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GENETIC ANALYSIS OF YIELD, ITS COMPONENTS AND NET BLOTCH DISEASE RESISTANCE IN BARLEY UNDER STRESS CONDITIONS:

2- F_4 SALT AND DROUGHT TOLERANT LINES

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ABSTRACT

Twelve F_4 lines of barley were selected through the crop breeding program of desert research center under saline and rainfed conditions. These elite newly bred lines were chosen according to their superiority in abiotic (saline or drought) and biotic (net blotch disease) resistance. Significant differences among all genotypes were detected in respect to grain yield, its main components and net blotch severity of infection.

Under Ras suder saline conditions, F_4 line No.1 gave the highest number of spikes / plant (3.8) and it was better than the check variety (Giza 123). Line (10) followed by line (9) and line (12) were the superior genotypes in grain yield / plant and yielded more than the check variety (Giza 123) by 70.96, 69.87 and 65.94 %, respectively. This superiority in yield potential was negatively correlated with severity of net blotch infection Positive and significant correlation coefficients were detected between grain yield / plant and each of number of spikes / plant and 100 grain weight which revealed that selection for each or both yield components would be accompanied by high yielding ability under similar saline environments.

One the other hand; under Maryout rainfed conditions, the three F_4 selected lines No. 12, 10 and 9 gave the highest grain yield / plant. These three lines outyielded the recommended variety (Giza 126), by 73.48, 63.64 and 62.88 % respectively. This superiority in yield potentiality mainly attributed to number of spikes / plant, 100-grain weight and tolerance to net blotch disease. Such elite newly bred lines had P_1, in its genetic background which was developed for drought tolerance under rainfed Syrian conditions and selected as a highly resistant genotype to net blotch disease under Egyptian conditions. This finding may explain the importance of the choice of parents in breading program.

Small differences between phenotypic and genotypic coefficients of variability for all traits were recorded except severity of net blotch disease infection suggesting the relative importance of genetic variance for such traits under both saline and rainfall conditions. Accordingly, broad sense heritability estimates were relatively high and ranging from 81.5 to 96.1 % and from 76.3 to 94.5 % under saline and rainfed conditions, respectively.

Keywords: F_4 Barley lines, Genetic analysis, Net Blotch, *Pyrenophora teres*, Resistance, Salt tolerance , Drought tolerance

INTRODUCTION

Net blotch infection caused by *Pyrenophora teres* Dreschs (Anamorph: Drechslera teres " Sacc " Shoem) is one of the barley fungal diseases which causing losses often vary between 10 and 40 % (Steffenson *et al.*, 1996).

Several methods are used to decrease the severity of this disease i.e. biological control which lead under specific condition to a limited success

(Gullimo and Bazzano, 1982). Application of some growth regulators and fertilizers were also studied to decrease the severity of the pathogens (Simeoni *et al.*,1987). On the other hand, breeding for resistant cultivars which requires a long period to evaluate its resistance could be a good suggestion for this reason (Kiesling, 1985) .

Barley is the main crop grown in a large scale at the Northwestern Coast of Egypt. It is grown also in low fertility soils such as the newly reclaimed lands, salt affected soils such as South Sinai where irrigation water is limited. In Egypt, the total area of barley fluctuates year after year according to the amount and distribution of rainfall. Its cultivated production area in the Nile Valley has gradually decreased, especially at the locations where soil and irrigation water are suitable for growing other strategic crops. On the other hand, barley production area has increased in the newly reclaimed lands under different available irrigation system. In 1999/2000 season, the production area under rainfall conditions, newly reclaimed lands and old lands was 24814 , 6127 and 17936 hectares with average productivity 1.7 , 2.69 and 3.77 ton / ha., respectively. The production in specific years varies drastically with the change in seasonal conditions (amount of rainfall and its distribution).

In Northwest coast of Egypt, rainfall is low (average of 50 years ago is 133 mm / year). Barley production could be successfully grown in this region particularly, when the soil structure is loamy sand which has a moderate water holding capacity. The government is planning to extend irrigation canals to the region to provide supplementary irrigation at the critical periods of crop life cycle. Under such limited water resources, the choice of barley variety that makes the use of available moisture is a key factor to successful cropping. Genotypes that are tolerant to drought have been identified on the bases of seed yield indices in natural stress environments (Bruckner and Frohberg 1987 and Osmanzai *et al.* 1987).

Several Egyptian barley cultivars have been developed with desirable characteristics related to yielding ability and good quality in the last decades. Through the Desert Research Center barley-breeding program, some elite genetic resources for biotic and abiotic tolerance were screened from local and exotic germplasm and hybridized in a half diallel function. The pedigree selection system was adopted for developing grain yield, its attributes and disease resistance under saline and rainfall conditions during the segregating generations up to obtaining F_4 hulled and hulles grain lines (2001 / 2002 growing season). Breeding for high yielding ability and more disease resistance under stress conditions, requires identification of the new hybrid recombinants that have a desired genes for the target area (Afiah and Zaki, 2001).

Information on heritability and genetic variation estimates is useful to formulate the exacted genetic gain from selection in the breeding program. Further, high heritability values indicate the effectiveness of selection for each character. Most genetic analyses in barley concentrate on elucidating the mode of inheritance of characters separately. However, it is equally important to study the relationships between different characters so that the consequences of selection for one character on the performance of another could be predicted. The degree of genetic relationship between pairs of characters is expressed by the genetic covariance or its standardized form. The correlation coefficient functionally, a significant relationship implies the pleiotropic effect of the same genes or linkage genes controlling the separate characters.

The progress in research for developing barley varieties under stress conditions has not been commensurate with the needs because the narrow base of germplasm used and inadequacy of the selection methods to detect genotypes superior under stress environments. Meantime, many reports identified lines with wide adaptation and ability to withstand the aimed environments outlined using early segregating generations. They have also used correlation analysis to ascertain relationships between variables.

Since each gene consists of hundreds of nucleotides, each capale of base substitutions and with additional permutations possible through sequence rearrangements, additions and deletions, the potential number of allelic states at a single locus is virtually infinite. The number of different allelic combinations which may exist at several loci is even greater. Obviously, only a small fraction of these potential alleles or allelic combinations exist in segregating generations in relation to the total number of variants. This is clearly impractical thus, this investigation aimed to evaluate, identify and select more salt, drought and net blotch disease resistant F_4 hulled barley lines. This occurred on the basis of variation, association and heritability for all traits recorded under Maryout rainfed conditions with one supplemental irrigation at sowing date and saline conditions of Ras Sudr - South Sinai.

MATERIALS AND METHODS

Four field experiments were conducted at the two locations:

1) Maryout Agricultural Experiment Station of Desert Research Center (DRC) during 2001/2002 growing season to evaluate 12 F_4 selected barley lines compared with 4 local and exotic genotypes. Sowing was performed on 13th Oct., 2001, after adding the recommended dose of NPK fertilizers. The soil of the experimental site is highly calcareous (38% Ca CO_3), sandy clay loam texture, mildly alkali (pH 7.7) with moderately saline extract (ECe 5.8 dSm^{-1}) and one supplemental irrigation at sowing was added from agricultural drainage water (EC=3.1 dSm^{-1}). The precipitated rain amount was 144.72 mm during the growing season.
2) Ras Sudr Agricultural Experiment Station of DRC during three successive seasons ended in 2001/2002. Through the barley breeding program of DRC, several local and exotic genotypes are selected as elite one's for diallel crossing to accumulate genes controlling net blotch disease resistance and high yielding ability. From such germplasm, the Syrian line used as P_1 (Orge 905/Cr. 289 – 53 - 2) and ICARDA line used as P_5 (Arar // 2762 / Bc – 2L – 2Y). F_2 segregants were isolated from all diallel sets in 1999/2000 growing season harvest. 150 F_3 families derived

from the chosen half diallel crosses according to the genetic parameters studied by Afiah and Zaki (2001) were evaluated in 2000/2001. 45 F_4 seed lines were selected according to their superiority in yield, one or more of its attributes and net blotch disease resistance. All lines were sown in a randomized complete block design (RCBD) with four replicates. Each line was represented in each replicate by two rows 4.5 m long, 30 cm apart and approximately 7.5 cm between plants. The check varieties and elite parents (Giza 123, Giza 126, P_1 and P_5) were also randomly included in each replicate. Bulk populations involving sensitive genotypes for net blotch disease such as hulles grain line P_4 (ICNB F_8 – 654 Sel 5 AP) were sown as border of the experiment in 23rd Oct. 2001. ECe of soil was 10.54 dSm^{-1} and EC of under ground water was 8.32 dSm^{-1}. All cultural practices were done as recommended for such newly reclaimed areas. After harvest and recording the raw data, the best 12 lines in each of both locations (Ras Sudr and Maryout) were selected to analyze their traits with all checks using fifteen competitive plants / from each Mat.

Disease index (severity of infection) was estimated according to the method of Khan and Boyd (1969) on the scale from 1 to 10 where: 1-3 resistant (R), 3.1-5 moderatly resistant (MR), 5.1-7 moderatly susceptible (MS) and > 7 susceptible (S) as described by Tekauz (1985).

Statistical analyses were performed as outlined by Gomez and Gomez (1984). Comparison between means of all traits studied among genotypes were made using Duncan's multiple range test (Duncan 1955). Simple correlation coefficients were calculated between grain yield / plant and each of other traits studied as described by Mode and Robinson (1959). Significance of each correlation coefficients were determined as shown by Snedecor and Cochran (1980) with df = n-2 (where n is the sample size in plot basis). Estimating phenotypic and genotypic coefficients of variability of the studied traits were done according to Comstock and Moll (1963). Heritability in broad sense (H_{bs}) was calculated for all studied traits using Allard equation (1960) as follows:

$$H_{bs}\ \% = (\text{Genotypic variation / Phenotypic variation}) \times 100$$

RESULTS AND DISCUSSION

The pertinent portion for analysis of variance was made for all recorded traits under both Ras Sudr saline conditions (soil and irrigation water) and Maryout rainfed environment. Significant differences between genotypic mean performances were separated under each environment by using Duncan's multiple range test. For better presentation of the obtained results, it was outlined in the three items as follows:

1- *Genotypic differences* and associations under saline conditions:

All barley genotypes (F_4 lines and check varieties) mean performances are differentiated and illustrated in Table 1 for all traits recorded. F4 line No. 1 gave the highest number of spikes / plant (3.8). Also, for number of spikes / plant, the recommended check variety (Giza 123) designated in the 1st group and insignificantly differed from P_1 as well as seven F_4 lines while Giza 126 was a limited tillering genotype (1.8 spikes / plant). F_4 line (9) bearing the heaviest grains followed by line (7) and (10). P_5, line (11) and line (1) gave the highest number of grains / spikes. F_4 line (10) followed by line (9) and line (12) were the superior genotypes in grain yield / plant and yielded more than the recommended variety (Giza 123) by 70.96, 69.87 and 65.94 %, respectively. This superiority in yield potential negatively correlated with severity of net blotch infection as shown in Table (1). It is worthy to note that abiotic resistance was inherited to the three superior lines from its P_1 parent. These results were in line with those previously obtained by Nagaz and Mechlia (1998), Afiah *et.al.* (1999), Abdel-Sattar and Afiah (1999) and Afiah *et al.* (2001).

Table 1: Mean performance and simple correlation coefficient under Ras Sudr – South Sinai saline conditions.

Genotype	Spikes / plant	Grains / spike	100-grain weight (g)	Severity of infection	Grain yield / plant	D%
P_3 Giza 123	3.7 ab	41.7 e-h	4.03 ef	3.0 gh	4.58 g	-
Giza 126	1.8 g	45.6 b-d	4.51 cd	2.7 h	3.41 g	-25.55
P_1	3.5 a-c	40.4 gh	4.05 ef	0.3 j	4.53 g	-1.09
P_5	3.4 b-d	51.3 a	4.62 cd	3.8 e-g	4.86 fg	6.11
F_4 (1) P_3xP_5	3.8 a	48.3 ab	3.65 g	4.3 de	6.15 c-e	34.28
F_4 (2) P_3xP_5	3.1 d-f	46.5 b-d	3.87 fg	6.7 a	5.24 f	14.41
F_4 (3) P_3xP_5	3.0 ef	46.3 b-d	4.51 cd	4.5 de	6.02 de	31.44
F_4 (4) P_3xP_5	3.5 a-c	44.7 c-f	4.06 ef	5.1 b-d	5.87 e	28.17
F_4 (5) P_3xP_5	3.7 ab	41.2 f-h	4.66 cd	5.5 bc	6.41 b-d	39.96
F_4 (6) P_3xP_5	3.4 b-d	44.6 c-f	4.53 cd	4.0 ef	6.57 bc	43.45
F_4 (7) P_1xP_5	3.5 a-c	38.9 hi	5.20 b	4.7 c-e	6.68 b	45.85
F_4 (8) P_1xP_5	3.3 c-e	47.1 bc	4.43 cd	4.1 ef	6.30 b-e	37.55
F_4 (9) P_1xP_5	3.8 a	36.8 i	5.92 a	3.3 f-h	7.78 a	69.87
F_4 (10) P_1xP_5	3.6 a-c	43.5 d-g	5.11 b	3.0 gh	7.83 a	70.96
F_4 (11) P_1xP_5	2.9 f	50.8 a	4.36 de	5.7 b	6.21 c-e	35.59
F_4 (12) P_1xP_5	3.7 ab	45.0 b-e	4.70 c	1.3 i	7.60 a	65.94
r.	0.592**	0.158	0.581**	-0.167	-	-

D%: Difference relative to the recommended variety for the region (Giza 123)
r.: simple correlation coefficient between grain yield / plant and each of the studied traits.
Tabular r. at p ? 0.05 level = 0.288 at p ? 0.01 level = 0.372

Positive and significant correlation coefficients were detected between grain yield / plant and each of number of spikes / plant and 100 grain weight revealed that selection for each or both yield components would be accompanied by high yielding ability under similar saline environments. The results previously obtained by El-Sayed and Mohamed (1992) in barley, Afiah and Abdel-Sattar (1998) and Afiah (1999) in wheat and Omar and Afiah (1999) in triticale were in line with these findings under stress conditions.

2- Genotypic differences and associations under rainfed conditions:

Data presented in Table 2 showed significant differences among genotypes for all studied traits. Under such experimental rainfed (drought) conditions that prevailing during the growing season, the three F_4 selected lines No. 12, 10 and 9 gave the highest grain yield / plant. These three lines outyielded 73.48, 63.64 and 62.88 % more than the recommended variety (Giza 126), respectively. This superiority in yield potentiality mainly attributed to number of spikes / plant, 100-grain weight and tolerance to net blotch disease. Such elite newly bred lines had in its genetic background P_1, which was developed for drought tolerance under rainfed Syrian conditions and selected as a highly resistant genotype to net blotch disease under Egyptian conditions (Afiah and Zaki 2001). This finding may explain the importance of parental chosen for the target of crossing program viz., drought tolerance and disease resistance.

Table 2: Mean performance and simple correlation coefficient under rainfed conditions with one supplemental irrigation at Maryout (NWC).

Genotype	Spikes / plant	Grains / spike	100-grain weight (g)	Severity of infection	Grain yield / plant	D%
P_3 Giza 123	3.1 b-d	38.5 g	3.66 hi	3.5 f-h	3.81 i	-3.79
Giza 126	1.7 g	47.3 b-e	4.85 bc	3.9 e-h	3.96 i	-
P_1	3.4 ab	38.0 g	3.77 gh	1.3 j	4.15 hi	4.80
P_5	2.6 f	45.8 c-f	4.18 e	5.7 a-c	4.63 gh	16.92
F_4 (1) P_3xP_5	3.6 a	50.1 ab	3.40 i	5.5 a-d	5.38 de	35.86
F_4 (2) P_3xP_5	2.8 d-f	49.1 bc	3.61 hi	6.3 a	4.76 fg	20.20
F_4 (3) P_3xP_5	3.0 c-e	45.8 c-f	4.32 de	4.7 c-f	5.21 ef	31.57
F_4 (4) P_3xP_5	3.4 ab	48.4 b-d	3.81 f-h	5.0 b-e	5.47 de	38.13
F_4 (5) P_3xP_5	3.3 a-c	43.8 ef	4.65 cd	6.0 ab	5.16 ef	30.30
F_4 (6) P_3xP_5	3.1 b-d	45.4 c-f	4.38 de	4.3 d-g	5.65 c-e	42.68
F_4 (7) P_1xP_5	3.6 a	35.7 g	5.16 ab	3.0 hi	6.06 bc	53.03
F_4 (8) P_1xP_5	3.1 b-d	51.2 ab	4.15 ef	4.0 e-h	5.86 cd	48.74
F_4 (9) P_1xP_5	3.6 a	36.4 g	5.36 a	3.0 hi	6.45 ab	62.88
F_4 (10) P_1xP_5	3.4 ab	42.8 f	5.08 ab	3.3 g	6.48 ab	63.64
F_4 (11) P_1xP_5	2.7 ef	54.4 a	4.03 e-g	5.0 b-e	5.63 c-e	42.17
F_4 (12) P_1xP_5	3.2 bc	44.5 d-f	4.85 bc	2.0 ij	6.87 a	73.48
r.	0.518**	0.107	0.552**	-0.295*	-	-

NWC: North Western Coast of Egypt

D%: Difference relative to the recommended variety for the region (Giza 126)

r.: simple correlation coefficient between grain yield / plant and each of the studied traits.

Tabular r. at p ? 0.05 level = 0.288 at p ? 0.01 level = 0.372

The three promising lines could be subjected for further studies under different environmental conditions and agricultural practices. The 12 selected barley genotypes under consideration gather the desirable gene combinations which acting well under saline and rainfall conditions in the direction of good grain yielding ability with fluctuated responses. Grain weight was the major contributor for grain yield in saline environment while, severity on net blotch infection and number of spikes / plant where the major ones under rainfed conditions. It is worthy to note that six and four lines under saline and rainfed stresses, respectively in addition to the three elite superior lines have a considerable concern from the breeders. El-Sayed and Mohamed (1992) and Noaman *et al* (1992) concluded the possibility for having some barley genotypes that combine high yielding potential under mild and severe drought stresses.

Simple correlation coefficient between grain yield / plant and each of all traits recorded were estimated and presented in Table 2. It was found that all significant relations were positive except the association between net blotch disease infection and yielding capacity which exhibited negatively significance. Highly significant relations between grain yield / plant and each of number of spikes / plant and 100-grain weight were detected reflecting the direct importance of these traits as an effective yield contributors. These findings are in agreement with those reported by Singh (1989), Gibril (1990), Dencic *et al.* (2000), Shukla *et al.* (2000) and Afiah and Moselhy (2001). Number of grains / spike showed insignificant positive association with grain yield / plant. Also, these two characteristics showed relatively lower estimates of broad sense heritability under rainfed than saline conditions as shown in Table 3. Rana et al. (1999) reported that number of grains / spike and grain yield / plant showed high sensitivity to moisture stress.

3- Variations, heritability and environmental effects:

Data presented in Table 3 revealed that small differences between phenotypic and genotypic coefficients of variability for all traits recorded except severity of net blotch disease infection suggesting the relative importance of genetic variance for such traits under both saline and rainfall conditions. Accordingly, broad sense heritability estimates were relatively high and ranging from 81.5 to 96.1 % and from 76.3 to 94.5 % under saline and rainfed conditions, respectively. For the exeptional case, H_{bs} estimates (45.9 and 48.8 % under saline and rainfed conditions, respectively) was sufficient for further improvements by other selection cycles between and within F_5 lines. Bhatia *et al.* (1978) estimates the heritability values from F_1 to F_4 generations in wheat and found that these estimates were much higher in F_4 than F_3 for eight traits recorded. Generally, pedigree selection could be continued to indentify the performance of more promissing lines for improving yield and its contributes with emphasis to net blotch disease resistance. The considerably high genotypic coefficients of variation and heritabilily are supported by the earlier results of Krishnawat and Sharma (1998), Afiah and Moselhy (2001) and Hassan and Afiah (2002).

In pedgree selection. the breeder is more concerned with the performance of individual selected lines while, the overall means gave idia for genotypes x environments effect. It worthy noting that genotypes tested were more yielded under saline conditions than rainfed environment for number of spikes / plant, 100-grain weight and grain yield / plant. The reverse was true for number of grains / spike and severity of net blotch infection.

Table 3: Effect of saline (S) and rainfed (R) conditions on the genotypes response (mean), genotypic (GCV) variability coefficients and heritability in broad sense (H_{bs}), phenotypic (PCV) and for the studied traits.

Genetic parameter		Spikes / plant	Grains / spike	100-grain weight (g)	Severity of infection	Grain yield / plant
Mean ± SE.	S	3.36 ± 0.124	44.54± 1.006	4.51 ± 0.140	3.88 ± 0.405	6.00 ± 0.309
	R	3.10 ± 0.121	44.83± 1.362	4.33 ± 0.152	4.16 ± 0.357	5.35 ± 0.227
PCV	S	31.3	23.8	17.5	33.5	34.7
	R	40.8	27.4	18.3	44.8	36.2
GCV	S	26.0	19.2	15.1	20.6	28.4
	R	34.2	21.9	15.7	31.2	28.8
Hbs%	S	81.5	92.3	96.1	45.9	82.7
		83.7	88.1	94.5	48.6	76.3

SE. : Standard Error.

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التحليل الوراثى للمحصول ومكوناته وتحمل مرض التبقع الشبكى فى الشعير تحت ظروف الاجهاد:
٢ – سلالات فى الجيل الرابع تتحمل الملوحة والجفاف

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- تم استنباط اثنى عشر سلالة من الشعير فى الجيل الرابع تحت ظروف الزراعة المطرية وكذلك الاجهاد الملحى وذلك ضمن برنامج تربية المحاصيل بالمركز . كان انتخاب هذه السلالات على أساس التميز والتفوق فى تحمل الاجهادات غير الاحيائية (ملوحة وجفاف) وكذلك الاجهادات الاحيائية (مقاومة مرض التبقع الشبكى)

- عند تقييم هذه المصادر الوراثية المختارة مقارنة بابائها والتى اشتملت على صنف جيزة (١٢٣) الموصى به للزراعة بالاراضى المتأثرة بالملوحة والصنف جيزة (١٢٦) المعتمد للزراعة تحت الظروف المطرية بمصر وجدت اختلافات معنوية بين كافة التراكيب الوراثية تحت الدراسة بالنسبة لمحصول الحبوب ومكوناته وكذلك مقاومة مرض التبقع الشبكى ويمكن تلخيص نتائج الدراسة فيما يلى :

١ – **تحت الظروف الملحية برأس سدر – جنوب سيناء**

أعطت السلالة رقم (١) أكبر عدد من السنابل بالنبات (٣,٨) كما تم توصيف الصنف المعتمد للزراعة بالأراضى المتأثرة بالملوحة ضمن المجموعة الأولى حيث لم يختلف معنويا عن الأب الاول وكذلك سبعة من السلالات المنتخبة فى هذه الصفة .

تفوقت ثلاثة من السلالات عن صنف المقارنة بدرجة ملحوظة وهى السلالة رقم (١٠) متبوعة بالسلالة رقم (٩) ثم (١٢) بالنسبة لمحصول الحبوب وبفارق ٧٠,٩٦، ٦٩,٨٧ ، ٦٥,٩٤ % على الترتيب عن الصنف المعتمد (جيزة ١٢٣).

كما ارتبط هذا التفوق فى المحصول عكسيا بشدة الاصابة بمرض التبقع الشبكى وكان الارتباط موجب ومعنوى بين الانتاجية من الحبوب وكل من عدد السنابل /نبات ووزن المائة حبة مما يجعل الانتخاب لاحد هاتين الصفتين او كليهما مجديا فى تحسين الكفاءة الانتاجية تحت البيئات الملحية المماثلة.

٢ – **تحت ظروف الزراعة المطرية بمريوط:–**

ابدت السلالات الثلاثة المتفوقة تحت الظروف الملحية تفوقا ملحوظا تحت الظروف المطرية مع اختلاف الترتيب حيث كانت رقم (١٢) هى الاعلى محصولا ثم رقم (١٠) و (٩) بنسب ٧٣,٤٨ و ٦٣,٦٤ و ٦٢,٨٨ % من صنف المقارنة جيزة (١٢٦) على الترتيب.

- ويلاحظ ان السلالات الثلاثة الاكثر تفوقا تحت الاجهادات البيئية المتباينة تشترك فى الاب السورى P1 والذى انتخب لتحمل ظروف الزراعة المطرية بسوريا وأبدى مقاومة عالية لمرض التبقع الشبكى فى الشعير تحت الظروف المصرية مما يوضح أهمية أختيار الاباء لبرنامج التربية تحت ظروف خاصة .

- كان الفرق بين معامل الاختلاف البيئى ونظيرة الوراثى صغير نسبيا لكل الصفات تحت الدراسة ماعدا شدة الاصابة بمرض التبقع الشبكى معبرا عن أهمية التباين الوراثى للتحكم فى هذه الصفات تحت كل من الظروف الملحية والمطرية. وبالتالى كانت قيم معامل التوريث بمعناه الواسع عالية نسبيا وتراوحت بين ٨١,٥ حتى ٩٦,١ % تحت الظروف الملحية و ٧٦,٣ حتى ٩٤,٥ % تحت ظروف الزراعة المطرية.