Annals of Agric. Sc., Moshtohor,
Vol. 32(1):109-117, 1994

STABILITY PARAMETERS FOR GRAIN YIELD OF SOME MAIZE GENOTYPES

By

Sedhom, S.A.
Agron. Dept. Fac. Agriculture, Moshtohor, Zagazig Univ. Egypt.

ABSTRACT

Ten maize genotypes were evaluated under eight environmental conditions to study their stability for grain yield. The eight environments included two planting dates, two nitrogen levels, and two growing seasons. The model suggested by Eberhart and Russell (1966) was followed for studying the stability parameters. Significant genotypes and genotypes x environment interaction were obtained for maize grain yield/plant. Also, (bi) values did not deviate significantly from the unity in seven genotypes. Moreover, the deviation from regression mean squares ((S^2di)) was significant for all of the studied genotypes. Results of grain yield also indicated that two genotypes namely, T.W.C. 310 and D.C. Taba had high mean value(x), (bi) values =1, and low values of deviation from regression. Therefore, these two genotypes are considered more stable than the other studied genotypes and could be used effectively in future maize breeding programs

INTRODUCTION

Genotype-environment interactions play an important role in the performance of a variety. These interactions have been studied by several investigators to identify the high yielding varieties that are more stable when grown in different environments. Comstock and Moll (1963) suggested the development of varieties adapted to a broad spectrum of environment or the development of highly adapted varieties for specific environment. Finlay and Wilkinson (1963) used the regression coefficient of the varietal means on the environmental means as an indicator for its phenotypic stability. From a regression analysis, Rowe and Androw (1964) showed that the segregating groups were more stable than the inbred lines since their mean for each environment deviated less from regression. Eberhart and Russell (1966) suggested a model to describe the performance of a variety over a range of environments. This model provides three statistics namely, mean performance, linear response (regression) of a variety to environment and deviation from linear response. According to this model a stable variety is one with high mean performance, unit regression coefficient and least deviation from regression.

The main objective of the present investigation was to study the stability parameters of yield in ten maize genotypes grown under different environments.

MATERIALS AND METHODS

Ten maize genotypes were under investigation in this study. These genotypes included, one composite variety (Giza 2), one synthetic variety (Cairo 1), four double crosses (D.C. 204, D.C. 215, D.C. Taba and D.C. Fatah), one three-way cross (T.W.C. 310), one single cross (S.C. 10), and two inbred lines (Rg 10 and M 12). Cairo 1, the synthetic variety, was developed by the Faculty of Agriculture, University of Cairo. Taba and Fatah hybrids were obtained from Pioneer Overseas Corporation, Cairo, Egypt. The new inbred line M 12 was developed by the author from the composite variety Giza 2 and it was at S_7 stage of inbreeding. The rest of the studied materials were provided from Maize Research Section, Field Crop Research Institute, Agricultural Research Center, Egypt.

These ten genotypes were evaluated in eight trials (environments) during two successive summer seasons at the Agricultural Research Center, Faculty of Agriculture, Moshtohor. The eight experiments represented the combinations of two growing summer seasons (1990 and 1991), two planting dates (May 30th and July 1st), and two nitrogen levels (60 and 120 kg N/fed.).

All genotypes were arranged in a randomized complete block design with three replications. Each plot contained two rows of 6 m long and 60 cm wide. Hills interspacing was 20 cm. All the other regular cultural practices were done properly. Data were recorded on grain yield per plant from the guarded plants in each plot. Grain yield/plant was adjusted to 15.5% moisture content.

The ordinary analysis of variance was processed for each experiment. A combined analysis of variance was carried out over the eight trials after applying the homogeneity test. The stability analysis was done according to the model of Eberhart and Russell (1966).

RESULTS AND DISCUSSION

Combined analysis of variance of grain yield for the studied genotypes over eight environments is presented in Table (1). Results indicated that variances due to environments, genotypes and genotypes x environment interaction were highly significant. The significance of environment mean squares led to the fact that the performance of maize grain yield per plant differed from one environment to another under the circumstances of this study. Moreover, the significant variance of genotype and genotype x environment interaction emphasize that the environment had stress and non-stress effects

Table (1): Analysis of variance for grain yield g/plant combined over eight environments.

Source of variance	d.f	Mean squares
Environment	7	6064.93**
Block/environment	16	504.25
Genotypes	9	34253.72**
Genotype x environment	63	1065.29**
Error	144	462.88

** Significant at 1% level probability.

Table (2): Mean performance of grain yield/plant and coefficient of variability for eight environments.

#	Environment: Year	Environment: Planting date	Environment: N levels kg/fed.	Grain yield g/plant	C.V. %
E1	1990	D1	60	179.45	14.27
E2			120	182.20	11.35
E3		D2	60	149.01	10.85
E4			120	174.73	12.95
E5	1991	D1	60	165.88	17.40
E6			120	187.61	10.26
E7		D2	60	156.12	11.49
E8			120	185.76	11.62
General mean				172.60	
L.S.D 0.05				10.89	

The significance of genotypes x environment interaction has been reported by several researchers such as El-Rouby and Galal (1972), Shehata and Dhawan (1975), Galal *et al.*, (1984), Nawar *et al.*, (1986) and El-Hosary *et al.*,(1988).

Mean grain yield per plant along with coefficient of variability (C.V. %) for the tested eight environments are presented in Table (2). It is clear that the highest grain yield was obtained from the sixth environment (first planting date with the application of 120 kg N/fed. in the second season), whereas the lowest yield was reported in the third environment (second planting date with 60 kg N/fed. in the first season). Moreover, environments # E1, E2, E4, E6 and E8 produced higher mean yields than the over all mean of the studied eight environments. These environments could be considered as non-stress environments for such maize genotypes.

The stability analysis of variance for the ten maize genotypes combined over eight environments is presented in Table (3). Results indicated that the linear response of environment as well as the pooled deviation were highly significant. Therefore, two stability parameters were calculated for each genotype. These parameters were a) the regression coefficient (bi) of grain yield on the environmental index and b) deviation from regression mean squares (S^2di) pooled over the eight environments (Table 4). The (bi) values ranged from -0.17 to 2.35. However, (bi) values did not deviate significantly from the unity in seven genotypes. The deviation from regression mean squares (S^2di) was significant for all of the tested genotypes (Table 4).

Meanwhile, results indicated that the average deviation (S^2di) for the inbred lines Rg 10 and M 12 as narrow base genotypes was higher than that of the rest broad base genotypes, being 148.19 and 91.79, respectively. Moreover, The average deviation of the synthetic and composite varieties (87.63) was lower than that of the other studied genotypes (107.13). These results reveal that the broad base genotypes were more stable than the narrow base ones. Similar results were reported by Eberhart *et al.*,(1964), Eberhart and Russell (1966), Hallauer (1972), Galal and Gad (1982), Galal *et al.*,(1984), and Nawar *et al.*,(1986).

The mean performance of the tested ten maize genotypes over the eight environments is also presented in Table (4). It is clear that the highest yielding genotypes were T.W.C 310, S.C. 10, D.C. Fatah, and D.C. Taba. From these four genotypes, the (bi) values were not differ significantly from the unity for D.C. Taba and T.W.C 310. Moreover, the minimum deviation from regression mean squares (S^2di) pooled over the eight environments were obtained for these two genotypes (D.C. Taba and T.W.C. 310).

According to the model of Eberhart and Russell (1966), the ideal genotype is one with a high mean ($\bar{x}$), unit regression coefficient (bi=1), and the

Table (3): Analysis of variance for stability of ten maize genotypes.

S.O.V	d.f	Mean squares
Genotypes	9	11417.83**
Env. + (G. x Env.)	70	521.74**
a) Env. (linear)	1	14151.44**
b) G. x Env. (linear)	9	833.78**
c) Pooled deviation	60	247.78*
genotype 1	6	248.74
genotype 2	6	215.63
genotype 3	6	245.28
genotype 4	6	123.28
genotype 5	6	355.34*
genotype 6	6	252.75
genotype 7	6	152.28
genotype 8	6	298.96
genotype 9	6	318.39*
genotype 10	6	267.12
Pooled error	144	144.56

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

Table (4): Mean grain yield (g/plant) over eight environments, regression coefficient (bi) and deviation mean squares (s^2di) for ten genotypes.

#	Genotype	$\overline{X}$	bi	S^2di
1	Giza 2	185.43	0.62 ± 0.42	104.18
2	Cairo 1	161.40	1.01 ± 0.39	71.07
3	Fatah	197.24	2.10 ± 0.42	100.72
4	Taba	192.52	1.17 ± 0.29	- 21.28
5	D.C. 204	188.03	1.29± 0.50	210.78
6	S.C. 10	199.42	2.35 ± 0.42	108.19
7	T.W.C. 310	203.88	0.64 ± 0.33	7.72
8	D.C. 215	187.18	0.53 ± 0.46	154.40
9	M12	119.19	-0.17 ± 0.47	173.83
10	Rg10	91.67	0.46 ± 0.43	122.55
General mean		172.60	0.99	103.22
S.E		1.98	0.42	2.23
L.S.D		15.74		

deviation from regression as small as possible (S^2di). Moreover, Eberhart and Russell (1969) and Brease (1969) reported that the most important stability parameter was the minimum deviation mean squares. Based on these parameters, T.W.C. 310 and D.C. Taba were considered more stable than the other studied genotypes since they had the highest mean grain yield and their (bi) values did not deviate from the unity with the minimum deviations from regression. The response of these two genotypes to varying environments is illustrated in Figure (1).

It could be concluded that the genotypes T.W.C. 310 and D.C. Taba should be used in future breeding programs towards the development of prospective inbred lines from which stable crosses could be constituted.

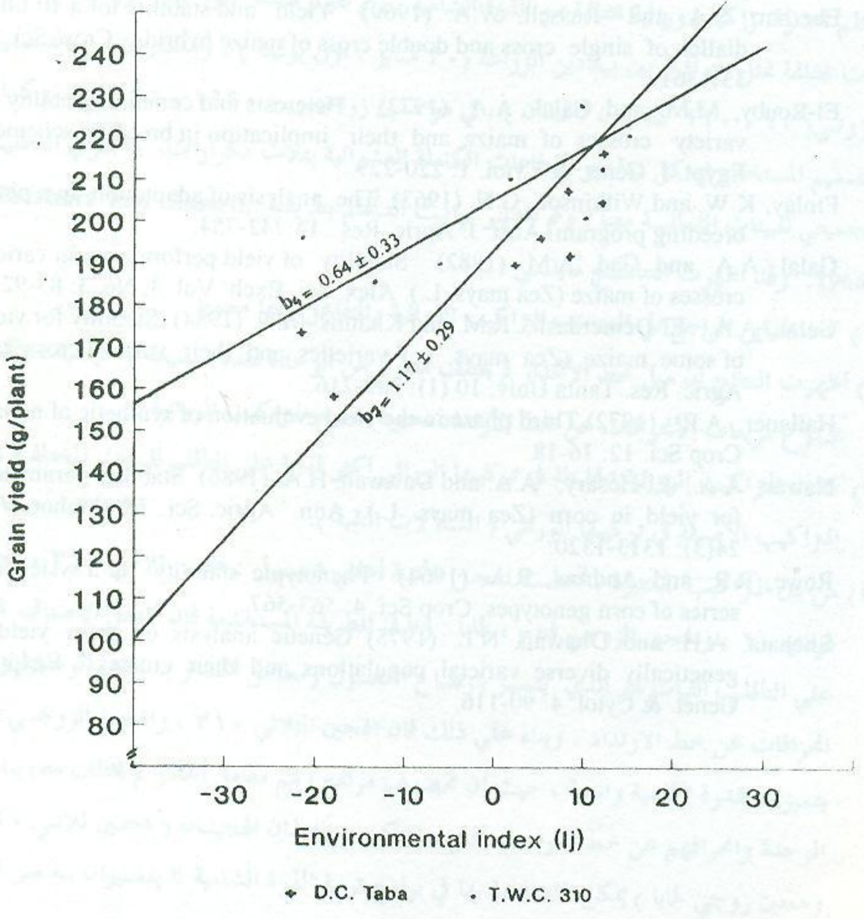

Figure (1): The response of T.W.C 310 and D.C. Taba to varying environments.

REFERENCES

Brease, E.L. (1969) The measurement and significance of genotypes-environment interaction in grasses. Heredity. 24: 27-44.

Comstock, R.E., and Moll, R.H. (1963) Genotype-environment interactions. Symposium on Statistical Genetics and Plant Breeding. NAS-NRC Pub. 982 p. 164-196.

Eberbart, S.A., and Russell, W.A. (1966) Stability parameters for comparing varieties. Crop Sci. 6: 36-40.

Eberhart, S.A., Russell, W.A. and Penny, L.H. (1964) Double cross hybrid prediction in maize when epistasis is present. Crop Sci. 4: 363-366.

Eberhart, S.A. and Russell, W.A. (1969) Yield and stability for a 10 lines diallel of single cross and double cross of maize hybrids. Crop. Sci. 9: 357-361.

El-Rouby, M.M. and Galal, A.A. (1972) Heterosis and combining ability in variety crosses of maize and their implication in breeding schemes. Egypt. J. Genet. & Cytol. 1: 220-229.

Finlay, K.W. and Wilkinson, G.N. (1963) The analysis of adaptation in a plant breeding program. Aust. J. Agric. Res.. 14:742-754.

Galal, A.A. and Gad, A.M. (1982) Stability of yield performance in variety crosses of maize (Zea mays. L.). Alex. Sci. Exch. Vol. 3, No. 3: 83-92.

Galal, A.A., El-Demerdash, R.M. and Khamis, M.N. (1984) Stability for yield of some maize (Zea mays, L.) varieties and their varietal crosses. J. Agric. Res. Tanta Univ. 10 (1): 209-216.

Hallauer, A.R. (1972) Third phase in the yield evaluation of synthetic of maize. Crop Sci. 12: 16-18.

Nawar, A.A., El-Hosary, A.A. and Dawwan, H.A. (1986) Stability parameters for yield in corn (Zea mays, L.). Ann. Agric. Sci.. Moshtohor, Vol. 24(3): 1313-1320.

Rowe, R.R. and Androw, R.A. (1964) Phenotypic stability for a systematic series of corn genotypes. Crop Sci. 4: 563-567.

Shehata, A.H. and Dhawan, N.L. (1975) Genetic analysis of grain yield of genetically diverse varietal populations and their crosses. Egypt. J. Genet. & Cytol. 4: 90-116.

تقديرات ثوابت التأقلم علي محصول الحبوب لبعض التراكيب الوراثية من الذرة الشاميـــة

سيدهـــم أسعـــد سيدهـــم
قسم المحاصيل – كلية الزراعة بمشتهر – جامعة الزقازيق – فرع بنهـــا

أجريت هذه الدراسه بمركز البحوث والتجارب الزراعية بكلية الزراعة بمشتهر لتقدير ثوابت التأقلم لعشرة تراكيب وراثية مختلفة من الذرة الشامية . وتم تقييم هـذه التراكيب الوراثية في ثمانية بيئات مختلفة تمثل التوافيق بين ميعادين الزراعة (٣٠ مـايو ، اول يوليـة) ، ومستويين من التسميد الأزوتي(٦٠ ، ١٢٠ كجم ن / فدان) ، في موسمـين زراعيـين (١٩٩٠ ، ١٩٩١) . وكـان التصميم المستخدم في كل بيئة هو القطاعات الكاملة العشوائية بثلاث مكررات، وأجري التحليل التجميعي للبيئات الثمانيـة معا ، وتم تقدير ثوابت التأقلم بطريقة (Eberhart and Russell, 1966). وقد أظهرت النتائـج مايلـي : -

١) كان التباين الراجع الي البيئات والتراكيب الوراثية والتفاعل بينها معنويا .

٢) أظهرت النتائج أن ميل خط الأنحدار لم يختلف معنويا عن الوحدة لعدد سبعة تراكيب ، وكـان مجموع مربعات الأنحرافات عن خط الأرتداد معنوية لجميع التراكيب الوراثية .

٣) كانت التراكيب الوراثية الخليطة في تركيبها الوراثي أكثر قدرة علي التأقلم للبيئات المختلفـة من التراكيب الأصيلة في تركيبها الوراثي (السلآلات النقية) .

٤) من بين التراكيب المختبرة ، أعطت الهجن الأتية أعلي محصول : هجـن ثلاثي ٣١٠ ، هجين فردي ١٠ ، والهجين الزوجي فتاح ، طابا . وطبقا للطريقة المستخدمة فان أفضل الأصناف قدرة علي التأقلم والثبات هو الذي يتميز بارتفـاع المحصول ومعامل انحدار يساوي الوحدة واقـل انحرافات عن خط الارتداد . وبناء علي ذلك فان الهجين الثلاثي ٣١٠ ، والهجين الزوجـي طابا يتميزان بقدرة تأقلمية واسعة ، حيث أن محصولهم مرتفع وهم معامل انحدار لم يختلف معنويـا عن الوحدة وانحرافهم عن خط الارتـداد أقـل مـا يمكـن . وهـذان الهجينـان (هجـين ثلاثي ٣١٠ ، وهجين زوجي طابا) يمكن الاستفادة بها في برامج تربية الذرة الشامية لما يتميـزان بـه من قـدرة ثبات عاليـــــة .