Assiut J. Agric. Sci., (46) No. (3) 2015 (29-43) *ISSN: 1110-0486*
Website: http://www.aun.edu.eg/faculty_agriculture/arabic *E-mail : ajas@aun.edu.eg*

Performance and Stability Analysis of Several Yellow Maize Hybrids

Kh. A. M. Ibrahim
Department of Agronomy, Faculty of Agriculture, Assuit University, New Valley, Egypt
Email: kh_ibrahim75@aun.edu.eg

Abstract:

Performance and stability of 13 maize single cross hybrids were estimated under five different environments in Egypt during 2013 summer season. A randomized complete block design was used at each environment. Mean squares due to environments, Genotypes and G x E interaction were highly significant for grain yield and other agronomic traits. Based on combined data H2 possessed the highest grain yield (5.15 kg/plot) and significantly outyielded the check hybrid H13 (4.59 kg/plot). According to stability analysis the G x E (linear) interaction was not significant and had low portion of the G x E interaction when compared to the environment linear mean of squares for grain yield and the other studied. If the mean yield ($\overline{\overline{X}}$), regression coefficient value (b_i) and the deviation from the regression (S^2_{di}) are considered together, then the most stable hybrid would be H2 and H9. The most stable hybrids according to the ecovalence method were H10, H8, H1, H9. These hybrids were not the best ranked for grain yield, except H9, which possessed the first rank for grain yield with 5.15 kg plote^{-1} (Plot size is 9.6 m^2) and is considered as a promising hybrid for stability.

Keyword: stability, maize**,** grain yield

Received on: 21/6/2015 **Accepted for publication on:** 5/7/2015

Referees: Prof. Adel M. Mahmoud Prof. Adel S. Taghian

Introduction:

Maize (*Zea mays* L.) is one of the most important cereal crops. Its cultivation extends over a wide range of geographical and environmental conditions ranging from 58°N to 40°S. Maize has been subjected to extensive genetic studies than any other crops (Hallauer and Miranda 1988). Plant breeders are interested in hybrids that are not affected much by environmental variations. Some hybrids give the best performance at special environment. Evaluation of these hybrids on the average basis over different environments would underestimate the productivity of such hybrids when were grown at their favorable environments.

The successful new maize hybrids must exhibit high performance for grain yield and other agronomic traits. Moreover, their superiority should be stable over a wide range of environmental conditions. The choice of suitable hybrids is subject to two considerations, high grain yield over a wide range of environment, and stable performance over different environments. Consistency of performance is depending upon the genotype x environment interaction (G x E). Hybrids, which have small G x E interaction are consider more stable. Stability of yield is defined as the ability of genotype to avoid substantial fluctuations in yield over a range of environments (Heinrich *et al.* 1983).

Stability analysis provides general information of the response patterns of genotypes to environmental changes. The main type of stability analysis, termed joint regression analysis (Freeman 1973), involves the regression of genotype means on an environmental index. The regression coefficient (b_i) for each genotype is considering a measure of stability. A b-value close to 1.0 pointed to average stability, genotypes with b_i = 1.0 and high mean yield are consider have general adaptation, while a genotype with b_i = 1.0 and low average yield is consider poor adaptation to all environments. In addition to regression coefficient Eberhart and Russell (1966) estimated the mean square of deviation from the regression as another stability parameters.

The regression coefficient and the deviation from regression describe the performance of a hybrid over different environments. The regression coefficient measure the increase of response of a hybrid per unit of environment index, whereas the deviations from regression measure the agreement between predicted and observed response. A high yielding hybrid with b_i =1.0 or below indicated that the hybrid possessed high stability over all environments. The most stable hybrid would be have b_i =1 with low deviation from regression (S^2_{di}).

Wricke (1962) proposed using the G x E interaction effect for each genotype, squared and summed over all environments, as a stability measure. This statistic, termed ecovalence (W_i) is far more simple to estimate and more directly related to the G x E interactions. Because ecovalence measures the contribution of a genotype to the G x E interaction a genotype with W_i = 0 is consider stable. Stable genotype give a high ecovalence (low values of W_i = high ecovalence).

The objective of this study was to estimate performance and stability of 13 yellow maize single crosses for number of days to 50% silking, plant and ear height and grain yield.

Materials and Methods:

Eleven new single cross hybrids of yellow maize were produced in 2012 growing season at Sakha, Gemmeiza and mallawy Agricultural Research Stations, Agricultural Research Center (ARC). The produced 11 hybrids along with two check hybrids were evaluated in 2013 growing season at five locations namely, Sakha (E_1), Gemmeiza (E_2), Sids (E_3), Mallawy (E_4) and Nubaria (E_5) Agricultural Research Stations. Hybrids which used in this study are shown in Table 1.

Table (1): Abbreviation of hybrids which used in this investigation.

Hybrid name	No.	Hybrid name	No.
Sk-179	H1	Mall 146	H8
Sk-180	H2	SC 01	H9
Gm-1	H3	SC 02	H10
Mall-125	H4	SC 03	H11
Mall-133	H5	SC Gz 162 (check)	H12
Mall-142	H6	SC Gz 166 (check)	H13
Mall 144	H7	-	-

Randomized complete block design with four replications was used. Each plot consisted of four rows of 6.0 m long and 0.8 m apart (plot size was 9.6m^2). Planting date at all locations was during the second half of May, planting was done in hills spaced 0.25m along the row. The plants were thinned to one plant per hill before the first irrigation. All other cultural practice for maize production were applied as recommended.

Harvested ears from two inner rows were weighed and five kg from each plot were taken for measuring moisture percentage. Grain yield was adjusted to 15.5% moisture content and recorded in kg plot^{-1}. Data were recorded for number of days to 50% silking, plant height (cm), ear height (cm) and adjusted grain yield in kg plot^{-1}. Data for all studied traits of each single environment and combined over environments were statistically analyzed according to Steel and Torrie (1980).

Stability parameters was performed according to the following approach.

1- Regression coefficient (b_i) and deviation mean squares (S^2_{di}) according to Eberhart and Russell (1966). The G x E is portioned into a components due to linear regression (b_i) at the ith genotype on the environment mean, and deviation (d_{ij}).

$$(GE)_{ij} = b_i E_j + d_{ij}$$

and thus:

$$Y_{ij} = \mu + G_i + E_j + (b_i E_j + d_{ij}) + e_{ij}$$

2- Ecovalence (W_i) according to Wricke (1962), defined the concept of ecovalence as contribution of each genotype to the GxE sum of squares. The ecovalence (W_i) is express as:

$$W_i = \sum(\bar{Y}_{ij} - \bar{Y}_{i.} - \bar{Y}_{.j} + \bar{Y}_{..})^2$$

Where:

$\bar{Y}_{ij}$ is the mean performance of genotype i^{th} in the j^{th} environment and $\bar{Y}_{i.}$ and $\bar{Y}_{.j}$ are the genotype and environment mean deviation, respectively and $\bar{Y}_{..}$ is the over all mean. For this reason, genotypes with a low W_i value have smaller deviations from the mean across environments and are thus more stable.

Results and Discussion:

Hybrids performance, environmental index (E. index) and phenotypic index for all traits are presented in Tables 2 and 3. Because the environmental index was calculated as the difference between the environment mean and the mean across all environments, it is directly reflects the rich or poor environment in term of positive and negative, respectively. Hence, E1 was the most favorable environment, which was linked to be the highest mean grain yield (5.12 kg $plot^{-1}$, while E5 was the poorest yielding environment (3.50 kg $plot^{-1}$).

Data in Table 2 and 3 showed that the best hybrids for plant height and ear height toward shortness and low ear height were H3, H4, H6 and H8 and are considered a good hybrids for shortness and low ear placement.

Data in Table 3 showed that grain yield varied from 2.96 to 6.36 kg/plot for H8 at E5 and H2 at E1, respectively. Based on combined data over all environments, H2 possessed the highest grain yield (5.15 kg/plot) and significantly outyielded the commercial check hybrid H13 (4.59 kg/plot). Moreover, 5 hybrids (H4, H5, H7, H9 and H11) gave high grain yield and did not significantly outyilded of the best check hybrid (H13), three of them namely, H4, H5, H7 also were significantly earlier than the check hybrid H13.

Mean squares due to environments, Genotypes and G x E interactions were highly significant ($P < 0.01$) for number of days to 50% silking, plant height, ear height and grain yield (Table 4). This could be due to presence of substantial variation of the mean performance of all the 13 hybrids across environments and in the environmental mean over the evaluated hybrids.

Significant G x E interaction variance is suggestive of differential performance of the evaluated hybrids under different environments. In this respect, Eberhart and Russell (1966), Freeman and Perkins (1971), Ibrahim *et al* (1984), Ragheb *et al* (1993), Soliman (2006) and Abd El-Moula (2011), stated that the basic cause of the differences among hybrids in their yield stability is the wide occurrence of hybrid x environment (G x E) interaction.

Table (2): Mean performance for number of days to 50% silking and plant height (cm) of 13 single cross hybrids evaluated at 5 different environments, 2013 growing season.

Hybrid	Number of days to 50% silking							Plant height (cm)						
	E1	E2	E3	E4	E5	Mean	Pheno. Index	E1	E2	E3	E4	E5	Mean	Pheno. Index
H1	64.75	65.75	62.25	65.25	63.50	64.30	3.53	310.00	242.50	263.75	250.25	226.50	258.60	**12.35**
H2	65.25	66.00	64.50	65.75	63.50	65.00	4.23	302.75	292.50	311.25	255.50	267.00	285.80	**39.55**
H3	61.75	62.75	59.50	60.00	58.00	60.40	-0.37	237.25	238.75	243.75	230.00	225.25	235.00	**-11.25**
H4	57.75	58.75	56.50	56.75	56.75	57.30	-3.47	261.00	215.00	251.25	230.50	209.25	233.40	**-12.85**
H5	58.25	59.00	56.75	56.75	56.75	57.50	-3.27	284.75	243.75	285.00	245.50	252.75	262.35	**16.10**
H6	60.25	58.75	56.25	57.00	57.75	58.00	-2.77	242.00	205.00	245.00	221.75	208.75	224.50	**-21.75**
H7	58.75	59.25	55.50	57.00	57.00	57.50	-3.27	283.75	243.75	280.00	247.50	230.00	257.00	**10.75**
H8	57.50	58.50	55.00	55.75	55.25	56.40	-4.37	245.00	212.50	236.25	227.00	203.00	224.75	**-21.50**
H9	62.25	62.75	59.75	62.75	60.25	61.55	0.78	252.75	210.00	260.00	238.75	195.25	231.35	**-14.90**
H10	64.25	64.25	59.25	62.25	63.25	62.65	1.88	268.25	235.00	265.00	253.25	223.75	249.05	**2.80**
H11	64.25	62.75	59.75	64.75	61.25	62.55	1.78	253.00	222.50	247.50	234.75	212.25	234.00	**-12.25**
H12	64.75	65.50	62.25	65.25	63.75	64.30	3.53	292.00	255.00	292.50	251.75	237.00	265.65	**19.40**
H13	63.75	62.50	61.50	63.50	61.50	62.55	1.78	273.25	218.75	263.75	233.50	210.00	239.85	**-6.40**
Mean ($\bar{X}$)	**61.81**	**62.04**	**59.13**	**60.98**	**59.88**	**60.77**	-	**269.67**	**233.46**	**265.00**	**240.00**	**223.13**	**246.25**	**-**
CV	2.07	1.47	2.48	2.10	1.53	1.96	-	4.99	5.07	4.03	5.03	5.52	4.91	**-**
$LSD_{0.05}$	1.78	1.27	2.03	1.77	1.27	1.65	-	18.64	16.36	14.79	16.73	17.08	16.77	**-**
E. index	**1.04**	**1.27**	**-1.64**	**0.21**	**-0.89**	**-**	**-**	**23.42**	**-12.79**	**18.75**	**-6.25**	**-23.12**	**-**	**-**

Table (3): Mean performance for ear height and grain yield (kg plot^{-1}) of 13 single cross hybrids evaluated at 5 different environments, 2013 growing season.

Hybrid	Ear height (cm)							Grain yield (kg plot^{-1})						
	E1	E2	E3	E4	E5	Mean	Pheno. Index	E1	E2	E3	E4	E5	Mean	Pheno. Index
H1	175.25	148.75	145.00	135.50	133.25	147.55	**13.80**	4.96	3.32	4.16	3.82	3.64	3.98	-0.29
H2	187.25	165.00	166.25	140.25	123.00	156.35	**22.60**	6.36	5.02	5.08	5.10	4.21	5.15	0.88
H3	130.50	137.50	120.00	120.25	115.00	124.65	**-9.10**	3.63	3.47	3.27	2.84	3.18	3.28	-0.99
H4	133.50	118.75	122.50	118.25	92.25	117.05	**-16.70**	5.36	2.84	4.66	4.83	3.61	4.26	-0.01
H5	156.00	140.00	138.75	131.50	122.75	137.80	**4.05**	5.19	3.03	4.46	5.02	3.51	4.24	-0.03
H6	128.25	133.75	112.50	110.75	96.25	116.30	**-17.45**	4.23	3.76	4.40	4.64	3.39	4.08	-0.19
H7	152.25	132.50	136.25	131.75	108.25	132.20	**-1.55**	5.75	3.48	4.95	5.45	3.40	4.61	0.34
H8	127.75	117.50	118.75	115.75	98.00	115.55	**-18.20**	4.52	3.41	4.09	4.50	2.96	3.90	-0.37
H9	145.25	128.75	133.75	130.25	104.75	128.55	**-5.20**	5.37	4.14	5.40	5.02	3.52	4.69	0.42
H10	152.75	146.25	140.00	137.25	119.75	139.20	**5.45**	4.85	3.26	4.62	4.32	3.24	4.06	-0.21
H11	154.50	141.25	140.00	126.25	121.00	136.60	**2.85**	4.68	4.07	4.52	4.23	3.70	4.24	-0.03
H12	160.50	156.25	158.75	140.25	118.25	146.80	**13.05**	5.58	4.10	5.11	4.19	3.29	4.45	0.18
H13	162.25	147.50	146.25	127.50	116.75	140.05	**6.30**	6.04	3.84	5.19	4.09	3.79	4.59	0.32
Mean ($\bar{X}$)	**151.27**	**139.52**	**136.83**	**128.12**	**113.02**	**133.75**	**-**	**5.12**	**3.67**	**4.61**	**4.47**	**3.50**	**4.27**	**-**
CV	4.52	6.54	4.20	7.28	8.04	7.41	**-**	8.48	6.44	6.40	7.61	9.31	7.90	-
$LSD_{0.05}$	9.48	11.61	7.97	12.92	12.60	13.74	**-**	0.63	0.33	0.41	0.47	0.45	0.46	-
E. index	**17.52**	**5.77**	**3.08**	**-5.63**	**-20.73**	**-**	**-**	**0.85**	**-0.60**	**0.34**	**0.20**	**-0.77**	**-**	**-**

Data in Table 4 revealed that G x E (linear) was not significant and had low portion of the G x E interaction when compared to the environment linear mean of squares for grain yield and the other studied traits. Hence, only the deviation mean square was considered important.

Significant pooled deviation were detected for number of days to 50% silking, plant height and grain yield. Significant pooled deviation clear that performance of different hybrids fluctuated significantly from their respective linear path of response to environments.

Therefore, on analysis the individual hybrid fluctuation from linearity, it becomes notice that all hybrids possessed significant variance, except H10 and H11 for grain yield. Theses hybrid had small and insignificant deviation from linearity and would be stable according to Paroda and Hays (1971), and Line *et al*. (1986). These results are in agreement with Soliman (2006), Al-Otayk (2010) and Hassan *et al*. (2013).

The hybrids H4, H6, H10, H11 and H12 for number of days to 50% silking, and H1, H2, H5 and H9 for plant height fluctuated significantly, other varieties did not they remained by and large, close to linear response.

Stability parameters according to Eberhart and Russell (1966) were used. Regression coefficient (b_i) for each hybrid and deviations from regression (S^2_{di}) are presented in Tables 5 and 6. A regression coefficient (b_i) close to 1.0 coupled with small value of (S^2_{di}) indicates average stability. Regression values above 1.0 indicate genotypes with higher sensitivity to environmental change and greater specificity of adaptability to high yielding environments.

Table (4): Stability analysis for grain yield, number of days to 50% silking, plant and ear height of 13 single cross hybrids evaluated at 5 different environments, during 2013 growing season.

S.O.V	d.f.	Days to 50% silking	Plant height (cm)	Ear height (cm)	Grain yield (kg plot^{-1})
Environments	4	80.807**	21282.71**	10545.45**	23.67**
Genotypes	12	178.32**	6859.76**	3317.74**	4.17**
G x E	48	3.037**	421.49**	173.68**	0.73**
E + (G x E)	52	13.29	2025.94**	968.98**	2.51**
E (linear)	1	234.05**	85121.46**	42116.02**	94.98**
G x E (linear)	12	10.97	614.49	283.56	1.20
Pooled deviation	39	8.35**	329.58**	124.82	0.54**
H1	3	2.31	1060.12**	314.32*	0.41*
H2	3	1.62	1377.02**	95.27	0.80**
H3	3	2.45	140.25	197.62	0.47*
H4	3	6.08**	63.00	113.45	0.85**
H5	3	1.37	447.82*	39.42	0.82**
H6	3	5.81**	162.88	278.62*	0.54**
H7	3	2.08	12.35	94.95	0.52*
H8	3	1.34	108.53	41.27	0.36*
H9	3	1.99	532.73*	132.66	0.39*
H10	3	10.90**	169.95	27.86	0.11
H11	3	10.71**	62.55	56.57	0.08
H12	3	5.81**	113.05	174.78	0.67**
H13	3	2.70	34.26	55.87	1.02**
Pooled error	180	1.42	146.36	98.32	0.13

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

A regression coefficient below 1.0 provides a measurement of greater resistance to environmental change and thus increases the specificity of adaptability to low yielding environments.

Regarding number of days to 50% silking (Table 5), the most stable hybrids with the lowest (S^2_{di}) value were H5 ranked first, H8 ranked second, H2 ranked third, H9 ranked fourth, H7 ranked fifth. If the number of days to 50% silking $(\overline{X})$ (towards earliness), regression coefficient value (b_i) and the deviation from the regression (S^2_{di}) are considered together, then the most stable hybrid would be H5 with number of days to 50% silking $(\overline{X})$ = 57.50 day, b_i = 1.082 close to one and the lowest S^2_{di} value (-0.05) followed by H4 with number of days to 50% silking $(\overline{X})$ = 57.30 day, b_i = 0.962 close to one and the (S^2_{di}) value = 4.66.

For plant height (Table 5), when average plant height $(\overline{X})$ (towards shortness), regression coefficient value (b_i) and the deviation from the regression (S^2_{di}) are considered together, therefore the most stable hybrid would be H6 with $(\overline{X})$ = 224.50 cm ranked the first, b_i = 0.822, (S^2_{di}) value = 16.52 and not significant. The hybrid H8 ranked the second with average plant height 224.75 cm, bi = 0.872 and S^2_{di} value = -37.83. Hybrid H4 ranked the third with plant height 233.40 cm, bi = 1.096 and S^2_{di} value = -83.36. Hybrid H11 ranked the fourth with plant height 234.00 cm, bi =0.822 and (S^2_{di}) value = -83.81.

For ear height (Table 6), when ear height mean $(\overline{X})$, regression coefficient value (b_i) are considered together, then the most stable hybrid would be H4 with $(\overline{X})$ = 117.05 cm ranked the first, bi = 1.015 close to unity, (S^2_{di}) value = 15.13 and not significant.

Table (5): Stability parameters for number of days to 50% silking and plant height (cm) of 13 single cross hybrids evaluated under different environments, during 2013 growing season.

Hybrid	Number of days to 50% silking								Plant height (cm)							
	Mean	Rank	b_i	Rank	S^2_{di}	Rank	$w_{i\%}$	Rank	Mean	Rank	b_i	Rank	S^2_{di}	Rank	$w_{i\%}$	Rank
H1	64.30	12	1.670*	8	0.89	7	4.39	6	258.60	10	1.407*	12	913.76**	12	21.14	13
H2	65.00	13	0.897	4	0.20	3	3.54	3	285.80	13	0.864	6	1230.66**	13	21.14	12
H3	60.40	6	2.056*	12	1.03	6	8.68	9	235.00	6	0.261*	13	-6.11	7	19.91	11
H4	57.30	2	0.962	2	4.66**	11	3.84	5	233.40	4	1.096	4	-83.36	4	1.23	2
H5	57.50	3	1.082	3	-0.05	1	2.55	1	262.35	11	0.927	2	301.46*	10	6.86	9
H6	58.00	5	1.573	7	4.39**	10	10.22	10	224.50	1	0.872	5	16.52	8	2.97	6
H7	57.50	4	1.846*	11	0.66	5	4.54	7	257.00	9	1.026	1	-134.01	1	1.09	1
H8	56.40	1	1.808*	10	-0.08	2	3.70	4	224.75	2	0.817	7	-37.83	5	2.72	4
H9	61.55	7	1.686*	9	0.57	4	2.70	2	231.35	3	1.273*	10	386.37*	11	10.05	10
H10	62.65	10	2.257*	13	9.48**	13	20.82	13	249.05	8	0.910	3	23.59	9	2.81	5
H11	62.55	8	1.543	6	9.29**	12	20.66	12	234.00	5	0.822	8	-83.81	3	1.98	3
H12	64.30	11	1.518	5	4.39**	9	11.42	11	265.65	12	1.227*	9	-33.31	6	3.34	7
H13	62.55	9	0.960	1	1.28	8	5.37	8	239.85	7	1.363*	11	-112.1	2	4.76	8

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

Hybrid H9 ranked the second with ear height 128.55 cm, $b_i = 0.980$ and (S^2_{di}) value = 34.34. Hybrid H7 ranked the third with ear height 132.20 cm, $b_i = 1.074$ and S^2_{di} value = -3.37.

For grain yield (Table 6) the most stable hybrids with the lowest (S^2_{di}) values were H11 ranked first, H10 ranked second, H8 ranked third, H9 ranked forth and H1 ranked fifth. The most unstable hybrids with the highest S^2_{di} values were H13, H4 and H5. If the mean yield $(\overline{X})$, regression coefficient value (b_i) and the deviation from the regression S^2_{di} are considered together, then the most stable hybrid would be H2 with an average grain yield $\overline{X}$ = 5.15 kg plot $^{-1}$ ranked first, b_i = 1.038 close to one and the (S^2_{di}) = 0.67 followed by H9 with an average grain yield 4.69 kg plot^{-1} and S^2_{di} = 0.26 ranked fourth. The relationship between grain yield and coefficient of regression (b_i) for the 13 tested hybrids are shown at Fig 1.

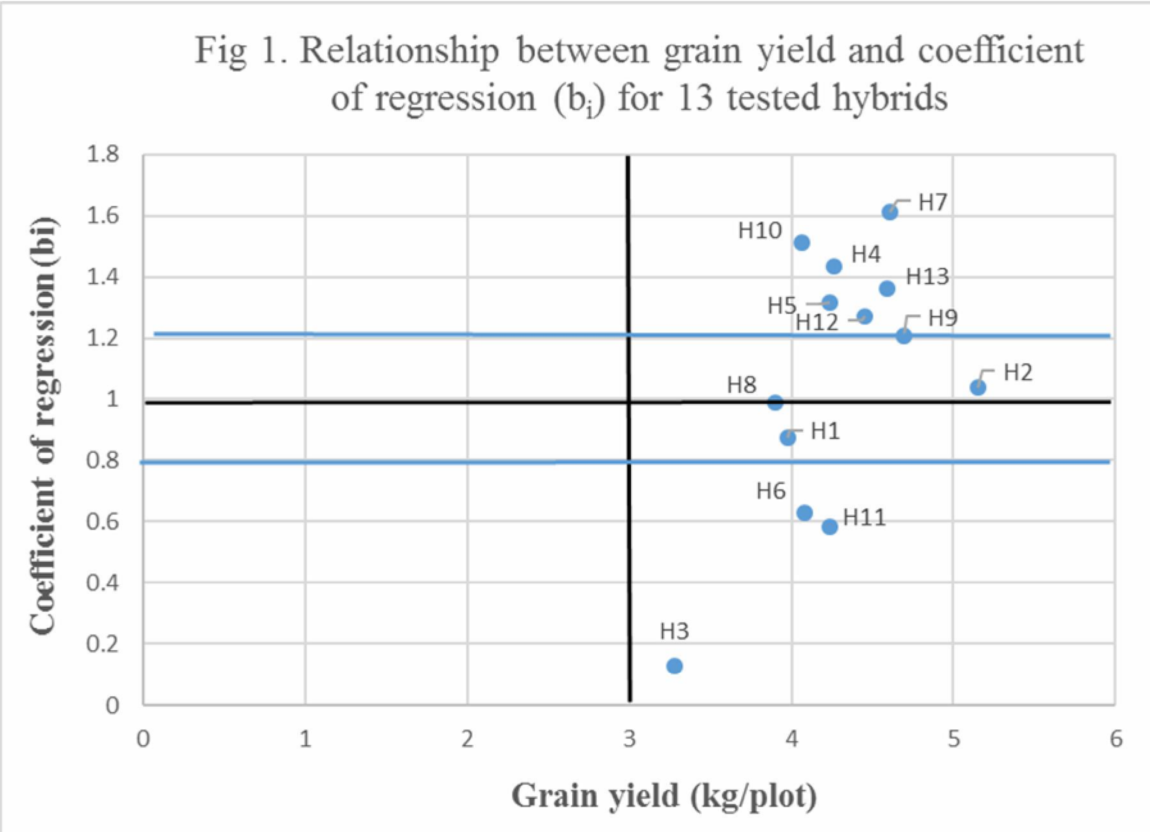

Table (6): Stability parameters for ear height and grain yield (kg plot^{-1}) of 13 single cross hybrids evaluated under different environments, during 2013 growing season.

Hybrid	Ear height (cm)								Grain yield (kg plot^{-1})							
	Mean	Rank	b_i	Rank	S^2_{di}	Rank	$w_{i\%}$	Rank	Mean	Rank	b_i	Rank	S^2_{di}	Rank	$w_{i\%}$	Rank
H1	147.55	12	1.012	1	216.00*	13	11.11	11	3.98	12	0.874	3	0.28*	5	4.01	3
H2	156.35	13	1.732*	13	-3.05	7	24.03	13	5.15	1	1.038	2	0.67**	10	6.75	6
H3	124.65	4	0.479*	12	99.30	11	17.23	12	3.28	13	0.128*	13	0.34*	6	20.83	13
H4	117.05	3	1.015	2	15.13	8	4.03	5	4.26	6	1.433*	10	0.72**	12	10.19	10
H5	137.80	8	0.842	8	-58.9	2	2.35	3	4.24	8	1.317*	6	0.69**	11	8.34	9
H6	116.30	2	0.920	5	180.30*	12	10.02	10	4.08	10	0.630*	8	0.41**	8	8.06	8
H7	132.20	6	1.074	4	-3.37	6	3.47	4	4.61	3	1.614*	12	0.39*	7	10.85	12
H8	115.55	1	0.738*	11	-57.05	3	4.05	6	3.90	9	0.987	1	0.23*	3	3.07	2
H9	128.55	5	0.980	3	34.34	9	7.63	8	4.69	2	1.208	4	0.26*	4	4.40	4
H10	139.20	9	0.858	7	-70.46	1	1.76	1	4.06	11	1.510*	11	-0.02	2	1.13	1
H11	136.60	7	0.904	6	-41.75	5	2.33	2	4.24	7	0.585*	9	-0.05	1	5.02	5
H12	146.80	11	1.185	9	76.46	10	7.86	9	4.45	5	1.270	5	0.54**	9	6.69	7
H13	140.05	10	1.240*	10	-42.45	4	4.14	7	4.59	4	1.363*	7	0.89**	13	10.66	11

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

Wricke's ecovalence was determined for each of the 13 hybrids evaluated at 5 environments and are presented in Tables 5 and 6.

Regarding number of days to 50% silking (Table 5), the most stable hybrids which possessed low ecovalence value were H5, H9 and H2. This hybrid did not have the best rank for earliness except, H5, which ranked the 3rd with 57.50 days. The most unstable hybrids according to ecovalence method were H10 and H11. These hybrids were ranked 8th and 10th for number of days to 50% silking.

For plant height (Table 5), the most stable hybrids according to ecovalence model were H7, H4, H5 and H2. These hybrids ranked the 9th, 4th, 5th and 2nd for plant height, respectively. On the other hand, the most unstable hybrid were H1 and H2.

Concerning ear height (Table 6) the most stable hybrid were H10, H11, H5 and H7. These hybrids were not the best rank for low ear height and it is rank were 9th, 7th, 8th, and 6th .The most unstable hybrids according to ecovalence model were H2 and H3.

For grain yield (Table 6) the most stable hybrids according to the ecovalence method of Wricke (1962) were H10, H8, H1, H9. These hybrids did not gave the best rank for grain yield, except H9, which possessed the first rank for grain yield with 5.15 kg plote^{-1} and it is consider promising hybrid for stability and may be recommended to be released as stable high yielding hybrid under a wide range of environmental conditions. The most unstable hybrids according the ecovalence method were H3 and H7 these hybrids were ranked 13th and 3rd for grain yield, respectively.

Conclussion:

According to Eberhart and Russell model the most stable hybrid would be H2 and H9. The most stable hybrids according to the ecovalence method were H10, H8, H1, and H9. These hybrids were not the best ranked for grain yield, except H9, which possessed the first rank for grain yield with 5.15 kg plote^{-1} (Plot size is 9.6 m^2) and is considered as a promising hybrid for stability.

Acknowledgment: My sincere thanks go to all the staff and technicians of maize research section, field crops research institute for taking care of the experiment to generate this data. I also thank my colleagues at Mallawy Agricultural Research station for their helping and critical review of the manuscript.

References:

Abd El-Moula, M.A., 2011. Yield Stability and Genotype-Environment interaction of Some Promising yellow Maize Hybrids. Egypt J. plant Breed. 15(4): 63-74.

Al-Otayk, 2010. Performance of yield stability of wheat genotypes under high stress environments of the central region of Saudi Arabia, Met. Env. Arid Land Agric. Sci. 21: 81-92.

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

Freeman, G.H. and J.M. Perkins, 1971. Environmental and genotype- environmental components of variability. VIII. Relation between genotypes grown in different environments and measures of these environments. Heredity, 27: 15-23.

Freeman, G.H., 1973. Statistical methods for the analysis of genotype-environment interactions. Heredity, 31: 339-354.

Hallauer, A.R. and J.B. Miranda Filho. 1988. Quantitative Genetics in Maize Breeding. 2nd ed. Iowa State University Press., Ames, IA.

Hassan, M.S., G.I.A. Mohamed and R.A.R. El-Said, 2013. Stability analysis for grain yield and its components of some Durum wheat genoypes (Triticum durum L.) under different environments. Asian J. Crop Sci., 5(2): 179-189.

Heinrich, G.M., C.A. Francis and J.D. Eastin, 1983.Stability of grain sorghum yield components across divers environments. Crop Sci., 23: 209-212.

Ibrahim, M.S.A., O.O. El-Nagouly and M.I. Salama, 1984. On-Farm evaluation for yield stability of maize varieties in Egypt. Administrative Report. Proc. EMCIP, 1: 103-112.

Lin, C.S., M.R. Binns and L.P. Lefkovitch, 1986. Stability analysis: Where do we stand? Crop Sci. 26:894-900.

Paroda, R.S. and J.D. Hayes, 1971. An investigation of genotype-environment interaction for rate of ear emergence in spring barley. Heredity 26: 157-175.

Ragheb, M.M.A., A.A. Bedeer, A. Sh. Gouda, Sh.F. Abo-El-Saad, and A.A. Abdel-Aziz, 1993. Phenotypic stability parameters for grain yield and other agronomic characters of white maize hybrids under different environmental conditions. Zagazig J. Agric. Res., 20(5): 1447-1461.

Soliman, M.S.M., 2006. Stability and environmental interaction of some promising yellow Maize Genotypes. Res. J. Agric. & Biol. Sci., 2(6): 249-255.

Steel, R.G.D. and Torrie, 1980. Principles and Procedures of Statistic. McGraw-Hill Book Company, New York, Toronto and London.

Wricke, G., 1962. Über eine Method zur Erfassung der Ökologischen Streubreite in Feldversuchen. Z. Pflanzenzuchtg, 47: 92-96.

Assiut J. Agric. Sci., (46) No. (3) 2015 (29-43) *ISSN: 1110-0486*
Website: http://www.aun.edu.eg/faculty_agriculture/arabic *E-mail : ajas@aun.edu.eg*

الآداء وتحليل الثبات لبعض هجن الذرة الشامية الصفراء

خالد عبد الحفيظ محمد ابراهيم
قسم المحاصيل – كلية الزراعة بالوادى الجديد – جامعة أسيوط

الملخص:

اجريت هذه الدراسة خلال الموسم الصيفى ٢٠١٣ فى خمسة مواقع وهى محطات البحوث الزراعية بسخا والجميزة وسدس وملوى والنوبارية التابعة لمركز البحوث الزراعية– مصر. كان الهدف من الدراسة تقدير ثبات انتاجية محصول الحبوب وبعض الصفات الخضرية الاخرى مثل عدد الأيام حتى ظهور ٥٠% من الحراير وارتفاع النبات وارتفاع الكوز لبعض هجن الذرة الشامية الصفراء. تم استخدام تصميم القطاعات كاملة العشوائية فى اربع مكررات لكل بيئة. وقد اظهرت النتائج ان هناك اختلافات معنوية بين البيئات والتراكيب الوراثية والتفاعل بين التراكيب الوراثية والبيئه بالنسبة لجميع الصفات المدروسة. كان متوسط مجموع مربعات الإنحرافات الراجعة للتفاعل بين التراكيب الوراثية والبيئة (الخطى) غير معنوى بالنسبة لصفة محصول الحبوب وباقى الصفات المدروسة وكان يمثل قيمة قليلة من التفاعل بين التراكيب الوراثية والبيئات عند مقارنته بمجموع مربعات الانحرافات الناتجة عن البيئات (الخطى). تفوق الهجين رقم ٢ تفوقا معنويا عن هجين المقارنة رقم ١٣(٤,٥٩ كجم/للقطعة) حيث اعطى اعلى محصول حبوب (٥,١٥ كجم/للقطعة). عند الأخذ فى الاعتبار كلا من محصول الحبوب للهجن ومعامل انحدار تلك الهجن (b_i) والانحراف عن خط الانحدار (S^2_{di}) فان اكثر الهجن ثباتا بالنسبة لمحصول الحبوب هما الهجين الفردى سخا (H2) والهجين الفردى (H9). اما بالنسبة لمعامل التكافؤ البيئى (W_i) فان اكثر الهجن ثباتا بالنسبة لصفة محصول الحبوب هى الهجن H9 و H8 و H1 و H2 وبالرغم من ذلك فان محصول الحبوب لتلك الهجن لم يكن عاليا ما عدا الهجين الفردى H2 حيث امتلك قدرة محصولية عالية (٥,١٥ كجم/قطعة) ويعتبر من الهجن الواعدة من حيث الثبات بالنسبة لصفة محصول الحبوب.