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CORRELATION AND PATH COEFFICIENT ANALYSIS FOR SOME TRAITS IN DIALLEL CROSSES OF BREAD WHEAT UNDER DIFFERENT ENVIRONMENTS

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ABSTRACT

Seven parents of bread wheat were crossed in 2002/2003 in a half-diallel pattern. In 2003/2004, 7 parents and their 21 F_1 crosses were grown on two sowing dates, i.e., 8th of November (early sowing date) and 8th of December (late sowing date) under two nitrogen fertilization levels, i.e., 40 (low level) and 80 (high level) kg N/fed. A field experiment was devoted for each sowing date and laid out in a split plot design with three replicates. The two N-levels and 28 wheat genotypes were distributed at random within the main and sub-plots, respectively. Simple phenotypic correlation coefficient was calculated between different pairs of the studied traits and path coefficient was analyzed for grain yield/plant and its contributors under target environments. Significant and positive phenotypic correlation coefficients were found between grain yield/plant and each of days to heading and maturity, flag leaf area, number of spikelets/spike and number of grains/spike under all environments, plant height under high N-level in early sowing date and the two N-levels in late sowing date, harvest index under low N-level in early sowing date and the two N-levels in late sowing date and number of spikes/plant under the two N-levels at late sowing date. Results of path coefficient analysis illustrated that number of grains/spike under all environments followed by flag leaf area under the two N-levels at early sowing date, number of spikes/plant under low N-level at late sowing date and number of spikelets/spike under high N-level at late sowing date proved to be the major contributors in grain yield variation. Thus, these traits should be considered as selection criteria for wheat yield improvement under the target environments

Key words: ***Wheat, Triticum aestivum, Sowing date, N-fertilization, Correlation, path coefficient analysis.***

INTRODUCTION

Knowledge of nature and magnitude of interrelationships among grain yield and their related attributes helps to improve the efficiency of selection in breeding programs. EL-Shouny *et al* (1987), EL-Marakby *et al* (1994), Ageez and EL-Sherbeny (1998), Tammam (2000), EL-Nagar (2003) and EL-Wakil and Abd-Alla (2004) found significant positive correlation between grain yield and each of heading date, plant height, flag leaf area, number of spikes/plant, number of spikelets/spike, number of grains/ spike, 1000-kernel weight and harvest index. However, EL-Marakby *et al* (1994), Shoran (1995) and Abd EL-Majeed (2004) found significant negative correlation between grain yield and each of heading date, number of grains/spike, 1000-kernel weight and grain protein content in wheat. On the other hand, path coefficient analysis allows an effective means of partitioning correlation coefficients into unidirectional pathway and alternate pathways (EL-Shouny *et al* 1987, EL-Marakby *et al* 1994, Tammam 2002, Ismail 2001 and EL-Wakil and Abd-Alla 2004). This analysis permits a critical examination of specific factors that produce a given correlation and can be successfully employed in formulating an effective selection strategy. Thus, identifying traits that can be used as selection criteria help the breeder in selection for favourable and stress conditions. The major objective of this work was to estimate correlation and path coefficient analysis and their interactions under different environments for some agronomic and quality traits.

MATERIALS AND METHODS

Four local wheat cultivars namely; Sakha 93, Giza 168, Sids 1, and Gemmeiza 9 and three advanced lines, i.e., Line-3, Line-37 and Line-47 of bread wheat (*Triticum aestivum*, L.) were chosen to establish the field experimental work of this investigation. The lines were developed and evaluated in F_6 and F_7 in Agronomy Dep., Fac. of Agric., Ain Shams Univ. by EL-Marakby *et al* (2002), while the four cultivars were obtained from Wheat Dep., Agric. Res. Cent., Giza, Egypt.

A half diallel set of crosses was achieved among the seven parents in 2002/2003 growing season at the Experimental Farm of the Faculty of Agriculture, Ain Shams University, at Shoubra El-Kheima, Kalubia Governorate and 21 F_1 seeds were obtained.

The seeds of the 21 hybrids and their respective parents were sown in 2003/2004 season at the Experimental Farm of the Faculty of Agriculture, Ain Shams University, at Shalakan, Kalubia Governorate on two sowing dates, i.e., 8^{th} of November (early sowing date) and 8^{th} of December (late sowing date) under two nitrogen fertilization levels, i.e., 40 (low level) and 80 (high level) kg N/fed. An experiment was devoted for each sowing date and laid out in a split plot design with three replicates. The two N-levels and 28 wheat genotypes were distributed at random within the main and sub-plots, respectively. The experimental plot consisted of 3 rows. Each of row was 2.5 m in length and 20 cm apart. Seeds were spaced at 15 cm within rows and one plant was left per hill. Nitrogen was added in the form of ammonium nitrate (33.5% N). The amount of each rate was splited into two parts; the first part (2/3) was immediately applied before the first irrigation, while the second part (1/3) was applied before the second irrigation. The other cultural practices were followed as recommended for wheat production in the region.

The physical and chemical properties of soil of the experimental site showed that the soil is clay in texture with pH (7.98 and 7.98), EC (2.39 and 2.88 dsm^{-1}) and total N (0.50 and 0.15 %) at the two depths of 0-15 and 15-30 cm of soil surface, respectively.

Days to heading was measured as number of days from sowing till complete emergence of the main stem spike from the sheath of flag leaf of 50% of plants per plot. Also, days to maturity was recorded when plants reached dead ripe stage.

However, flag leaf area (cm^2) of the highest stem was recorded at anthesis stage as maximum length (cm) x maximum width (cm) x 0.75 (Palamisway and Gomez 1974).

At harvest (10^{th} and 19^{th} of May for early and late sowing date, respectively), ten plants randomly taken from each plot were used for recording data of the following traits:

1- Plant height (cm): measured from soil surface to the tip of the highest spike excluding awns.
2- Number of spikes per plant.
3- Number of spikelets for the highest spike.
4- Number of grains for the highest spike.
5- 1000-kernel weight (g).
6- Grain yield per plant (g).
7- Harvest index % (H.I): was calculated as follows:
H.I = Grain weight/plant (g) x 100 / Biological weight (g)
8- The crude protein content was calculated by multiplying the total nitrogen content by 5.75 which was determined by using micro Kjeldahal apparatus as described in the A.O.A.C. (1995).
9- Fermentation test was estimated according to the method outlined by A.A.C.C. (1970).

Phenotypic (r_p) correlation coefficient was computed for different pairs of traits for genotypes under different environments. However, partitioning correlation coefficient into direct and indirect effects at phenotypic level was made by determining path coefficients under different environments using method utilized by Dewey and Lu (1959).

The involved characters in this analysis were:

(y) Grain yield/plant.
(x_1) Flag leaf area.
(x_2) No. of spikes/plant.
(x_3) No. of spikelets/spike.
(x_4) No. of grains/spike.

The path coefficients were obtained by the simultaneous solution of the following equations, which express the basic relationship between correlation and path coefficients.

Thus, for plant yield factors:

$$r_{y1} = p_{y1} + r_{12}p_{y2} + r_{13}p_{y3} + r_{14}p_{y4}$$
$$r_{y2} = r_{12}p_{y1} + p_{y2} + r_{23}p_{y3} + r_{24}p_{y4}$$
$$r_{y3} = r_{13}p_{y1} + r_{23}p_{y2} + p_{y3} + r_{34}p_{y4}$$
$$r_{y4} = r_{14}p_{y1} + r_{24}p_{y2} + r_{34}p_{y3} + p_{y4}$$

Assuming that the total plant yield variation equal 1, then:

$$1 = p^2_{y0} + p^2_{y1} + p^2_{y2} + p^2_{y3} + p^2_{y4} + (2\ p_{y1}\ r_{12}p_{y2}) + (2\ p_{y1}\ r_{13}p_{y3}) + (2\ p_{y1}\ r_{14}p_{y4}) + (2\ p_{y2}\ r_{23}p_{y3}) + (2\ p_{y2}\ r_{24}p_{y4}) + (2\ p_{y3}\ r_{34}p_{y4}).$$

The elements of the right end of the latter equation represent different coefficients of determination, which assess the portions of the total variation determined directly and jointly by each factor.

The relative importance (RI %) of each variable to the total variation was estimated according to the following Formula:

$$RI\% = CD_i \ / \Sigma_I\ CD_i \quad x\ 100$$

Where:

r = Simple correlation.

P = Path coefficient.

$ry_1, ry_2, \ldots$.etc = Simple correlation between yield and x_1, yield and $x_2, \ldots$...etc.

$Py_1, Py_2, \ldots$.etc = Path coefficient of $x_2, x_3, \ldots$.etc on individual grain yield (y).

CD_i: the coefficient of determination.

RESULTS AND DISCUSSION

Phenotypic correlation coefficients estimated between different pairs of traits under each environment are given in Tables (1 and 2). As shown in both tables, positive and significant correlation was found between grain yield/plant and each of days to heading and maturity, flag leaf area, number of grains/spike and number of spikelets/spike under the four environments (two sowing dates and two N-levels), harvest index under three environments (low N-level in early sowing date and the two N-levels in the late sowing date), plant height under high N-level in early sowing date and the two N-levels in late sowing date and number of spikes/plant under the two N-levels in late sowing date. On the other hand, significant negative correlation coefficients were found between grain yield/plant and grain protein content under three environments (the two N-levels in early sowing date and low N-level in late sowing date). These results are in agreement with those reported by EL-Shouny *et al* (1987), EL-Marakby *et al* (1994), Ageez and EL-Sherbeny (1998), Tammam (2000), EL-Nagar (2003) and EL-Wakil and Abd-Alla (2004) who found significant positive correlation between grain yield and each of heading date, plant height, flag leaf area, number of spikes/plant, number of spikelets/spike, number of grains/ spike, 1000-kernel weight and harvest index. However, EL-Marakby *et al* (1994), Shoran (1995) and Abd EL-Majeed *et al* (2004) found significant negative correlation between grain yield and each of heading date, number of grains/spike, 1000-kernel weight and grain protein content in wheat.

Other inter-character correlations revealed that harvest index was significantly and positively correlated with each of number of spikes/plant under high N-level in early sowing date and the two N-levels in late sowing date, flag leaf area under the two N-levels in late sowing date, plant height

Table 1. Values of simple phenotypic correlation coefficients estimated between different pairs of traits recorded on the early sowing date under low (upper) and high (bottom) N-levels in wheat.

	1	2	3	4	5	6	7	8	9	10	11	12
1- Grain yield/plant		0.48**	0.54**	0.64**	0.28	0.49**	0.25	0.50**	0.71**	-0.01	-0.39*	-0.07
2- Harvst index	0.34		-0.31	0.02	-0.50**	-0.24	0.28	-0.29	-0.03	-0.39*	0.08	0.26
3- Days to heading	0.67**	-0.20		0.56**	0.62**	0.50**	-0.07	0.97**	0.61**	0.30	-0.44*	-0.18
4- Flag leaf area	0.80**	0.09	0.65**		0.38*	0.76**	0.25	0.58**	0.50**	0.39*	-0.24	-0.21
5- Plant height	0.58**	-0.26	0.64**	0.64**		0.50**	-0.03	0.57**	0.52**	0.30	-0.25	-0.03
6- No.of spikelets/spike	0.64**	-0.05	0.65**	0.74**	0.64**		0.12	0.43*	0.63**	0.29	-0.51**	-0.43*
7- No.of spikes/plant	0.17	0.46*	-0.25	0.03	-0.13	-0.25		-0.11	0.01	-0.33	-0.18	-0.14
8- Days to maturity	0.60**	-0.27	0.95**	0.58**	0.61**	0.53**	-0.33		0.55**	0.39*	-0.38*	-0.15
9- No.of grains/spike	0.68**	0.25	0.56**	0.52**	0.51**	0.67**	-0.04	0.50**		0.17	-0.62**	-0.15
10- 1000-grain weight	-0.09	-0.34	0.05	0.00	0.18	0.06	-0.47*	0.1	0.14		0.03	0.04
11- Grain protein content	-0.52**	-0.08	-0.47*	-0.43*	-0.26	-0.61**	-0.18	-0.40*	-0.57**	0.18		0.60**
12- Fermentation test	0.05	0.02	0.17	-0.08	0.2	0.07	-0.15	0.17	0.03	-0.19	0.20	

*,** denote significant differences at 0.05 and 0.01 levels, respectively for phenotypic correlation.

Table 2. Values of simple phenotypic correlation coefficients estimated between different pairs of traits recorded on the late sowing date under low (upper) and high (bottom) N-levels in wheat.

		1	2	3	4	5	6	7	8	9	10	11	12
1-	Grain yield/plant		0.82**	0.68**	0.56**	0.78**	0.69**	0.69**	0.63**	0.75**	0.15	-0.54**	0.1
2-	Harvst index	0.74**		0.37*	0.54**	0.47*	0.60**	0.74**	0.32	0.56**	-0.13	-0.32	0.22
3-	Days to heading	0.73**	0.32		0.55**	0.64**	0.60**	0.26	0.98**	0.49**	0.27	-0.59**	0.03
4-	Flag leaf area	0.67**	0.44*	0.61**		0.43*	0.58**	0.43*	0.53**	0.35	0.00	-0.36	0.05
5-	Plant height	0.67**	0.26	0.64**	0.44*		0.58**	0.31	0.63**	0.65**	0.34	-0.37	0.14
6-	No.of spikelets/spike	0.61**	0.25	0.59**	0.45*	0.51**		0.37	0.54**	0.63**	0.25	-0.48**	-0.04
7-	No.of spikes/plant	0.38*	0.42*	0.10	0.48*	0.07	-0.06		0.27	0.39*	-0.12	-0.1	0.01
8-	Days to maturity	0.70**	0.26	0.99**	0.61**	0.64**	0.52**	0.09		0.44*	0.23	-0.53**	0.01
9-	No.of grains/spike	0.71**	0.29	0.56**	0.62**	0.54**	0.69**	0.16	0.52**		0.12	-0.50**	-0.05
10-	1000-grain weight	0.11	-0.09	0.32	-0.08	0.33	0.26	-0.16	0.28	0.02		-0.2	0.11
11-	Grain protein content	-0.37	-0.19	-0.51**	-0.51**	-0.27	-0.60**	0.08	-0.50**	-0.52**	-0.04		0.25
12-	Fermentation test	0.07	0.12	-0.01	-0.20	0.03	-0.31	-0.06	0.00	-0.07	-0.06	0.48*	

*,** denote significant differences at 0.05 and 0.01 levels, respectively for phenotypic correlation.

and number of grains/spike under low N-level in late sowing date and number of spikelets/spike under low N-level in late sowing date, while this trait showed significant and negative correlations with 1000-kernel weight and plant height under low N-level in early sowing date.

Days to heading gave positive and significant correlations with each of maturity date, plant height, flag leaf area, number of spikelets/spike and number of grains/spike under all environments, while it gave negative and significant correlation with grain protein content under all environments.

Regarding flag leaf area, positive and significant correlation coefficients were obtained with each of maturity date, plant height and number of spikelets/spike under all environments, number of grains/spike under the two N-levels in early sowing date and high N-level in late sowing, number of spikes/plant under the two N-levels in the late sowing date and 1000-kernel weight under low N-level in the early sowing date, while it gave negative and significant correlation between grain protein content under high N-level in both sowing dates.

Plant height exhibited positive and significant correlation coefficients with days to maturity, number of spikelets/spike and number of grains/spike under all environments.

Number of spikelets/spike exhibited positive and significant correlation coefficient with days to maturity and number of grains/spike under all environments, whereas it gave negative and significant correlations with grain protein content under all environments and fermentation test under low N-level in early sowing date.

Number of spikes/plant showed positive and significant correlation with number of grains/spike under low N-level in late sowing date while, it showed negative and significant correlation with 1000-kernel weight under high N-level in early sowing date.

Days to maturity gave positive and significant correlation coefficient with number of grains/spike under all environments and 1000-kernel weight under low N-level in early sowing date, while it gave negative and significant correlation between grain protein content under all environments.

Number of grains/spike exhibited negative and significant correlation coefficient with grain protein content under all environments. However, grain protein content showed positive and significant correlation coefficient with fermentation test under low N-level in early sowing date and high N-level in late sowing date. Similar results were obtained by EL-Shouny *et al* (1987), EL-Bana and Aly (1993), EL-Marakby *et al* (1994), Nawar and Khalil (1997) and Abd EL-Majeed *et al* (2004) who found significant positive correlation, while EL-Shouny *et al* (1987) and Abd EL-Majeed *et al* (2004) found significant negative correlation between different pairs of studied traits. The rest cases of correlations were insignificant

From the pervious results of correlations, it is obvious that relationships between pairs of traits were approximately constant and showed the same direction under all environments, suggesting the possibility of selection for common traits for genetic improvement of yield under wide range of environments. Meantime, selection of genotypes with high mean performance for flag leaf area, number of spikelets/spike and number of grains/spike will lead to high yielding genotypes under target environments.

Path coefficient analysis

The traits flag leaf area, number of spikes/plant, number of spikelets/spike and number of grains/spike which exhibited significant positive correlation with grain yield/plant were used in path coefficient analysis to detect the relative importance of each trait to grain yield/plant variation at phenotypic level under the four environments used in the present study.

The direct and indirect effects of four yield attributes are shown in Table (3). The data reveal that the direct effect of flag leaf area on grain yield/plant was positive and high under low and high N-level in early sowing date, which amounted to 0.54 and 0.62, respectively, while it was relatively low under the two N-levels in late sowing date which amounted to 0.12 and 0.21, respectively. The indirect effects of flag leaf area via number of grains/spike was moderate (0.33) under low N-level in early sowing date and relatively low under the other three environments. Also the indirect effects via number of spikes/plant and number of spikelets/spike were relatively low under low and high N-levels at late sowing date while, the indirect effects via the same two traits were unimportant under low and high N-levels in early sowing date.

The direct effect of number of spikes/plant was positive and moderate on grain yield/plant under the low N-level in late sowing date, while it was relatively low under the other three environments. The indirect effects of this trait were relatively low via flag leaf area under low N-level in early sowing date and under high N-level in late sowing date and via number of grains/spike under low N-level in late sowing date. On the other hand, the indirect effects of number of spikes/plant via number of spikelets/spike under all environments and via other cases were very low or negative.

Number of spikelets/spike Table (3) showed negligible direct effect on grain yield/plant under the two N-levels in early sowing date, which showed negative values, while it showed positive and relatively low and moderate direct effects under low and high N-level in late sowing date, respectively. The indirect effects of number of spikelets/spike via flag leaf

Table 3. Phenotypic path coefficient analysis of grain yield/plant and its contributors characters under different environments in wheat.

Source of variation	D1+		D2	
	N1++	N2	N1	N2
Flag leaf area vs.grain yield/plant				
Direct effect	0.544	0.627	0.122	0.212
Indirect effect via no.of spikes/plant	0.038	0.005	0.170	0.117
Indirect effect via no.of spikelets/spike	-0.273	-0.036	0.120	0.135
Indirect effect via no.of grains/spike	0.331	0.204	0.148	0.207
Total	0.64	0.80	0.56	0.67
No.of spikes/plant vs.grain yield/plant				
Direct effect	0.151	0.155	0.396	0.243
Indirect effect via flag leaf area	0.136	0.019	0.052	0.102
Indirect effect via no.of spikelets/spike	-0.043	0.012	0.076	-0.018
Indirect effect via no.of grains/spike	0.007	-0.016	0.165	0.053
Total	0.25	0.17	0.69	0.38
No.of spikelets/spike vs.grain yield/plant				
Direct effect	-0.359	-0.048	0.206	0.299
Indirect effect via flag leaf area	0.413	0.464	0.071	0.096
Indirect effect via no.of spikes/plant	0.018	-0.039	0.147	-0.015
Indirect effect via no.of grains/spike	0.417	0.263	0.266	0.230
Total	0.49	0.64	0.69	0.61
No.of grains/spike vs.grain yield/plant				
Direct effect	0.663	0.392	0.423	0.333
Indirect effect via flag leaf area	0.272	0.326	0.043	0.132
Indirect effect via no.of spikes/plant	0.002	-0.006	0.155	0.039
Indirect effect via no.of spikelets/spike	-0.226	-0.032	0.130	0.206
Total	0.71	0.68	0.75	0.71

+ D1 and D2 = 8 Nov. and 8 Dec.,respectively.
++ N1and N2 = 40 and 80 kg N/ fed.,respectively.

area was positive and relatively high under the two N-levels in early sowing date and via number of grains/spike under low N-level in early sowing date. Meantime, the indirect effect of this trait was relatively low via number of grains/spike under high N-level in early sowing date and the two N-levels in late sowing date and via number of spikes/plant under low N-level in late sowing date, while the indirect effects of this trait via other cases were negative or low.

The direct effect of number of grains/spike was positive and high under low N-level in early sowing date, relatively high under high and low N-levels in early and late sowing date, respectively and moderate under high N-level in late sowing date on grain yield/plant. The indirect effect of this trait via flag leaf area was moderate under low and high N-levels in early sowing date, while it was relatively low via number of spikelets/spike under the two N-levels in late sowing date, via flag leaf area under low and high N-level in early and late sowing date and via number of spikes/plant under low N-level in late sowing date. However, the indirect effects of this trait via other cases were low or negative.

The components of the total grain yield variation determined directly and jointly by each factor are presented in Table (4). Under low N-level in early sowing date, the main sources of plant yield variation in order of importance were the direct effect of number of grains/spike (19.845%) and its joint effects with each of flag leaf area (16.253%), number of spikelets/spike (13.502%) as well as the direct effect of flag leaf area (13.311%) and number of spikelets/spike (5.786%). The other joint effects contributed in total grain yield variation were joint effect of number of spikelets/spike with flag leaf area (13.340%). Hereby, the direct and simultaneous selection for these traits may be useful for improving wheat grain yield. The total contribution of the four traits was 85.593%, while the residual effect assumed to be about 14.407% of the total phenotypic variation.

Under high N-level in early sowing date, the main sources of plant yield variation in order of importance were the direct effects of flag leaf area (34.103%) and its joint effect with number of grains/spike (22.210%) and number of spikelets/spike (3.870%) as well as the direct effect of number of grains/spike (13.373%) and number of spikes/plant (2.091%). Small effect (2.194%) was contributed by the joint effect of number of spikelets/spike with number of grains/spike. It is apparent that the four traits and their interaction amounted to 79.294% of the whole yield variation while, the residual effect amounted to 20.706%.

Under low N-level in late sowing date, the main sources of plant yield variation in order of importance were the direct effect of number of grains/spike (17.893%) and its joint effect with number of spikes/plant (13.066%), number of spikelets/spike (10.979%) and flag leaf area (3.612%) and the direct effect of number of spikes/plant (15.682%), number of spikelets/spike (4.244%) and flag leaf area (1.488%). The other joint effects contributed in total grain yield variation were joint effect of number of spikelets/spike with number of spikes/plant (6.037%), flag leaf area with number of spikes/plant (4.155%) and flag leaf area with number of spikelets/spike (2.915%).

The total effect of four traits was (80.071%) and the residual was (19.929%).

Under high N-level in late sowing date the main sources of plant yield variation in order of importance were the direct effect of number of grains/spike (10.899%) and its joint effect with number of spikelets/spike

Table 4. Phenotypic components (direct and joint effects) in percent of grain yield/plant variation under different environments in wheat.

	D1+				D2			
	N1++		N2		N1		N2	
Source of variation	C.D	RI %	C.D	RI %	C.D	RI %	C.D	RI %
Flag leaf area (X1)	0.295	13.311	0.392	34.103	0.015	1.488	0.045	4.417
No.of spikes/plant (X2))	0.023	1.029	0.024	2.091	0.157	15.682	0.059	5.804
No.of spikelets/spike (X3)	0.128	5.786	0.002	0.201	0.042	4.244	0.089	8.787
No.of grains/spike (X4)	0.440	19.845	0.154	13.373	0.179	17.893	0.111	10.899
(X1) x (X2)	0.041	1.851	0.006	0.507	0.042	4.155	0.049	4.861
(X1) x (X3)	-0.295	13.340	-0.044	3.870	0.029	2.915	0.057	5.607
(X1) x (X4)	0.360	16.253	0.255	22.210	0.036	3.612	0.088	8.604
(X2) x (X3)	-0.013	0.586	0.004	0.324	0.060	6.037	-0.009	0.857
(X2) x (X4)	0.002	0.090	-0.005	0.423	0.131	13.066	0.026	2.545
(X3) x (X4)	-0.299	13.502	-0.025	2.194	0.110	10.979	0.137	13.505
Residual	0.319	14.407	0.238	20.706	0.199	19.929	0.347	34.115
Total	1.00	100.00	1.00	100.00	1.00	100.00	1.00	100.00

C.D: coefficient of determination, RI %: Relative importance.
+D1 and D2 = 8 Nov. and 8 Dec., respectively.
++N1and N2 = 40 and 80 kg N/ fed., respectively.

(13.505%), flag leaf area (8.604%) and number of spikes/plant (2.545%) and the direct effect of number spikelets/spike (8.787%), number of spikes/plant (5.804%) and flag leaf area (4.417%). The other joint effects contributed in total grain yield variation were joint effect of flag leaf area with number of spikelets/spike (5.607%) and flag leaf area with number of spikes/plant (4.861%). The total effect of the four traits was 65.885% and the residual was 34.115%.

From the above mentioned results, it is noticed that number of grains/spike under all environments followed by flag leaf area under the two N-levels in early sowing date and number of spikes/plant under low N-level in late sowing date and number of spikelets/spike under high N-level in late sowing date proved to be the major grain yield contributors. Thus the breeders should take into consideration these traits as selection criteria for wheat yield improvement under these target environments. Similar results were obtained by EL-Shouny *et al* (1987), EL-Marakby *et al* (1994), Tammam *et al* (2000), Ismail (2001) and EL-Wakil and Abd-Alla (2004).

In general conclusion, the results obtained from correlation and path coefficient analysis studied under low and high N-level in early and late sowing dates (as environments) indicated that flag leaf area, number of spikes/plant, number of spikelets/spike and number of grains/spike could be used effectively as selection criteria for screening and isolating high yielding genotypes under the environments of the present study; especially these traits were positively and significantly correlated with grain yield/plant.

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تحليل الأرتباط ومعامل المرور لبعض الصفات في الهجن التبادلية من قمح الخبز تحت بيئات مختلفة

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اجرى هذاالبحث لدراسة طبيعة العلاقات التى تربط بين الصفات المحصولية المختلفة وتحليل معامل المرور والتى تعتبر أساس لتحسين قمح الخبز تحت البينات المختلفة وقد استخدم فى هذة الدراسة سبعة تراكيب وراثية من قمح الخبز أشتملت علي أربعة أصناف تجارية هي سخا 93 ، جيزة 168، سدس 1، جميزة 9 وثلاث سلالات مبشرة هى السلالة 3، السلالة 37 والسلالة 47. أجريت جميع التهجينات التبادلية دون العكسية في الموسم الزراعي 2003/2002 وتم الحصول علي بذرة 21هجينا فرديا. زرعت الهجن وأبائها الأصلية (28تركيب وراثي) فى المزرعة التجريبية لكلية الزراعة - جامعة عين شمس بشلقان -محافظة القليوبية خلال الموسم الزراعي 2004/2003 تحت ميعادين للزراعة (8 نوفمبر، 8 ديسمبر) ومستويين من التسميد النيتروجينى (40، 80 كجم ن / فدان) فى تصميم قطع منشقة مرة واحدة حيث خصص لكل ميعاد تجربة مستقلة فى ثلاث مكررات وتم توزيع مستويي النيتروجين بالقطع الرئيسية والتراكيب الوراثية بالقطع المنشقة. قدرت قيم معامل الأرتباط المظهري البسيط بين جميع الصفات المدروسة وتم تحليل معامل المرور للمحصول ومساهماتة تحت البينات المختلفة.

أوضحت نتائج الأرتباط بين متوسطات الصفات للتراكيب الوراثية المختلفة تحت الدراسة وجود أرتباط موجب ومعنوي بين محصول حبوب النبات الفردي و كلا من تاريخ طرد السنابل والنضج ، مساحة ورقة العلم ، عدد السنيبلات/ سنبلة و عدد الحبوب/ سنبلة تحت كل البينات ومع أرتفاع النبات تحت المستوي العالي من التسميد النيتروجيني في الميعاد المبكر ومستويي النيتروجين في الميعاد المتأخر ومع دليل الحصاد تحت المستوي المنخفض من التسميد النيتروجيني في الميعاد المبكر ومستويي التسميد النيتروجين في الميعاد المتأخر، ومع عدد السنابل/ نبات تحت مستويي التسميد النيتروجيني في الميعاد المتأخرمما يشير الي أن الأنتخاب لصفة أوأكثر من هذة الصفات يمكن أن يساعد في تحسين محصول الحبوب تحت البينات المستهدفة.

أوضحت نتائج معامل المرور أن صفة عدد الحبوب/سنبلة تحت كل البينات تلاها صفة مساحة ورقة العلم تحت مستويي التسميد النيتروجيني في الميعاد المبكر وعدد السنابل/نبات تحت المستوي المنخفض من التسميد النيتروجيني في الميعاد المتأخر وعدد السنيبلات/سنبلة تحت المستوي العالي من النيتروجين في الميعاد التاخر كانت أكثر الصفات مساهمة في تباين محصول الحبوب سواء من حيث تأثيرها المباشر أو المشترك مع بعضها البعض أو مع باقي الصفات. وهذة الصفات تعتبر صفات هامة يجب أن يوليها المربي أهتمامة عند تحسين القمح خاصة تحت ظروف الأجهاد المدروسة.

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