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*NATURE OF GENE ACTION AND PATH COEFFICIENT ANALYSIS OF YIELD ATTRIBUTES IN SOME CROSSES OF BARLEY

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ABSTRACT

Eight hull-led and hull-less barley genotypes were crossed in a half diallel fashion to study gene action effects and path coefficient for grain yield and its contributing characters in both F_1 and F_2 generations. Results of $(H_1/D)^{1/2}$ was more than unity for all characters in F_1 and F_2 generations confirming the important role of non-additive gene effects in the genetic control of the studied characters indicating the presence of over- dominance for these traits. The narrow sense heritability estimate was relatively high or moderate for no. of spikes per plant, no. of kernels per spike, spike kernel weight and 100-kernel weight in both F_1 and F_2 generations as well as grain yield per plant in F_1. Path coefficient analysis revealed that no. of spikes per plant and spike kernels weight in F_1 and F_2 generations and their joint effects were the greatest contributors to grain yield of barley and could therefore be considered as the main selection criteria in barley improvement programs.

Key words: ***Barley (Hordeum vulgare), Diallel, Gene action, Heritability, Correlationcoefficient, Path coefficient, Relative importance.***

INTRODUCTION

Yield is a complex character and is an ultimate product of the action and interaction of a number of quantitative characters, which are known to be controlled by different sets of polygenes. The development of high yielding barley varieties depends upon the recovery of desirable segregates from crosses between high yielding cultivars or those of genetically diverse origin. El-Marakby *et al* (1993), reported that, crossing widely divergent strains may not be always advantageous. Choice of parents for crossing is considered to be an important step in any plant breeding program aimed to improve yield and other economic traits. Increasing the yield of barley requires certain information regarding the nature and magnitude of gene action involved in the expression of quantitative traits of economic importance in a hybridization program. Diallel analysis also provides a unique opportunity to obtain a rapid and over all pictures of genetical control of a set of parents in the early generation. To increase the yield,

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study of direct and indirect effects of yield components provides the basis for its successful breeding programme and hence the problem of yield increase can be more effectively tackled on the basis of performance of yield components and selection for closely related characters (Choudhry *et al* 1986). The aim of this study was to determine the correlations and path analysis of yield and yield components in barley and evaluate their suitabilities in a breeding program. Thus the main objective of the present study was to identify genetic architecture of different important traits of barley for further improvement of grain yield.

MATERIALS AND METHODS

The present study was carried out at the Experimental Farm, Agricultural Research Center, Giza, Egypt, during the three successive seasons 2005/2006, 2006/2007, and 2007/2008. Eight parental genotypes of six-rowed barley representing a wide range of genetic diversity for six traits were selected for this study. Four of them are hull-led barley genotypes i.e., Giza 119 (P1), Giza 117 (P2), Giza 124 (P3) and Giza 126 (P4). The other four genotypes namely, Giza 129 (P5), Giza 131 (P6), Congona (P7) and Higo (P8) are hull-less barley. Using a diallel mating system in 2005 / 2006 season, the eight parental genotypes were crossed in all possible combinations, excluding reciprocals, to obtain a total of 28 F_1 crosses. In 2006/2007 season, the parents and their F_1 hybrids were grown and selfed to produce seeds of F_2 generation and harvested as single plants. In 2007/2008 season, the parents, F_1 hybrids and F_2 populations were grown in a randomized complete block design with three replications. Each experimental plot consisted of 19 rows, i.e., two for each of the parents and F_1 as well as 13 rows for F_2. The cultural practices for barley production were applied as recommended at Giza. Observations and measurements were recorded on 20 guarded plants for each of the parent and F_1 crosses and 120 plants of F_2 population chosen at random from each plot. Rows were 3.5m long, and 20cm apart. The plant spacing was 15 cm in each row. The studied characters were; number of spikes per plant, number of kernels per spike, spike kernels weight, 100-kernel weight, harvest index and grain yield per plant.

Data were processed and subjected to analysis of gene action according to Hayman (1954), Jinks (1956) and Chaudhary *et al* (1977). In 1956 Jinks gave the procedure for estimating these components from F_2 data as well. The coefficients of H_1 and H_2 are 1/4 in F_2 data as well. The coefficients of H_1 and H_2 are 1/4 in F_2, while they are 1 in F_1.

Degree of dominance in $F_1 = [(H_1/D)^{1/2}]$.

Degree of dominance in $F_2 = [1/4 (H_1/D)^{1/2}]$.

Path coefficient analysis and the direct and indirect effects at phenotypic level were made by using method proposed by Dewey and Lu (1959).

RESULTS AND DISCUSSION

Gene action in both F_1 and F_2 generations

The computed parameters for all traits are presented in Table (1). Data in both F_1 and F_2 generations revealed that the additive genetic variances (D) were significant for number of spikes per plant, number of kernels per spike, spike kernels weight, 100-kernel weight, harvest index and grain yield per plant. These results indicated the importance of additive genetic effects in the inheritance of these traits. H_1 which represents dominance component of variation and H_2 which represents dominance variance corrected for asymmetric gene distribution were significant for all traits studied in both F_1 and F_2 generations except H_2 for harvest index in F_2. However, the relatively higher magnitude of H_1 and H_2 as compared with those of (D) revealed the preponderance of dominance type of gene action in the inheritance of these traits. These results are in agreement with those reported by Rohman *et al* (2006), Sharma and Sharma (2008) and Dharam and Kumar (2009). The over all dominance effects of heterozygous loci (h^2) were significant for no. of spikes per plant, no. of kernels per spike, spike kernels weight and grain yield per plant in F_1 generation. In F_2 generation, highly significant h^2 values were detected for no. of spikes per plant, harvest index and grain yield per plant. This result indicates that the effect of dominance was due to heterozygousity and that dominance was unidirectional appreciable heterotic effect. Similar results were obtained by Youssef (2005) and Dharam and Kumar (2009). The covariance of additive and dominance effect (F) was not significant for no. of spikes per plant, no. of kernels per spike, harvest index and grain yield per plant in both F_1 and F_2 generations as well as spike kernels weight and 100-kernel weight in F_1. It could be generally concluded that an equality of the relative frequencies of dominant and recessive alleles in the parents. However, the value of (F) was positive and significant for spike kernels weight and 100-kernel weight in F_2. This indicates that there was asymmetric gene distribution with an excess of dominant alleles as compared with recessive ones in the parents. These results are in line with those reported by Abd-El Sabour *et al.* (1990), Sharma and Sharma (2008). The environmental component of variation (E) was significant for grain yield per plant in both F_1 and F_2 generations as well as no. of spikes per plant in F_1 and 100-kernel weight in F_2, revealing that the environmental effect had a share in the expression of these traits. Some useful genetic ratios and parameters were further estimated and given in Table (1). The average degree of dominance over all loci measured by the

Table 1. Estimation of genetic components for 8 X 8 diallel crosses analysis for yield attributes in F_1 and F_2 generations.

Genetic Components	No. of spikes per plant		No. of kernels per spike		Spike kernels Weight	
	F_1	F_2	F_1	F_2	F_1	F_2
D	19.27*	18.42**	36.67**	35.51**	0.51*	0.44**
H1	62.10**	28.00**	100.02**	84.72**	1.56**	0.68**
H2	44.69**	60.14**	133.23**	114.28**	1.65*	0.93*
h2	200.36**	38.02**	119.43**	3.78	1.76**	0.03
F	18.72	18.11	31.96	26.15	0.16	0.438*
E	3.90*	3.76	3.83	5.00	0.05	0.02
$(H1/D)^{1/2}$	2.58	0.43	1.65	0.38	1.93	0.31
H2/4H1	0.18	0.53	0.30	0.33	0.26	0.34
KD/KR	2.28	3.52	1.71	1.62	1.23	2.32
hns	70.47	53.57	79.12	60.00	59.37	78.40
t^2	5.70	0.03	0.14	6.03*	1.43	0.13

Table 1. Cont.

Genetic Components	100-kernel weight		%Harvest index		Grain yield per plant	
	F_1	F_2	F_1	F_2	F_1	F_2
D	2.44**	0.45**	24.93*	24.56**	8.88**	7.82**
H1	2.69**	1.49**	73.02**	72.71**	89.62**	31.56**
H2	-8.21**	5.97**	56.85**	24.31	57.50**	77.83**
h2	3.99	0.15	14.37	80.85**	218.35**	34.41**
F	0.88	0.96**	18.61	14.40	-2.79	6.82
E	0.13	0.13**	3.24	3.60	4.64**	3.58**
$(H1/D)^{1/2}$	1.04	0.45	1.71	0.43	3.38	0.47
H2/4H1	-0.76	1.00	0.19	0.08	0.16	0.61
KD/KR	2.24	3.87	1.55	1.41	0.90	1.51
hns	59.56	52.55	39.17	49.15	52.89	32.06
t^2	2.92	0.04	1.45	4.17	0.68	0.02

*and ** denote significant at 0.05 and 0.01 levels of probability, respectively

ratio $(H_1/D)^{½}$ was more than unity for all characters in F_1 generation indicates over dominance gene effects in the genetic control of the studied characters indicating the presence of over dominance for these traits. However, in F_2 generation the average degree of dominance was greater than zero but less than 1, there partial dominance for these traits. Similar results were obtained by El-Hosary *et al* (1992). The average frequency of negative vs. positive alleles in parental population was detected by computing the ratio $(H_2/4H_1)$, values largely deviating from 0.25 were obtained for no. of kernels per spike, spike kernels weight, 100-kernel weight in both F_1 and F_2 generations indicating that negative and positive alleles were symmetrically distributed among the parents. The ratio of total number of dominant to recessive alleles in the parents (KD/KR) was greater than unity for all traits studied in both F_1 and F_2 generations except for grain yield per plant in F_1. These results indicated that the proportion of dominant alleles are greater in the parents than the recessive ones for the studied traits while the recessive genes are in excess for grain yield per plant in F_1. Similar results were obtained by Dharam and Kumar (2009).

Heritability estimates in narrow sense for all characters studied in F_1 and F_2 generations are presented in Table (1). Heritability estimates in narrow sense for F_1 crosses were higher than for F_2 populations for most characters studied. The highest heritability values of narrow sense in F_1 and F_2 generations were detected for no. of kernels per spike, no. of spikes per plant, spike kernels weight and 100-kernel weight. These high estimates of heritability may reveal the efficiency of selection for these traits in early segregating generations. Intermediate to high estimates of heritability in narrow sense for these traits were also reported by El-Marakby *et al* (1994a) Youssef (2005) and Rohman *et al* (2006). Moderate values of narrow sense heritability were obtained for the other traits. However low values of narrow sense heritability were detected for grain yield per plant in F_2, indicating that most of genetic variance for these traits may be attributed to non additive effects of genes.

Correlation coefficients and Path coefficient analysis in both F_1 and F_2 generations

Phenotypic correlation coefficients estimated from the 28 genotypes between all possible pairs of studied characters in F_1 generation are presented in Table (2). Results showed positive correlations among all traits studied in most cases. Results indicated significant positive correlation coefficients between grain yield per plant and each of number of spikes per plant (r=0.39), number of kernels per spike (r=0.27), spike kernel weight (r=0.67), 100-kernel weight (r=0.53) and harvest index (r=0.53). Similar results were obtained by Sundeep *et al* (2002), Muhammad (2005), Kundalia *et al* (2006). These results indicate the possibility of obtaining high yielding genotypes through selection for one or more of these characters. Number of spikes per plant gave significant and positive association with, spike kernel weight and harvest index. However significant and negative correlation coefficients were observed between 100-kernel weight and each of number of kernels per spike and number of spikes per plant. Moreover, significant and positive correlation coefficients were found between spike kernel weight and each of 100-kernel weight, number of kernels per spike, number of spike per plant and harvest index. These results are in agreement with those obtained by Ataei (2006) and Akram *et al* (2008). El-Marakby *et al* (1994 a) found that 100-kernel weight showed negative phenotypic correlation with number of spikes per plant and kernels per spike. Phenotypic correlation coefficients estimated between all possible pairs of studied characters in F_2 generation are presented in Table (3). Data showed significant and positive correlation coefficients between grain yield per plant and each of spike kernel weight (r = 0.59), 100-kernel

Table 2. Phenotypic correlation coefficients between all possible pairs of studied characters in F_1 generation.

Characters	Grain yield per plant	Number of spikes per plant	Number of kernels per spike	Spike kernels weight	100-kernel weight	% Harvest index
Grain yield per plant	-	0.390**	0.277*	0.671**	0.533**	0.536**
Number of spikes per plant		-	-0.436**	-0.269*	0.378**	0.270*
Number of kernels per spike			-	0.393**	-0.311**	0.246*
Spike kernels weight				-	0.371**	0.236*
100-kernel weight					-	0.332**

* and ** denote significant at 0.05 and 0.01 levels of probability, respectively.

Table 3. Phenotypic correlation coefficients between all possible pairs of studied characters in F_2 generation.

Characters	Grain yield per plant	Number of spikes per plant	Number of kernels per spike	Spike kernels weight	100-kernel weight	% Harvest index
Grain yield per plant	-	0.433**	0.543**	0.595**	0.348**	0.872**
Number of spikes per plant		-	0.512**	-0.352**	0.293*	0.443**
Number of kernels per spike			-	0.403**	-0.291*	0.310*
Spike kernels weight				-	0.256*	0.416**
100-kernel weight					-	0.346**

* and ** denote significant at 0.05 and 0.01 levels of probability, respectively.

weight (r=0.34), number of kernels per spike (r=0.54), number of spikes per plant (r=0.43) and harvest index (r=0.87). These results indicate the possibility of obtaining high yielding genotypes through selection for one or more of these characters in early segregating generations. Number of kernels per spike showed significant and positive correlation with number of spikes per plant, and harvest index. Meanwhile, negative correlation was found between spike kernel weight and number of spikes per plant. Significant and positive phenotypic correlation coefficients were found between harvest index and each of spike kernel weight, number of kernels per spike and number of spike per plant. These results are in agreement with those obtained by Muhammad (2005), Kundalia *et al* (2006).

Path coefficient analysis involves a method of partitioning the correlation coefficients into direct effects and indirect effects via alternate characters or pathways. In this analysis grain yield, being the complex outcome of different characters, was considered the resultant variable and number of spikes per plant, number of kernels per spike, 100-kernel weight, spike kernel weight and harvest index the causal variables. The direct and indirect effects of the five yield component characters on grain yield per plant in F_1 generation are shown in Table (4). These characters showed positive direct effects on grain yield. Number of spikes per plant had the highest direct effect on grain yield (0.582), followed by spike kernel weight (0.543) and number of kernels per spike (0.402). While, the lowest direct effect on grain yield belonged to harvest index (0.05). Puri *et al* (1982) reported that spike yield had large direct effect on grain yield per plant. El-Marakby (1994 b) also found that grain yield was affected directly by number of spikes per plant and spike yield. Koumber *et al* (2006) indicated that number of spikes per plant had the highest direct effect on yield. The indirect effects of number of spikes per plant via number of kernels per spike and spike kernels weight were negative with values of -0.175 and -0.146, respectively. However, the positive indirect effects of number of spikes per plant via harvest index and 100-kernel weight were 0.0137 and 0.116, respectively. The indirect effects of harvest index via number of spikes per plant, number of kernels per spike, spike kernel weight and 100-kernel weight were positive with values of 0.157, 0.098, 0.128 and 0.102, respectively. The indirect effects of number of kernels per spike via harvest index and spike kernels weight were 0.0125 and 0.212, respectively. However, the negative indirect effects of number of kernels per spike via number of spike per plant and 100-kernel weight were -0.253 and -0.096, respectively. The indirect effects of spike kernels weight via harvest index, number of kernels per spike and 100-kernel weight were positive with values of 0.012, 0.157 and 0.115 respectively, whereas the indirect effect of spike kernels weight via number of spikes per plant was negative with value of -0.156. The indirect effect of 100-kernel weight via number of spikes per plant was high and positive with value of 0.219. However, the indirect effect of 100-kernel weight via number of kernels per spike was negative with value of -0.126. These results are in agreement with those obtained by Ganusheva and Lozanov (199), Ataei (2006).

In this analysis grain yield per plant was considered the resultant variable and number of spikes per plant, harvest index, number of kernels per spike, spike kernel weight and 100-kernel weight the causal variables. Estimates of path coefficients for the direct and indirect effects of the five yield component traits on grain yield per plant in F_2 generation are shown in Table (4). Results indicated that the greatest positive direct effects on grain yield per plant were expressed by spike kernel weight (0.501), followed by harvest index (0.467) and number of spikes per plant (0.368). While number of kernels per spike (0.031) and 100-kernel weight (0.073) exhibited the least direct effects on grain yield per plant. These results are in harmony with those obtained by El-Sayed *et al* (1990), Afiah and Abd-El–Hakim (1999) and Kundalia *et al* (2006). The phenotypic indirect effect of number of spikes per plant via harvest index was relatively high and positive with value of 0.206. The indirect effect of number of spikes per plant through number of kernels per spike (0.015) and 100-kernel weight (0.020) were very low with positive effects. While, the indirect effect of number of spikes per plant via spike kernels weight was negative (-0.176). The indirect effect of harvest index via spike kernels weight was relatively high and positive with value of 0.208. Meanwhile, the indirect effects of harvest index via number of kernels per spike and 100-kernel weight were very low and positive with values of 0.009 and 0.024, respectively. The indirect effect of number of kernels per spike via spike kernel weight had high and positive effect with value of 0.201. However, the indirect effect of number of kernels per spike via number of spikes per plant was negative. The indirect effect of spike kernel weight via harvest index (0.194) was high positive but number of kernels per spike (0.012) and 100-kernel weight (0.017) showed very low and positive indirect effects (-0.129). While, the indirect effect of spike kernels weight via number of spikes per plant (-0.129) was negative. The phenotypic indirect effects of 100-kernel weight via harvest index (0.161), number of spikes per plant and spike kernels weight (0.107) were positive. However, the indirect effect of 100-kernel weight via number of kernels per spike (-0.009) was negative. These results are in agreement with those reported by Koumber *et al* (2006) and Ataei (2006).

The components of the total grain yield variation determined directly and jointly by each factor for yield component traits in F_1 generation are presented in Table (5). The main sources of grain yield variation ranked according to their importance were the direct effects of number of spikes per plant (18.63%), followed by spike kernels weight (16.25%) and number of kernels/spike (8.90%). Furthermore, the joint effects of number of spikes

Table 4.Estimates of path coefficients for the direct and indirect effects of some yield component traits on grain yield per plant in the F_1 and F_2 generations.

Sources	Effect	F_1	F_2
Number of spikes/plant (X_1) and grain yield per plant (y)			
Direct effect	p1y	0.582	0.368
Indirect effect via harvest index (X_2)	r12p2y	0.0137	0.2068
Indirect effect via number of kernels/spike (X_3)	r13p3y	-0.1752	0.0158
Indirect effect via spike kernels weight (X_4)	r14p4y	-0.1460	-0.1760
Indirect effect via 100-kernel weight (X_5)	r15p5y	0.1164	0.0205
Direct + Indirect effects	**r1y**	**0.390**	**0.433**
Harvest index (X_2) and grain yield per plant (y)			
Direct effect	p2y	0.051	0.467
Indirect effect via number of spikes/plant (X_1)	r12p1y	0.1570	0.1630
Indirect effect via number of kernels/spike (X_3)	r23p3y	0.0981	0.0096
Indirect effect via spike kernels weight/spike(X_4)	r24p4y	0.1280	0.2084
Indirect effect via 100- kernel weight (X_5)	r25p5y	0.1022	0.0242
Direct + Indirect effects	**r2y**	**0.536**	**0.872**
Number of kernels/spike (X_3) and grain yield per plant (y)			
Direct effect	p3y	0.402	0.031
Indirect effect via number of spikes/plant (X_1)	r13p1y	-0.2530	0.1884
Indirect effect via harvest index (X_2)	r23p2y	0.0125	0.1447
Indirect effect via kernels weight/spike (X_4)	r34p4y	0.2128	0.2019
Indirect effect via100- kernel weight (X_5)	r35p5y	-0.0967	-0.0203
Direct + Indirect effects	**r3y**	**0.277**	**0.543**
Spike kernels weight (X_4) and grain yield per plant (y)			
Direct effect	p4y	0.543	0.501
Indirect effect via number of spikes/plant (X_1)	r14p1y	-0.1565	-0.1295
Indirect effect via harvest index (X_2)	r24p2y	0.0120	0.1942
Indirect effect via number of kernels/spike (X_3)	r34p3y	0.1575	0.0124
Indirect effect via 100- kernel weight (X_5)	r45p5y	0.1155	0.0179
Direct + Indirect effects	**r4y**	**0.671**	**0.595**
100-kernel weight (X_5) and grain yield per plant (y)			
Direct effect	P5y	0.308	0.073
Indirect effect via number of spikes/plant (X_1)	r15p1y	0.2199	0.1078
Indirect effect via harvest index (X_2)	r25p2y	0.0161	0.1615
Indirect effect via number of kernels/spike (X_3)	r35p3y	-0.1262	-0.0090
Indirect effect via spike kernels weight (X_4)	r45p5y	0.1155	0.0179
Direct + Indirect effects	**r5y**	**0.533**	**0.348**

Table 5. Relative importance (RI) of some attributes of 28 barley genotypes in F_1 and F_2 generations to grain yield per plant.

Sources of variation		CD		RI%	
Direct effect		F_1	F_2	F_1	F_2
Number of spikes/plant	(X_1)	0.338	0.1354	18.63	11.43
Harvest index	(X_2)	0.002	0.2180	0.143	18.40
Number of kernels/spike	(X_3)	0.161	0.0009	8.90	0.07
Spike kernel weight	(X_4)	0.264	0.2510	16.25	21.19
100-kernel weight	(X_5)	0.094	0.0049	5.22	0.41
Indirect effect					
(X_1) x (X_2)		0.0159	0.1522	0.87	12.85
(X_1) x (X_3)		-0.2039	0.0116	11.19	0.97
(X_1) x (X_4)		-0.1699	-0.1295	9.36	10.93
(X_1) x (X_5)		0.1354	0.0150	7.46	1.26
(X_2) x (X_3)		0.001	0.009	0.05	0.75
(X_2) x (X_4)		0.0130	0.1946	0.71	16.43
(X_2) x (X_5)		0.010	0.0226	0.55	1.90
(X_3) x (X_4)		0.171	0.0125	9.42	1.05
(X_3) x (X_5)		-0.077	-0.0012	4.24	0.10
(X_4) x (X_5)		0.125	0.0179	6.89	1.51
Residual		0.09	0.077	0.11	0.7
Total		1.00	1.00	100	100

*** CD: Coefficient of Determination.**
*** RI: Relative Importance.**

per plant with each of number of kernels/spike, spike kernels weight and 100-kernel weight were 11.19%, 9.36% and 7.46% respectively, as well as the joint effects of number of kernels/spike with spike kernels weight and 100-kernel weight were 9.42% and 4.24% respectively. Also, the joint effect of spike kernels weight with 100-kernel weight was 6.89%. The total contribution of the five studied characters was 99.89% while the residual effect amounted to about 0.11% of the total phenotypic variation.

The components of the total grain yield variation determined directly and jointly by each factor for yield component traits in F_2 generation are presented in Table (5). The main sources of grain yield variation in order to importance were the direct effects of number of spike/plant (11.43%), harvest index (18.40%), and spike kernels weight (21.19%). Moreover, the joint effects of number of spikes/plant with each of harvest index and spike kernels weight were 12.85% and 10.93%, respectively as well as the joint effect of harvest index with spike kernel weight was 16.43%. The total

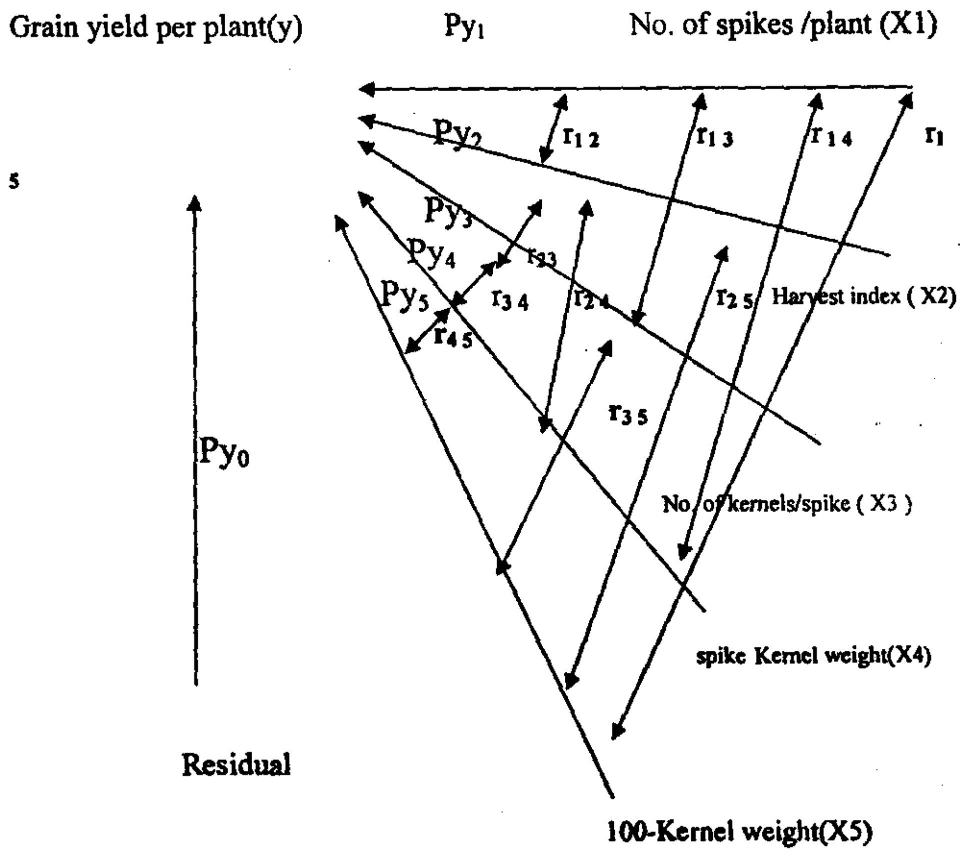

Fig. 1. The path diagram of factors influencing grain yield per plant in barley Ganusheva and Lozanov (1991).

contribution of the five studied traits directly or jointly amounted to 99.3% whereas the residual effect was 0.7% of the total phenotypic variation. This indicates that most of the factors involved in plant yield variation were identified. Similar results were obtained by Deniz *et al* (2009). Larik *et al* (1987) and Ganusheva and Lozanov (1991) also indicated that spike kernels weight in barley was the most effective source of grain yield. On the other hand, Singh and Singh (1990) found that the weight of 1000-grain in barley was the most contributer to barley plant yield variation. However, El-Marakby (1994 b) in barley and Lad *et al* (2003) reported that number of spike per plant and spike kernel weight were the greatest contributers to grain yield and the breeder may consider these traits as the main selection criteria. From the previous results in both F_1 and F_2 generations, it could be concluded that number of spikes per plant and spike kernels weight and their joint effects are considered as important selection criteria in barley yield improvement programs.

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طبيعة الفعل الجينى و معامل المرور للمحصول و مكوناتة فى بعض هجن الشعير

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[1]المشروع المصرى الأوروبى للتنمية المستدامة للشعير تحت الظروف المطرية فى مصر – قسم بحوث الشعير – معهد المحاصيل الحقلية- مركز البحوث الزراعية.
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أجرى هذا البحث فى محطة التجارب التابعة لمركز البحوث الزراعية بالجيزة خلال ثلاث مواسم زراعية متتالية بداية من الموسم الزراعى 2006/2005 بهدف دراسة طبيعة الفعل الجينى و معامل المرور لصفة محصول الحبوب و مكوناتة فى الجيل الأول و الثانى و ذلك فى مجموعة من الهجن التبادلية بين ثمانية أصناف من الشعير ذات أصول وراثية متباعدة أربعة منها شعير مغطى و أربعة شعير عارى لتحديد أفضل الأباء و الهجن التى يمكن أستخدمها فى برامج تربية الشعير و تشير أهم النتائج المتحصل عليها ألى يلى :-

- **أوضحت النتائج أن تأثير الفعل المضيف (D) و غير المضيف (H_1) كان معنوياً لجميع الصفات المدروسة و ذلك فى كلاً من الجيل الأول و الثانى.**
- **أظهرت النتائج أن هناك دليل على السيادة الراجعة لتأثير الجينات الموجبة و السالبة فى الأباء (H_2) و ذلك فى كل الصفات المدروسة فى كلاً من الجيل الأول و الثانى و صفة دليل الحصاد وذلك فى الجيل الثانى.**
- **أوضحت النتائج أن هناك تأثير سيادى لجميع المواقع الوراثية الخليطة فى الهجن (h^2) حيث أعطت معنوية و ذلك فى صفات محصول الحبوب/نبات ، عدد السنابل/نبات و ذلك فى الجيل الأول و الثانى.**
- **وجد أن هناك تباين مشترك للجينات ذات التأثير المضيف و السيادى فى الأباء (F) حيث أعطت معنوية موجبة و ذلك لصفات وزن ال100 حبة ، وزن حبوب السنبلة و ذلك فى الجيل الثانى.**
- **أشارت النتائج أن هناك تباين راجع للبيئة (E) و أعطى تأثير معنوى موجب و ذلك لصفة محصول الحبوب/نبات فى كلاً من الجيل الأول و الثانى.**
- **النسبة $(H_1/D)^{1/2}$ سجلت قيماً أعلى من الوحدة فى كل الصفات المدروسة فى كل من الجيل الأول و الثانى وهذا يدل أن درجة السيادة تكون سيادة فائقة فى جميع الصفات المدروسة فى الجيل الأول و الثانى .**
- **أوضحت النتائج أن النسبة ($H_2/4H_1$) كانت أقل من 0.25 فى أغلب الصفات المدروسة فى الجيل الأول وهذا يعطى دليل أن هناك عدم توزيع متساوى للأليلات السالبة و الموجبة فى الأباء ما عدا صفات عدد حبوب السنبلة ، وزن حبوب السنبلة ، وزن ال100 حبة تكون النسبة لهذة الصفات أعلى**

ورقة علمية مستخلصة من المشروع المصرى الأوربى للتنمية المستدامة لأنتاج الشعير تحت ظروف الزراعة المطرية بمصر الممول من حصيلة المعونات الغذائية للأتحاد الأوربى لمصر.

من 0.25 وهذا دليل على وجود توزيع متماثل بين الأليلات الموجبة و السالبة فى الأباء. بينما فى الجيل الثانى فكانت النسبة أعلى من 0.25 لصفات عدد حبوب السنبلة/نبات , ووزن حبوب السنبلة ، وزن ال100 حبة ، وزن محصول الحبوب/نبات لهذة الصفات و هذا دليل أن هناك تماثل بين أليلات السالبة و الموجبة فى الأباء.

- دلت النتائج أن قيمة النسبة KD/KR لتوضيح النسبة بين الجينات السائدة و المتنحية فى الأباء كانت هذة النسبة أعلى من الوحدة فى جميع الصفات المدروسة فى كلاً من الجيل الأول و الثانى. بينما صفة محصول الحبوب/نبات كانت النسبة أقل من الوحدة وذلك فى الجيل الأول و لكن فى الجيل الثانى كانت أعلى من الوحدة.
- أظهرت النتائج أن كفاءة التوريث بالمعنى الضيق كانت عالية لصفات عدد السنابل/نبات ، عدد حبوب السنبلة/سنبلة ، وزن حبوب السنبلة ، وزن ال100 حبة وذلك فى كل من الجيل الأول و الثانى. أما بالنسبة لصفة محصول الحبوب/نبات كانت كفاءة التوريث بالمعنى الضيق عالية فى الجيل الأول فقط منخفضة فى الجيل الثانى.

أظهرت النتائج معنوية الأرتباط الموجب بين محصول الحبوب/نبات و كلا من عدد السنابل/نبات ، عدد حبوب السنبلة ، وزن حبوب السنبلة ، وزن ال100 حبة ، دليل الحصاد و ذلك فى الجيل الأول بينما أظهرت النتائج وجود أرتباط معنوى موجب بين محصول الحبوب/نبات و كلا من عدد حبوب السنبلة ، عدد السنابل/نبات وزن حبوب السنبلة و ذلك فى الجيل الثانى.

- أظهرت نتائج دراسة معامل المرور أن صفة عدد السنابل/نبات و صفة وزن حبوب السنبلة و تأثيرهما المشترك كانت أكثر الصفات تأثيراً على محصول الحبوب فى الجيل الأول و الجيل الثانى.