0.21*	-0.33*	-0.01	-0.02	0.04	0.24*
No.K/S x100 KW	0.71*	0.86*	0.79*	0.98*	-0.06	-0.05	-0.03	-0.07	-0.16*	-0.16*
No.K/S x PLH	0.24	0.26	0.75*	0.77*	0.18*	0.30*	-0.09	-0.18	0.21*	0.30*
No.K/S x H.D.	0.35*	0.29	-0.12	-0.02	0.01	-0.03	0.55*	0.66*	0.07	-0.02
No.K/S x M.D.	-0.66*	-0.79*	0.76*	0.91*	-0.14	-0.26*	-0.10	0.02	-0 27*	-0.44*
100 KW x PLH	0.26	0 28	-0.43*	-0.81*	-0.21*	-0.49*	-0.20	-0.29*	-0 11	0.09
100 KW x H.D.	-0.22	-0 35*	0.01	0.45*	-0.19*	-0.23*	0.07	0.21*	0.03	0.25*
100 KW x M.D.	0.67*	0.77*	-0.69*	-0.78*	0.05	0.18*	-0.32*	-0.86*	0.26*	0.65*
PLH x H.D.	0.26	0.31	0.52*	0.65*	-0.19	-0.22	0.10	0.15	0.05	-0.13
PLH x M.D.	0.37*	0 39*	0.47*	0.62*	-0.31*	-0.82*	0.25*	0.36*	-0.14	-0.25*
H.D. x M.D.	-0.15	-0.23	-0.23	-0.39*	0.39*	0.75*	0.01	-0.12	0.28*	-0.04

*** significant at 0.05 level of probability.**

Number of spikes / plant showed high positive direct phenotypic effect under two level of irrigations but the genotypic direct was positive with parents, cross No.1 in the F_2 under drought treatment irrigation, F_1, cross No.1 and cross No.3 in the F_2 generation. These results which was agreed with positive genotypic and phenotypic correlations as well as the indirect effect via each of number kernels / spike, 100- kernel weight and plant height had negative phenotypic under two level of irrigation for all populations except F_1 under normal condition was positive. The indirect genotypic for the number of spikes/ plant were (0.75, 1.80) of parents, F_1 (1.99, -0.26), cross

No.1 (-0.70, -0.64), cross No.2 (5.64, 0.24) and cross No.3 (1.30, -0.05) under drought and normal treatment irrigations respectively. Similar results were found by El-Sayed (1990) Mitkees *et. al.* (1992) and El-Sawi (1996).

Table(3):Phenotypic (ph) and genotypic (g)correlation coefficients among some studied characters under drought stress.

Source of variation	Parents		F_1 hybrids		F_2 population					
					Cross No1		Cross No2		Cross No3	
	Ph	G	Ph	G	Ph	G	Ph	G	Ph	G
G.Y/PL x No.S/PL	0.78*	0.98*	0.87*	1.00*	0.35*	0.26*	0.63*	0.95*	0.04	-0.70*
G.Y/PL x No.K/S	0.40	0.47*	-0.37*	0.82*	0.57*	0.72*	-0.04	-0.09	-0.03	-0.02
G Y/PL x100 KW	0.66*	0.83*	-0.23	0.67*	0.15	-0.14	0.46*	0.43*	-0.70*	0.47*
G.Y/PL x PLH	0.51*	0.58*	0.15	0.24	0.11	0.26*	0.53*	0.77*	-0.03	-0.02
G.Y/PL x H.D.	0.17	0.10	0.40*	0.61*	0.17*	0.07	-0.13	-0.29*	-0.04	0.02
G Y/PL x M.D.	0.58*	0.63*	0.82*	0.94*	0.20*	0.38*	0.18*	0.19*	0.14	0.28*
No.S/PLx No.K/S	-0.27	-0.02	-0.76*	-1.00*	0.01	-0.19*	-0.46*	0.50	-0.11	-0.36*
No.S/PLx 100 KW	0.40*	0.97*	-0.18	0.88*	-0.25*	-0.40*	0.32*	0.29*	0.13	0.75*
No.S/PLx PLH	0.07	0.10	0.13	0.17	0.21*	0.33*	0.26*	0.49*	-0.03	0.06
No S/PLx H.D.	0.12	-0.56*	0.36*	0.57*	0.07	0.13	-0.04	-0.04	-0.03	0.18*
No.S/PLx M.D	0.18	0.37*	0.86*	0.88*	0.08	0.10	0.27	0.71*	-0.03	-0.18*
No K/S x100 KW	0.22	0.83*	-0.15	0.22	0.13	0.12	-0.30*	-0.36*	-0.04	0.09
No K/S x PLH	0.59*	0.70*	0.20	0.46*	0.01	0.01	0.02	0.03	0.09	0.11
No K/S x H.D.	0.24	0.97*	0.09	-0.14	0.14	0.09	-0.17*	-0.46*	0.11	0.15
No.K/S x M.D.	0.70*	0.89*	-0.42*	-0.70*	0.04	0.05	-0.22*	-0.80*	0.24*	0.27*
100 KW x PLH	0.56*	0.93*	-0.45*	0.56*	0.12	0.31*	0.39*	0.85*	-0.21*	-0.30*
100 KW x H.D.	0.18	-0.14	-0.32	-0.82*	-0.07	-0.01	0.01	-0.07	-0.05	-0.40*
100 KW x M.D.	0.45*	0.59*	-0.53*	0.84*	0.16*	0.29*	0.01	0.03	-0.06	-0.09
PLH x H.D.	0.26	0.41*	0.81*	0.98*	0.28*	0.56*	-0.15	0.32*	-0.06	-0.14
PLH x M.D.	0.30	0.37*	0.56*	0.65*	0.15	0.30*	-0.01	-0.02	-0.14	-0.37*
H.D. x M.D	0.56*	0.85*	0.63*	0.99*	0.59*	0.84*	0.23*	0.34*	0.70*	0.94*

*** significant at 0.05 level of probability.**

The total phenotypic and genotypic indirect effect of number of kernels / spike,(via No.S/P, 100-kwt. and PLH) for parents, F_1, cross No.1, cross No.2 and cross No.3 in the F_2 generations were (2.63 and -3.04), (0.47 and- 0.27), (0.57 and 1.12),(0.45 and 0.16) and (0.4 and 0.41) under normal condition, respectively and it were (-0.18 and 0.29), (-2.5 and 1.19),(-0.18 and -0.58), (-0.01and 3.11), (-0.039 and 1.13) under drought treatment irrigation. These results were in agreement with those obtained by Edhaie and Waines (1989), El –Sayed (1990) and Mitkees *et. al.* (1992).

Although 100 - kernel weight had phenotypic and genotypic positive direct effect for most all studied generations. It had low total indirect effect via (No.S/PL , No.K/s and PLH), compared with the total indirect effect for number of spikes /plant and number of kernels /spike. This result showed the importance of number of spikes / plant and number of kernel /spike than kernel weight. These results were the same line of those reported by El-Sayed (1990), Mitkees *et. al.* (1992), El-Sawi (1996) and Tammam *et. al.* (2000) .

Plant height showed low and positive under normal irrigation and negative direct effect in most population studied under drought treatment irrigation compared with another traits number of spikes / plants, number of kernels / spike and 100- kernel weight. Also the indirect effect via each of number of spikes / plant, number of kernels / spike and 100- kernel weight were mostly less than these obtained by another two pairs traits in this study.

Table(4):- Partitioning of simple correlation coefficients into the direct and indirect effect under normal condition.

Level of estimation	Parents		F1		F2					
					Cross No.1		Cross No.2		Cross No.3	
	Ph	G	Ph	G	Ph	G	Ph	G	Ph	G
G.Y/PLxNo.S/pl (r)	0.72	0.79	0.90	0.92	0.36	0.28	0.35	0.02	0.46	0.55
Direct effect P_1	2.21	-1.01	0.32	1.19	0.38	0.92	0.38	-0.22	0.55	0.60
Indirect effect:-	-1.49	1.80	0.56	-0.26	-0.02	-0.64	-0.03	0.24	-0.10	-0.05
1-via No.K/s.	-1.81	2.74	0.37	-0.26	-0.03	-0.35	-0.13	-0.09	-0.12	-0.08
2-via 100 Kw	0.91	1.26	-0.12	-0.25	0.01	-0.17	0.03	-0.09	0.01	-0 01
3-via PLH	-0.59	0.32	0.32	0.25	-0.002	-0.12	0.06	0.42	0.01	0.04
Total correlation	0.72	0.79	0.90	0.92	0.36	0.28	0.35	0.02	0.46	0.55
G.Y/PLx No.K/s (r)	-0.27	-0.50	0.90	0.92	0.55	0.68	0.36	0.62	0.23	0.23
Direct effect P_2	2.63	-3.04	0.47	-0.27	0.57	1.12	0.45	0.16	0.40	0.41
Indirect effect:-	-2.90	2.54	0.43	1.19	0.03	-0.44	-0.09	0.46	-0.18	-0.18
1-via NoS/PL.	-1.52	0.91	0.25	1.17	-0.02	-0.29	-0.11	0.12	-0.16	-0.11
2-via 100 Kw	-0.88	1.37	-0.12	-0.17	-0.004	0.02	-0.05	0.04	-0.01	-0.03
3-via PLH	-0.49	0.26	0 30	0.20	-0.007	-0.18	0.07	0.31	-0.01	-0.03
Total correlation	-0.27	-0.50	0.90	0.92	0.55	0.68	0.36	0.62	0.23	0.23
G.Y/PLx100KW (r)	0 51	0 81	-0.56	-0.95	0.11	0.28	0.23	-0.25	0.25	0 35
Direct effect P_3	1.28	-1.46	0.17	0.25	0.07	-0.38	0.29	-0.24	0.20	0.47
Indirect effect:-	-0.77	2.27	-0 73	-1.21	0.04	0.66	0.07	-0.01	0.00	-0.11
1-via No.S/PL.	1.57	-0.87	-0.22	-1.19	0.06	0.42	0.04	-0.08	0.03	-0.02
2-via No.K/s	-1.81	2 86	-0.34	0.19	-0.03	-0.06	-0.07	-0.03	-0.01	-0.03
3-via PLH	-0.53	0.28	-0.17	-0.21	0.008	0.29	-0.04	0.09	-0.02	-0.06
Total correlation	0.51	0.81	-0.56	-0.95	0.11	0.28	0.23	-0.25	0.25	0.35
G.Y/PL XPLH (r)	-0.42	-0.53	0.93	0.98	0.07	0.12	0.47	0.92	0.09	0.10
Direct effect P_4	-2.03	1.01	0.40	0.26	-0.04	-0.59	0.34	1.02	0.09	0.19
Indirect effect:-	1.60	-1.54	0.53	0.72	0.11	0.71	0.13	-0.06	0.00	-0.08
1-via No.S/PL.	0.64	-0.32	0.26	1.14	0.02	0.18	0.07	-0.09	0.09	0.13
2-via No.K/s	0.63	-0.79	0 32	-0.21	0.10	0.34	0.09	0.05	-0.04	-0.07
3-via 100Kw.	0.33	-0.43	-0.07	-0.20	-0.01	0.18	-0.03	-0.02	-0.05	-0.14
Total correlation	-0.42	-0.53	0.93	0.98	0.07	0.12	0.47	0.92	0.09	0.10

Similar results were obtained by El-Sayed (1990) and Mitkees *et. al.*(1992). Investigating results of path analysis (Table 6 and 7) revealed the importance of number of spikes / plant, number of kernels /spike and 100-kernel weight. Considering gone unit variation in grain yield we could evaluate precisely to how extent they contribute to grain yield and the effect of every one of this components on this contribution. At the phenotypic level it was obvious that the direct effect summed about 17.56, 0.51, 0.47, 0.54 and 0.53 under normal treatment irrigation 17.56, 0.51, 0.47, 0.54 and 0.53 under normal treatment irrigation and 1.12, 16.91, 0.92, 0.27, 0.77 under drought treatment irrigation for the four traits studied (No.S/pl, No.K/s,100-K.wt and PLH) respectively, compared with 13.41, 1.61, 2.59, 1.17 and 0.78 under normal treatment and 0.68, 4.89, 2.97, 90.31, 16.00 under drought treatment irrigation at genotypic level. Indirect effects due to their interrelationships, occurred less values compared with direct effect for phenotypic and genotypic under two treatments of irrigations. These out comes may assess the important role of genotype. On the other hand, the residual values showed the magnitude at normal treatment irrigations in most crosses compared with drought treatment irrigation this may be due to genotype x environment interactions .

Accordingly and in agreement with Grafius (1956) it could be easier to increase grain yield by selecting for yield components (No.S/p, No.K/s and 100-K.wt) which are presumably more simply inherited than per se. Hence, grain yield in wheat is the product of number of spikes, kernels / spike and kernel weight when each of them could be measured without error. The two most important components from the present study are number of spikes / plant and number of kernels / spike.

In general the final conclusion from this study is that phenotypic and genotypic correlations help the breeder to improve the efficiency of selection by using the favorable combinations of traits and to minimize the retarding effect of negative correlation. Also, studying path coefficient proved the direct and indirect effects of the yield contributions of the traits, No.S/pl., No.k/s and 100- K.wt which had direct and indirect effects via each others.

Table(5):- Partitioning of simple correlation coefficients into the direct and indirect effect under drought stress.

Level of estimation	Parents		F1hybrids		F2 population					
					Cross No.1		Cross No.2		Cross No.3	
	Ph	G	Ph	G	Ph	G	Ph	G	Ph	G
G.Y/PLxNo.S/pl (r)	0.78	0.98	0.87	1.00	0.35	0.26	-0.004	-0.70	0.63	0.95
Direct effect P_1	0.86	0.23	3.05	-0.99	0.54	0.96	0.04	-6.34	0.68	-0.35
Indirect effect:-	-0.081	0.75	-2.18	1.99	-0.19	- 0.70	-0.07	5.64	-0.05	1.30
1-via No.K/s.	-0.16	0.002	-2.02	0.41	-0.19	- 0.52	-0.06	0.84	-0.20	0.53
2-via 100 Kw	0.08	0.76	-0.08	1.65	0.003	- 0.10	-0.009	4.65	0.09	-0.70
3-via PLH	-0.001	-0.009	-0.07	-0.08	-0.008	- 0.08	0.003	0.15	0.06	1.47
Total correlation	0.78	0.98	0.87	1.00	0.35	0.26	-0.04	-0.70	0.63	0.95
G.Y/PL x No.K/s (r)	0.40	0.47	0.17	0.78	0.57	0.72	0.50	0.76	0.04	0.09
Direct effect P_2	0.58	-0.11	2.66	-0.41	0.75	1.30	0.51	-2.34	0.43	-1.06
Indirect effect:-	-0.18	0.29	-2.50	1.19	-0.18	- 0.58	-0.01	3.11	-0.039	1.13
1-via NoS/PL	-0.24	-0.005	-2.32	0.99	-0.14	- 0.38	-0 004	2.28	-0.31	0.18
2-via 100 Kw	0.06	0.65	-0.07	0.41	-0.04	- 0.19	0.003	0.56	-0.08	0.86
3-via PLH	-0.01	-0.06	-0.11	-0.21	-0.004	-0.002	-0.008	0.27	0.005	0.09
Total correlation	0.40	0.58	0.17	0.78	0.57	0.72	0.50	0.76	0.04	0.09
G.Y/PL x 100KW (r)	0.66	0.83	-0.23	0.67	0.13	- 0.14	-0.07	0.47	0.46	0.43
Direct effect P_3	0.21	0.78	0.46	1.88	0.26	0.55	-0.07	6.20	0.27	-2.40
Indirect effect:-	0.45	0.05	-0.69	-1.22	-0.13	- 0.69	0.005	-5.71	0.18	2.83
1-via No.S/PL.	0.33	0.22	-0.55	-0.87	0.005	- 0.18	0.005	-4.76	0.22	-0.10
2-via No.K/s	0.13	-0.09	-0.40	-0.09	-0.13	- 0.44	-0.02	-0.21	-0.13	0.38
3-via PLH	-0.01	-0.08	0.26	-0.26	-0.004	- 0.07	0.02	-0.75	0.09	2.55
Total correlation	0.66	0.83	-0.23	0.67	0.13	- 0.14	-0.07	0.47	0.46	0.43
G.Y/PL XPLH (r)	0 51	0.58	0.15	0.24	0.19	0.26	-0.03	-0.02	0.53	0 77
Direct effect P_4	-0 01	-0 09	-0.57	-0 46	-0.04	- 0.24	-0.09	2.49	0.24	3.00
Indirect effect:-	0.51	0.67	0 72	0.69	0.15	0.50	0.06	-2.49	0.29	-2.24
1-via No.S/PL.	0.06	0.02	0 40	-0.17	0.11	0 32	-0.001	-0.38	0.18	-0.18
2-via No.K/S	0.34	-0 08	0 53	-0.19	0.01	0.01	0.05	-0.26	0.01	-0 03
3-via 100KW.	0.12	0.73	-0.21	1.05	0.03	0.17	0.01	-1.86	0.11	-2 04
Total correlation	0.51	0 58	0 15	0.24	0.11	0.26	-0 03	-0.02	0.53	0.77

Table(6):-Coefficient of determination to grain yield under normal condition.

Level of estimation	Parents		F1		F2					
					Cross No.1		Cross No.1		Cross No.1	
	Ph	G	Ph	G	Ph	G	Ph	G	Ph	G
Direct effect:-	17.5603	13.4134	0.5122	1.6191	0.4758	2.5933	0.5466	1.1720	0.5382	0.7851
No.S/PL p_1^2	4.8841	1.0201	0.1024	1.4161	0.1444	0.8464	0.1444	0.0484	0.3025	0.3600
No.K/S p_2^2	6.9169	9.2416	0.2209	0.0729	0.3249	1.2544	0.2025	0.0256	0.1600	0.1681
100Kw p_3^2	1.6384	2.1316	0.0289	0.0625	0.0049	0.1444	0.0841	0.0576	0.0676	0.2209
PLH p_4^2	4.1209	1.0201	0.1600	0.0676	0.0016	0.3481	0.1156	1.0404	0.0081	0.0361
Indirect effect:-	-14.149	-19.4098	0.4795	-0.7510	-0.0306	-1.641	-0.0243	-0.0411	-0.1195	-0.1510
No.s/pl x No.k/s $2r_{12}\,p_1p_2$	-8.0210	-5.5267	0.2376	-0.6297	-0.0260	-0.638	-0.0958	0.0387	-0.1276	-0.0935
No.s/pl x 100kw $2r_{13}\,p_1p_3$	4.0169	2.5363	-0.074	-0.5950	0.0090	-0.322	0.0242	0.0380	0.0143	-0.0169
No.s/pl x PLH $2r_{14}\,p_1p_4$	-2.6021	-0.6529	0.2074	0.5940	-0.0018	-0.217	0.0465	-0.1840	0.0158	5.0502
No.k/s x 100kw $2r_{23}\,p_2p_3$	-3.6294	-8.3442	-0.115	0.0932	-0.0048	0.0426	-0.0418	0.0123	-0.0062	-0.0109
No.k/s x PLH $2r_{24}\,p_2p_4$	-2.5627	-1.5966	0.2820	-0.1081	-0.0082	-0.396	0.0643	0.0979	-0.0065	-0.0280
100kw x PLH $2r_{34}\,p_3p_4$	-1.3512	-0.8258	-0.585	-0.1053	0.0012	-0.109	-0.0217	-0.0441	-0.0094	-0.0518
Residual value Po^2	-2.4109	0.9964	-0.008	0.1319	0.5548	0.0481	0.4777	-0.1309	0.5813	0.3659
Total	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000

Table(7):-Coefficient of determination to grain yield under drought stress.

Level of estimation	Parents		F1 hybrids		F2 population					
					Cross No.1		Cross No.2		Cross No.1	
	Ph	G	Ph	G	Ph	G	Ph	G	Ph	G
Direct effect:-	1.1202	0.6815	16.9146	4.8942	0.9233	2.9717	0.2747	90.3113	0.7778	16.0061
No.S/PL p_1^2	0.7396	0.0529	9.3025	0.9801	0.2916	0.9216	0.0016	40.1956	0.4624	0.1225
No.K/S p_2^2	0.3364	0.0121	7.0756	0.1681	0.5625	1.6900	0.2601	5.4756	0.1849	1.1236
100Kw p_3^2	0.0441	0.6084	0.2116	3.5344	0.0676	0.3025	0.0049	38.4400	0.0729	5.7600
PLH p_4^2	0.0001	0.0081	0.3249	0.2116	0.0016	0.0576	0.0081	6.2001	0.0576	9.0000
Indirect effect:-	-0.0834	0.0841	-14.026	-5.0669	-0.2759	-1.5241	-0.0131	-84.6941	-0.0816	-0.0816
No.s/pl x No.k/s $2r_{12}\,p_1p_2$	-0.2693	0.0010	-12.332	-0.8118	-0.2025	-0.9984	-0.0045	-10.6816	-0.2690	-0.2690
No.s/pl x 100kw $2r_{13}\,p_1p_3$	0.1445	0.3480	-0.5051	-3.2757	0.0028	0.2006	-0.0007	-58.9620	0.1175	0.1175
No.s/pl x PLH $2r_{14}\,p_1p_4$	-0.0012	-0.0041	-0.4520	0.1548	-0.0091	-0.1521	0.0002	-1.9439	0.0849	0.0849
No.k/s x 100kw $2r_{23}\,p_2p_3$	0.0536	-0.1424	-0.3671	-0.3392	-0.0663	-0.4862	0.0029	-2.6114	-0.0697	-0.0697
No.k/s x PLH $2r_{24}\,p_2p_4$	-0.0068	0.0139	-0.6065	0.1735	-0.0006	-0.0062	-0.0083	-1.2819	0.0041	0.0041
100kw x PLH $2r_{34}\,p_3p_4$	-0.0024	-0.1322	0.2360	-0.9686	-0.0002	-0.0818	-0.0026	-9.2628	0.0505	0.0505
Residual value Po^2	-0.0368	0.2344	-1.8882	1.1727	0.3526	-0.4476	0.7384	-4.06172	0.3038	-14.9245
Total	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.00000	1.0000	1.0000

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دراسة الارتباط و تحليل معامل المرور لبعض مكونات المحصول في بعض التراكيب الوراثية لقمح الخبز تحت بيئتين مختلفتين.

احمد محمد تمام وعزالدين عبد الرحمن محمد و موريس بديع توفيلس
البرنامج القومي لبحوث القمح – معهد بحوث المحاصيل الحقلية – مركز البحوث الزراعية – مصر

اجريت هذه الدراسة في المزرعة البحثية لمحطة البحوث الزراعية بشندويل – مركز البحوث الزراعية – مصر خلال المواسم الزراعية ٢٠٠١/٢٠٠٢ ، ٢٠٠٢/٢٠٠٣ و ٢٠٠٣/٢٠٠٤. و ذلك بهدف تقدير الارتباط المظهري و الوراثي و معامل المرور في خمسة تراكيب وراثية مختلفة وثلاث هجن للجيل الأول وعشائر الجيل الثاني تحت معاملتين للري (الري الأمثل ومعاملة حرمان).

أظهرت نتائج الدراسة أن محصول الحبوب ارتبط ارتباطا موجبا و معنويا مع كل من عدد السنابل/النبات ووزن ١٠٠ حبة و طول النبات و عدد أيام النضج في كلا معاملتي الري (للأباء و الجيل الأول) في كل من الارتباط المظهري و الوراثي. بينما في عشائر الجيل الثاني أظهرت صفة المحصول ارتباطا موجبا و متباينا بين المعنوي و غير المعنوي لكلا الارتباط المظهري و الوراثي تبعا لاختلاف الهجين بين كل من عدد السنابل/النبات و وزن ١٠٠ حبة و طول النبات. بينما كان الارتباط المظهري و الوراثي سالب بين صفة محصول الحبوب و كل من عدد الحبوب / السنبلة و عدد أيام التزهير و ذلك في الأباء فقط تحت الري الأمثل ، بينما كانت العلاقة في هجن الجيل الأول و الثاني موجبة لهذه الصفات تحت معاملتي الري.

أيضا أوضحت النتائج أن صفة عدد السنابل / النبات ارتبطت مظهريا ووراثيا ارتباطا موجبا و معنويا مع وزن ١٠٠ حبة و عدد أيام النضج في الأباء تحت معاملتي الري و موجبا وغير معنويا مع كل من طول النبات و عدد أيام التزهير في كل التراكيب الوراثية تحت الدراسة و مع معاملتي الري. فى حين أظهرت ارتباطا سالبا و معنوي مع عدد الحبوب / السنبلة في الأباء

و الهجين الثاني (p_2 x p_3) و الثالث (p_4xp_5) من عشائر الجيل الثاني. كان الارتباط المظهري و الوراثي موجبا و معنويا بين كل من عدد الحبوب / السنبلة و وزن ١٠٠ حبة و عدد أيام التزهير في الأباء تحت معاملة الري المثلى و في الجيل الأول مع وزن ١٠٠ حبة و طول النبات ، بينما في الجيل الثاني اختلفت العلاقة ما بين الموجب والسالب حسب الهجين.

أظهرت العلاقة بين وزن ١٠٠ حبة و كل من طول النبات و عدد أيام التزهير و عدد أيام النضج اختلفت ما بين الموجب و السالب و المعنوي و غير المعنوي تبعا لاختلاف التراكيب الوراثية ومعاملة الري. أوضحت أيضا صفة طول النبات ارتباطا موجبا مع عدد أيام التزهير في الأباء وهجن الجيل الأول في معاملتي الري و الهجين الأول (p_1x p_2) من عشائر الجيل الثاني تحت معاملة الجفاف فقط.

أظهرت صفة عدد أيام التزهير ارتباطا سالبا مع عدد أيام النضج في الأباء و هجن الجيل الأول تحت الري الأمثل في حين كان الارتباط موجب ومعنوي تحت معاملة الجفاف لكل الأجيال تحت الدراسة.

أظهر تحليل معامل المرور أن محصول الحبوب يتأثر تأثيرا مباشرا تحت معاملة الري المثلى بكل من عدد الحبوب / السنبلة بالنسبة للأباء وهجن الجيل الأول و عشائر الجيل الثاني ومن ناحية أخرى عدد السنابل / النبات في الجيل الأول والهجين الثالث (p_4 x p_5) من عشائر الجيل الثاني و عدد الحبوب / السنبلة في الهجين الأول (p_1 x p_2) من عشائر الجيل الثاني . بينما تحت معاملة الجفاف تأثر المحصول تأثيرا مباشرا بعدد السنابل / النبات في الأباء و الهجين الثالث من عشائر الجيل الثاني و عدد الحبوب / السنبلة في الهجين الأول و الثاني من عشائر الجيل الثاني ، ووزن ١٠٠ حبة في الأباء والهجين الثاني من الجيل الثاني .

هذه النتائج توضح أن الانتخاب للسلالات العالية في عدد السنابل/النبات و عدد الحبوب / السنبلة و وزن حبوب عالي سوف يعطى سلالات عالية المحصول.