Assiut Journal of Agricultural Science, 37 (4) (95-118)

COMBINING ABILITY AND STABILITY ANALYSIS IN SPRING WHEAT UNDER FOUR LEVELS OF SOIL AVAILABLE WATER

Mohamed. A. Ali

Depart. Of Agronomy, Fac., of Agric., South Valley Uni., Qena, Egypt.

Abstract: Thirty six genotypes (8 parents and their 28 F_1 crosses) were evaluated for days to heading, plant height, grain yield/plant and 1000–grain weight under four levels of soil available water (25, 50, 75 and 100%) over two years. Highly significant differences among parents, F_1 crosses and parents vs. crosses over two years and over all environments were obtained for all studied traits. Also, genotype x irrigation interaction was highly significant for all traits. Year x genotype x irrigation interaction was highly significant for all traits, except days to heading. Decreasing the level of soil available water reduced number of days from sowing to heading, plant height, grain yield/plant and 1000-grain weight. Drought tolerance index (DTI) and drought susceptibility index (DSI) were estimated for grain yield/plant. The parents $P_1$and P_5 were relatively drought tolerant. The crosses (P_1 x P_5), (P_1 x P_8), (P_3 x P_8) and (P_4 x P_6) displayed DSI values less than one and they were relatively tolerant to drought .

General (GCA) and specific (SCA) combining ability variances were highly significant for all studied traits. The ratio of GCA to SCA was more than one for days to heading, indicating that additive gene effect played a major role in the inheritance for this trait.

The stability analysis for grain yield revealed that the intermediate yielding parents P_2, P_3 and P_4 were stable and ranged in yield/plant from 13.51 to 17.29g. The crosses including P_2 and P_4 were stable. The cross (P_4 x P_6) was relatively tolerant to drought and stable for grain yield/plant. In addition, it could be considered as the best cross combination for all studied traits under different levels of soil available water. This cross could be used in a breeding program for drought tolerance.

Key words: Ability, stability, wheat, levels water.

Introduction

Wheat is the first strategic food crop in the world as well as Egypt, it is exposed to various stresses during the growing season causing reductions in crop yield. Combining ability analysis provides a guideline to the breeder in evaluating and selecting the elite parents and desirable cross combinations to be used in the formulation of systematic breeding programs for improving quantitative traits such as yield and yield attributes (Singh *et al*., 1980).

Stability parameters have been proposed to identify superior genotypes under normal and stress conditions. So, the breeder must be select the productive and stable genotypes under poor and normal environments. Tolerance implies relative stability of economic yield of wheat in the presence of varying levels of water stress (Guttieri *et al*., 2001). Jana and Sen (1978), Pal *et al*. (1979) and Rab *et al*. (1984) noticed that water deficit at tillering stage caused reduction in grain yield. Bruckner and Frohberg (1987a), Hassan *et al*. (1987), Schonfeld *et al*. (1988) and Kobata *et al*. (1992) concluded that grain yield and 1000-grain weight were reduced under drought stress. Grain yield increased with the increase in soil moisture content (Dawood *et al*., 1988).

Grain yield exhibited overdominance type of gene action under normal irrigated conditions (Kheiralla *et al*., 1993 and Choudhry *et al*., 1999). Ahmed (2003) reported that general and specific combining ability effects were dominant and played a major role in the inheritance of days to heading, plant height, 1000-kernel weight and grain yield/plant. He found that exposing wheat plant to drought reduced grain yield and 1000-kernel weight. The present study has been undertaken to study :(1) general and specific combining ability for parental genotypes and their crosses under four levels of soil available water and (2) stability analysis for grain yield .

Materials and Methods

Eight genotypes of spring wheat (*Triticum aestivum* L.em Tell) of diverse origin namely; Giza 168 (P_1), two lines,i.e., Assiut 103 (P_2) and Assiut 106 (P_3), Sakha 69 (P_4), Gimmaza 7 (P_5), Gimmaza 9 (P_6), Sahel 1 (P_7) and Sids 1 (P_8). These parents were sown on two different dates 15th and 27th November during the two seasons 2003/2004 and 2004/2005 to avoid differences in flowering time and to secure enough hybrid seed. Each genotype was grown in three rows, 3 m long, 40 cm apart and 15 cm between plants within rows. All possible combinations, without reciprocals, were obtained by hand emasculation and pollination.

The resulting 28 F_1 crosses and their 8 parents were evaluated of four traits in replicated trails conducted in eight environments (four levels of soil available water,i.e., 25 , 50 , 75 and 100% during the two successive cropping seasons; 2004/2005 and 2005/2006 at Qena Exp. Farm, Faculty of Agric., South Valley Unv., Egypt. Table (1) shows some physical and chemical properties of a representative soil sample of the experimental site. Sowing occurred on 17th and 25th November in the two seasons, respectively.

The experimental design was a split–plot in RCBD of three replications . Water levels and genotypes (8 parents + 28 F_1 crosses) were assigned to main plots and sub-plots, respectively. In each replicate the seed genotypes were planted by hand in one row 2.00 m long with 20 cm row spacing and 10 cm interplant spacing. All cultural practices except irrigation were applied according to recommendations. After the surface irrigation, four soil samples were taken from each plot by soil tube (1.3 cm in diameter) at depth of 30 cm from the soil surface. The samples were oven–dried at 105C^o to a constant weight and the soil moisture was determined. The four soil moisture stress were kept constant at 25, 50, 75 and 100 % of the available water until the yellow ripe stage by daily supply of the required water. Each five days the soil moisture were checked throughout the growing season by dry-oven soil samples.

Table(1): Some physical and chemical properties of a representative soil sample of the experimental site.

Soil property		Value$^+$
Sand	(%)	74
Silt	(%)	16.6
Clay	(%)	9.4
Soil texture		Sandy loam
Field capacity	(%)	16.5
Wilting point	(%)	8.00
Bulk density	(gm/cm^3)	1.43
pH (1:1 Soil : Water suspension)		8.12
ECe	(dS/m)	4.62
Total N	(%)	0.04
Available P	(ppm)	9.4
K^+	(meq/100g soil)	0.19

+ Each value represents the mean of two seasons. + Soil depth= (0 – 30 cm).

Days to heading was measured as the number of days from planting to the day when 50% of the heads were extruded from the flag leaf sheath. Data on three traits viz., plant height, grain yield/plant and 1000-grain weight were recorded at maturity on ten randomly plants from a genotype in each plot .

Statistical analysis

The combined analysis of variances over two years for each water level and then combined over all environments were done according to Gomez and Gomez (1984) after carrying out homogeneity test. The diallel analysis was conducted according to Griffing (1956) method II model 1 (excluding reciprocal F_1's). Drought tolerance index (DTI) calculated according to the following equation

$$DTI = \frac{\text{Grain yield under stress conditions}}{\text{Grain yield under normal conditions}} \times 100$$

Drought susceptibility index (DSI) was computed according to Fischer and Maurer (1978) equation:

$$S = (1 - Yd / Yp) / D$$

Where:

Yd = mean yield in stress environment

Yp = mean yield in non-stress environment

D = environmental stress intensity;

=1- (mean Yd of all genotypes / mean Yp of all genotypes

- Stability analysis was carried out as outlined by Eberhart and Russell (1966).

Results and Discussion

Mean performance :

The combined analysis of variance for each water level over the two seasons (Table 2) as well as the combined analysis of variance over all environments (Table 3) revealed significant and highly significant differences between years for all studied traits, indicating the wide differences in climatic factors. Also, highly significant differences among genotypes and their interaction with years were obtained for all traits, reflecting the importance of evaluation these traits over a number of years. Moreover, mean squares due to parents and F_1 crosses were highly significant for days to heading, plant height, grain yield/plant and 1000-grain weight under different levels of soil available water tolerance. Parents vs. crosses were highly significant for all studied traits, indicating the average heterotic effect for these traits under different environments. In addition, mean square (Table 3) due to irrigation and genotype x irrigation interaction were highly significant for all studied traits, reflecting the differential response of genotypes under different water treatments. Highly significant year x genotype x irrigation interaction was highly significant for all traits except days to heading.

Data in Table (4) show that the average days from sowing to heading for parental genotypes ranged from 72.00 for P_2 to 97.67 days for P_8 at 100% level of soil available water, but it reduced to 63.33 and 85.17 days for the same genotypes at 25% level of soil available water. The average of all parents was 86.88 days at 100% level of soil available water but it reduced to 76.06 days at 25% level of soil available water, indicating a reduction of 12.60 % in days to heading as a result of water stress. The F_1 crosses performance ranged from 74.17 for (P_2 x P_3) to 94,33 days for (P_7 x P_8) at 100% level of soil available water, but it reduced to 64.83 and 84.50 days for the same crosses at 25% level of soil available water. The average number of days to heading of all F_1 crosses reduced from 83.52 days at 100% level of soil available water to 73.28 days at 25% level of soil available water, indicating about 12.26 % reduction in heading time. It is clear that, decreasing levels of soil available water reduced the number of days from sowing to heading. The increase in adaptation to dry environments in many crops has been linked to earlier flowering (Turner, 1979). These results agree with those reported by Abdel-Karim (1991), Kheiralla and Ismail (1995), Attia (1998), Kheiralla *et al*., (2001) and Ahmed (2003).

Average plant height for parental genotypes ranged from 80.00 for P_6 to 104.00 cm for P_4 at 100% level of soil available water, while it reduced to 60.50 for (P_5) and 82.33 cm for (P_7) at 25% level of soil available water. The average of all parents was 90.56 cm at 100% level of soil available water, but it decreased to 71.17 cm at 25% level of soil available water, indicating about 21.41% reduction in plant height. The average plant height for F_1 crosses ranged from 83.00 for (P_5 x P_6) to 105.83 cm for (P_4 x P_7) at 100% level of soil available water, while it was from 63.17 for (P_2 x P_5) to 84.17cm for (P_4 x P_8) at 25% level of soil available water . The average plant height of all F_1 crosses decreased from 91.73 cm at 100% level of soil available water to 73.32cm at 25% level of soil available water, indicated a reduction of 20.07% in plant height . These results are in line with those obtained by Muhammed (1992), Attia (1998), Kheiralla *et al*., (2001) and Ahmed (2003) .

Average 1000-grain weight of parental genotypes ranged from 38.35 for (P_5) to 45.62 g for (P_2) at 100% level of soil available water, but it ranged from 23.07 for (P_7) and 30.56 g for (P_2) at 25% level of soil available water. The average over all parents was 41.77g at 100% level of soil available water, but it reduced to 26.98 g at 25% level of soil available water, indicating a reduction of 35.41% in 1000-grain weight. The F_1 hybrids performance ranged from 40.05 for (P_5 x P_7) to 48.83 g for (P_2 x P_4) at 100% level of soil available water, while it ranged from 20.48 for (P_4 x P_7) to 31.14 g for (P_2 x P_4) at 25% level of soil available water. The average 1000-grain weight over all F_1

hybrids was 44.65 g at 100% level of soil available water, but it decreased to 26.07 g at 25% level of soil available water, indicating a reduction of 41.61%. Aggarwal *et al*. (1986) found that 1000-grain weight reduced by water stress and Bruckner and Frohberg (1987b) found a reduction of about 30.00% in 1000- kernel weight due to water stress conditions, while Schonfeld *et al*., (1988) found a reduction of about 17.00% in 1000-kernel weight under drought. These results are in agreement with the findings of Attia (1998), Kherialla *et al*. (2001) and Ahmed (2003).

Average grain yield/plant (Table 5) for parental genotypes ranged from 19.60 for (P_4) to 30.30 gm for (P_7) at 100% level of soil available water, while it ranged from 8.06 to 13.01 g at 25% level of soil available water for P_4 and P_1,, respectively. The overall average reached 23.21 g at 100% level of soil available water, but it decreased to 10.52 g at 25% level of soil available water, indicating a reduction of 54. 67 %. The F_1 hybrids performance ranged from 23.28 for (P_2 x P_6) to 30.65 g for (P_7 x P_8) at 100 % level of soil available water, while it ranged from 9.68 for (P_4 x P_7) to 15.86 g for (P_1 x P_5) at 25% level of soil available water. The average grain yield/plant of all F_1 crosses decreased from 26.64 g at 100% level of soil available water to 21.99, 16.71 and 12.65 g at 75, 50 and 25% levels of soil available water, respectively, indicating a reduction of 17.45, 37.27 and 52.52% at 75, 50 and 25% levels of soil available water in grain yield/plant, respectively . The F_1 hybrids (P_1 x P_4), (P_1 x P_5), (P_1 x P_6), (P_1 x P_7) and (P_1 x P_8) gave high grain yield/plant as compared to the average over all F_1 hybrids under different levels of soil available water . Schonfeld *et al*., (1988) found a reduction of about 30.00% in grain yield under drought. Kobata *et al*., (1992) reported that grain yield at low moisture was reduced by 33.00% relative to high moisture, this reduction was mainly due to the decrease in 1000-grain weight. These results agree with those reported by Gamil (1984), Tammam (1989), Attia (1998), Kheiralla *et al*., (2001) and Ahmed (2003).

Table(3): Mean squares for days to heading, plant height, 1000-grain weight and grain yield/plant over all environments.

S.O.V	Df	Days to heading	Plant height (cm)	1000-grain weight(g)	Grain yield /plant (g)
Years (Y)	1	6845.63^{**}	8443.75^{**}	12239.64^{**}	3806.59^{**}
R/Y	4	127.61	60.12	55.36	5.93
Irrigation(I)	3	4405.24^{**}	15309.09^{**}	7071.08^{**}	7698.95^{**}
Y x I	3	66.78^{**}	89.05	3177.56^{**}	65.44
Error(a)	12	8.40	63.74	50.89	64.56
Genotypes(G)	35	738.19^{**}	925.61^{**}	132.18^{**}	109.58^{**}
Parents(P)	7	1343.80^{**}	1417.47^{**}	106.66^{**}	129.86^{**}
P vs. C	1	1125.83^{**}	627.94^{**}	260.94^{**}	1270.49^{**}
Crosses(C)	27	566.82^{**}	809.12^{**}	134.03^{**}	61.33^{**}
GCA	7	3323.99^{**}	3357.58^{**}	15.83^{**}	11.09^{**}
SCA	28	91.74^{**}	317.62^{**}	2.93^{*}	2.93^{**}
Y x G	35	20.98^{**}	29.66^{**}	17.82^{**}	10.48^{**}
Y x GCA.	7	36.98^{**}	67.81^{**}	33.55^{**}	22.91^{**}
Y x SCA.	28	16.98^{**}	20.12^{**}	7.24^{**}	6.78^{**}
I x G	105	7.37^{**}	25.81^{**}	14.09^{**}	8.00^{**}
I x GCA	7	9.44^{**}	32.45^{**}	71.74^{**}	50.22^{**}
I x SCA	28	6.85^{**}	24.16^{**}	19.09^{**}	15.84^{**}
Y x I x G	105	5.02^{**}	10.09^{**}	11.58^{**}	4.45^{**}
Y x I x GCA	7	5.80	15.03^{**}	167.50^{**}	109.56^{**}
Y x I x SCA	28	4.82	8.86^{**}	54.66^{**}	39.61^{**}
Error(b)	560	3.78	4.31	1.84	1.43
GCA/ SCA @	-	3.82	1.07	0.61	0.38

*,** Significant at 0.05 and 0.01 levels, respectively .

@, The ratio was estimated according to Griffing 1954, Method II, Model I.

Drought tolerance index (DTI) at different levels of soil available water are illustrated in Table (5). Results show that the parents P_5 and P_6 at 25%, P_1, P_5 and P_6 at 50% and P_1, P_2, P_3, P_5, P_6 and P_8 at 75% levels of soil available water were highly tolerant for drought stress since they gave intermediate yield, i.e., yield under 25, 50 and 75% levels of soil available water compared to yield under 100% ones. The crosses (P_1xP_3), (P_1xP_5), (P_1 x P_8) and (P_4 x P_6) at 25%, (P_1 x P_3), (P_1 x P_5), (P_2 x P_4), (P_2 x P_6) and (P_3 x P_8) at 50% and (P_1xP_6), (P_1xP_8), (P_2xP_6), (P_3xP_4), (P_3xP_5), (P_4xP_8) and (P_5xP_7) at 75% indicated high drought tolerance.

Drought susceptibility index (DSI) was calculated for parents and F_1 crosses according to Fischer and Maurer, 1978 (Table 5). Application

of drought susceptibility index based on grain yield/plant, it is clear that P_1, P_5 and P_6 and 13 F_1 crosses at 25%, P_1 and P_5 and 17 F_1 crosses at 50% and P_1, P_2, P_3, P_5, P_6 and P_8 and 13 F_1 crosses at 75% level of soil available water were relatively drought tolerant. It is noticed that P_1 and P_5 and (P_1 x P_5), (P_1 x P_8), (P_3 x P_8) and (P_4 x P_6) were relatively drought tolerant under 25, 50 and 75% levels of soil available water. Only the cross (P_1 x P_8) gave high potential yield under 100% level of soil available water. These crosses could be considered as breeding material to select for high grain yield and drought tolerance.

From pervious, it is noted that increasing soil available water levels produced the taller plants, higher grain yield/plant and heavier grain weight.

Combining ability

Highly significant effects due to general (GCA) and specific (SCA) combining ability were obtained for all studied traits under the four levels of soil available water over the two seasons and over all environments (Tables 2 and 3), indicating the presence of additive and non–additive gene effects in the inheritance of these traits . The ratio GCA/ SCA was more than one for days to heading at each level of soil available water over the two seasons and over all environments, indicating that GCA effect accounted for the largest portion of the phenotypic variation, additive gene effect was the most important in the inheritance of this trait . In the same time, the other studied traits exhibited more dominance effects . Similar results were reached in other studies (Gamil, 1984, El–Hennawy, 1991, Li *et al.*, 1991, Hendawy, 1994, Patil *et al.*, 1995, Zaid, 1995, El-Hennawy, 1996, Attia, 1998, Khierralla *et al.*, 2001 and Ahmed, 2003) using different sets of genotypes . For all studied traits the GCA x year and SCA x year interactions were significant and highly significant (Tables 2 and 3) . Also, the GCA x irrigation and SCA x irrigation interactions (Table 3) were highly significant for all traits . The GCA x year x irrigation and SCA x year x irrigation interactions (Table 3) were highly significant for all traits, except days to heading.

General (GCA) and specific (SCA)combining ability effects :

1-Days to heading

Considering days to heading, the parents P_2 and P_3 had highly significantly negative GCA effects under all levels of soil available water over the two seasons and over all environments (Table 6). These parents could be considered as good combiners for earliness and posse's favorable genes for earliness.

Three crosses; (P_2 x P_4), (P_3 x P_6) and (P_4 x P_6) showed negative and highly significant SCA effects for days to heading under all levels

of soil available water over the two seasons and over all environments (Table 7). These results indicate that selecting such crosses on the basis of its mean performance may be effective in wheat breeding programs. Also, four crosses; (P_1 x P_7), (P_1 x P_8), (P_5 x P_6) and (P_5 x P_8) exhibited negative highly significant SCA effect for days to heading at most levels of soil available water.

2-Plant height

For plant height, the parents (P_4) and (P_7) showed highly significant and positive GCA effects under the four levels of soil available water over the two years and over all environments (Table 6). On the other hand, the parents P_1, P_2, P_5 and P_6 showed negative and highly significant GCA effects at the four levels of soil available water over the two seasons and over all environments.

Six crosses; (P_1 x P_2), (P_1 x P_6), (P_4 x P_6), (P_4 x P_8), (P_5 x P_8) and (P_6 x P_7) had highly significant and positive SCA effects for plant height under the four levels of soil available water over the two years and over all environments (Table 7) . Moreover, three crosses; (P_1 x P_8), (P_2 x P_4) and (P_3 x P_6) showed negative and highly significant SCA effects under the four levels of soil available water over the two seasons and over all environments. However, three crosses exhibited negative and highly significant SCA effect for plant height at most levels of soil available water.

3-1000-grain weight

With respect to 1000-grain weight, the parent (P_2) showed highly significant and positive GCA estimate under the four levels of soil available water over the two years and over all environments (Table 6). Meanwhile, the parents (P_3) and (P_8) gave highly significant and positive under most levels of soil available water. These genotypes could be considered as good combiners for 1000-grain weight.

Three crosses; (P_2 x P_4), (P_3 x P_7) and (P_4 x P_6) had positive and highly significant SCA effects under the four levels of soil available water over the two years and over all environments (Table 8). In addition, the crosses (P_1 x P_5), (P_2 x P_6) and (P_6 x P_8) had positive and highly significant SCA effects under most levels of soil available water over the two years and over all environments.

4-Grain yield/plant

Regarding grain yield/plant, the parents (P_1) and (P_7) exhibited highly significant and positive GCA estimate under the four levels of soil available water over the two seasons and over all environments (Table 6). These parents could be considered as good combiners for grain yield/plant.

Highly significant positive SCA effects (Table 8) for grain yield/plant existed for crosses (P_4 x P_6) and (P_4 x P_8) under the four levels of soil available water over the two years and over all environments. In addition, the crosses (P_1 x P_8), (P_2 x P_5), (P_6 x P_8) and (P_7 x P_8) gave highly significant and positive SCA estimates under most levels of soil available water over the two years and over all environments.

From previous, it is reveal that the parent (P_2) was considered as the best combiner for heading and 1000-grain weight, while the parent (P_7) was considered as the best combiner for plant height and grain yield/plant. The cross (P_4 x P_6) could be considered as the best combination for all studied traits under different levels of soil available water.

Stability analysis for grain yield/ plant

a- Parents

The joint regression analysis of variance (Table 9) revealed highly significant differences among genotypes and environments. Also, parent x environment interaction was highly significant, indicating the change in the phenotypic expression of the genotypes from environment to another or genotypes exhibited different responses to yield when growing in different environments.

Table(9): The joint regression analysis of variance for grain yield/plant for parents and F_1 crosses.

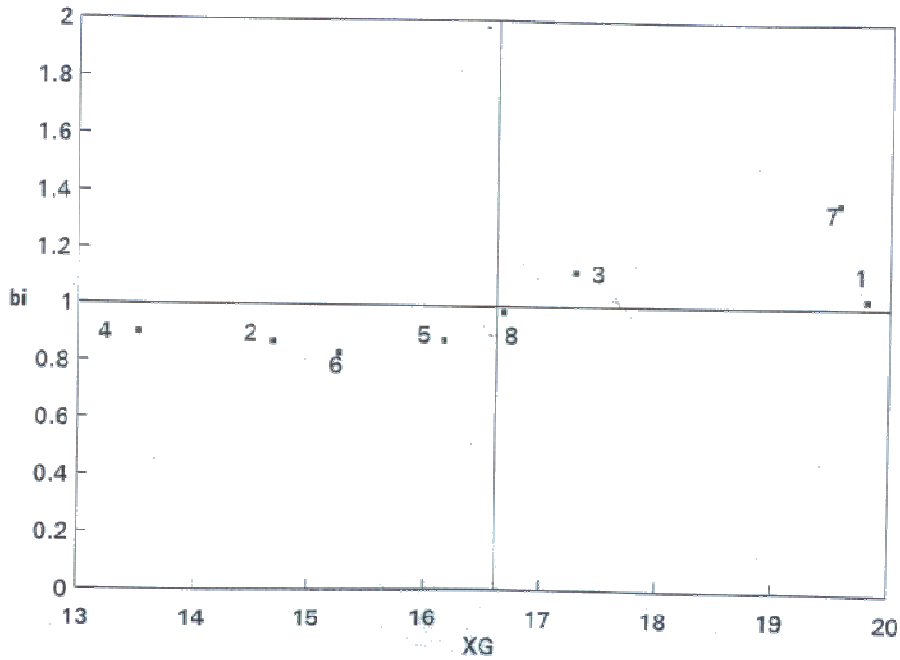
S.O.V	Mean squares			
	df	Parents	df	F_1 Crosses
Genotypes (G)	7	39.72**	27	20.40**
Env. + (G x Env.)	56	32.21**	196	39.70**
Env. (linear)	1	1633.54**	1	7410.83**
G x Env. (linear)	7	6.48**	27	3.61**
Pooled deviation	48	2.60**	168	1.63**
Pooled error	112	0.21	432	0.55

*,** Significant and highly Significant at 0.05 and 0.01 probability levels, respectively .

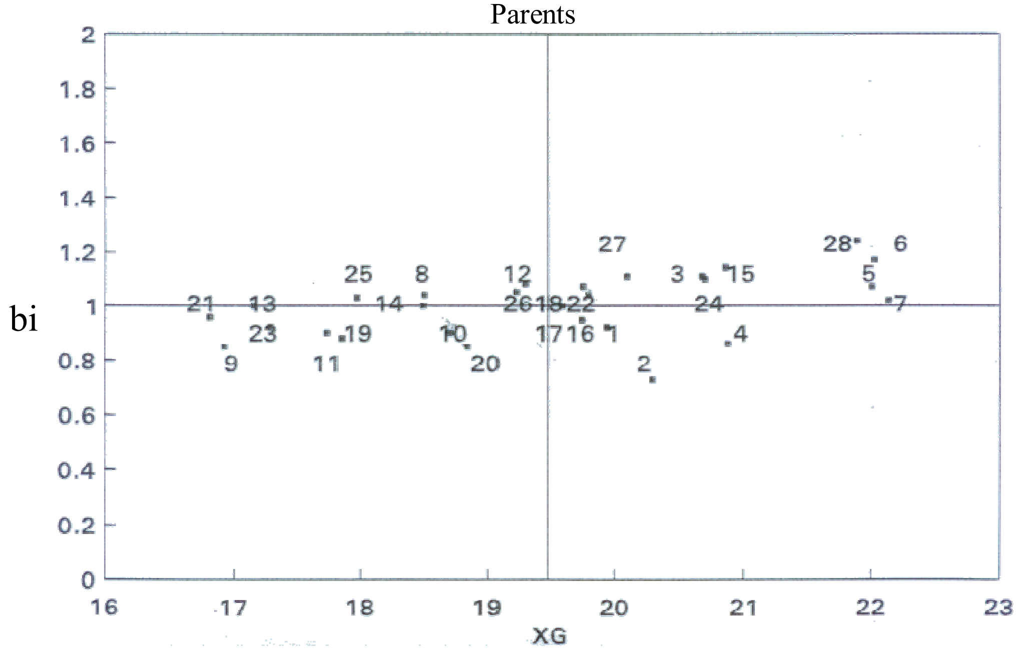
Table(10): Genotypes average performance over eight environments and stability parameters of 8 parents and their 28 F_1 crosses for grain yield/plant .

N0.	Parents	$\bar{x}$	b_i	S^2d_i	N0.	Crosses	$\bar{x}$	b_i	S^2d_i
1	P_1	19.80	1.03	0.51*	11	P_2 x P_6	17.74	0.90	0.70
2	P_2	14.68	0.87	0.44	12	P_2 x P_7	19.29	1.08	0.21
3	P_3	17.29	1.12	0.19	13	P_2 x P_8	17.16	1.00	0.01
4	P_4	13.51	0.90	0.35	14	P_3 x P_4	18.49	1.00	0.18
5	P_5	16.15	0.88	1.19**	15	P_3 x P_5	20.86	1.14	3.06**
6	P_6	15.25	0.83	3.45**	16	P_3 x P_6	19.79	1.04	1.41*
7	P_7	19.56	1.37	10.14**	17	P_3 x P_7	19.74	0.95	0.76
8	P_8	16.67	0.98	2.81**	18	P_3 x P_8	19.58	1.00	1.26*
Mean		16.61	-	-	19	P_4 x P_5	17.85	0.88	1.07
$LSD_{0.05}$		0.26	-	-	20	P_4 x P_6	18.84	0.85	0.02
Crosses					21	P_4 x P_7	16.81	0.96	1.04
1	P_1 x P_2	19.94	0.92	-0.18	22	P_4 x P_8	19.75	1.07	0.72
2	P_1 x P_3	20.30	0.73**	0.45	23	P_5 x P_6	17.29	0.92	1.56**
3	P_1 x P_4	20.70	1.10	0.58	24	P_5 x P_7	20.68	1.11	0.45
4	P_1 x P_5	20.88	0.86	1.81**	25	P_5 x P_8	17.97	1.03	0.22
5	P_1 x P_6	22.03	1.17*	1.59**	26	P_6 x P_7	19.22	1.05	2.83**
6	P_1 x P_7	22.01	1.07	0.74	27	P_6 x P_8	20.10	1.11	0.60
7	P_1 x P_8	22.14	1.02	1.30*	28	P_7 x P_8	21.89	1.24**	4.98**
8	P_2 x P_3	18.50	1.04	0.35	Mean		19.47	-	-
9	P_2 x P_4	16.92	0.85	1.05	$LSD_{0.05}$		0.42	-	-
10	P_2 x P_5	18.70	0.90	0.36					

*,** Significantly different from unity for (bi) and from zero for (S^2d_i) at 0.05 and 0.01 probability levels, respectively .



Parents



F1 crosses

Fig(1): Distribution of stability parameters for grain yield/plant.

Eberhart and Russell's stability statistics (Table 9 and Fig1) found that the genotypes P_2, P_3 and P_4 were stable (bi and S^2d_i not significantly different from one and zero, respectively) and ranged in yield from 13.51 to 17.29 g. It is clear that, the highest yielding genotypes (Giza 168 " P_1") and (Sahel 1 " P_7") were unstable.

b- F_1 hybrids

Mean squares due to F_1 hybrids, environments as well as F_1 hybrids x environments interaction were highly significant for grain yield/plant (Table 9), suggesting that the change in the phenotypic expression different from environment to another.

The results of the stability statistics (Table 10 and Fig 1) showed that eighteen F_1 hybrids were stable (b_i and S^2d_i not significantly different from one and zero, respectively) and ranged in grain yield/plant from 16.81 to 22.01 g. While, the highest yielding F_1 hybrids (P_1 x P_6) and (P_1 x P_8) were not stable. The results are in agreement with those obtained by Salem *et al*., (1990), Kheiralla and Ismail (1995), El-Morshidy *et al*., (2000) and Ahmed (2003). It is of interest to clear that all the crosses including P_2 and P_4 were stable. Moreover, the F_1 crosses were more stable than parents.

References

Abdel-Karim, A. A. 1991. Evaluation of some wheat germplasm under stresses . M. Sc. Thesis, Fac. of Agric., Assiut Univ., Egypt

Aggarwal, P. K., G. S. Chaturvedi, A. K. Singh and S. K. Sinha. 1986. Performance of wheat and tritical cultivars in a variable soil-water environment. III-source-sink relationships. Field Crops Res., 31: 317-330 .

Ahmed, A. A. S. 2003. Diallel analysis and stability of yield and yield components in bread wheat (*Triticum aestivum* L. em. Thell). M. Sc. Thesis, Fac. of Agric., Assiut Univ., Egypt.

Attia, I. A. 1998. Morophysiological and genetical studies on earliness in wheat. M. Sc. Thesis, Fac. of Agric., Assiut Univ., Egypt .

Bruckner, P. L. and R. C. Frohberg. 1987a. Stress tolerance and adaptation in spring wheat. Crop Sci., 27: 31-36 .

Bruckner, P. L. and R. C. Frohberg. 1987b. Rate and duration of grain fill in spring wheat. Crop Sci., 27: 451-455 .

Choudhry, M. A., I. Rassool, I. Mahmood and M. M. Gilani. 1999. Genetics of some matric traits in spring wheat under normal and drought environments. Rachis, 18: 34-39.

Dawood, R. A., K. A. Kheiralla and E. E. Mahdy. 1988. Evaluation of some wheat cultivars for drought resistance under three levels of soil available water. Assiut J. Agric. Sci., 19: 83-96.

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

El–Hennawy, M. A. 1991. The analysis of combining ability in beard wheat crosses . Zagazig J. Agric. Res., 18: 1855-1865.

El–Hennawy, M. A. 1996. Heterosis and combining ability in diallel crosses of eight bread wheat varieties. Bull . Fac. Agric. Cairo Univ., 47: 379-392 .

El-Morshidy, M. A., E. E. M. Elorong, A. M. Tammam and Y. G. Abd El-Gawad. 2000. Analysis of genotype x environment interaction and assessment of stability parameters of grain yield and its components of some wheat genotypes ((*Triticum aestivum* L.) under new valley conditions. Assiut J. Agric .Sci., 1: 13-34.

Fischer, R. A and R. Maurer. 1978. Drought resistance in spring wheat cultivars: 1-Grain yield response . Aust. J. Agric. Res., 29: 897-912.

Gamil, K. H. 1984. Combining ability for yield and its components in wheat (*Triticum aestivum* L.). Minia J. Agric. Res. and Deve., 6: 351-365.

Gomez, K. A. and A. A. Gomez. 1984. Statistical Procedures for Agricultural Research. John Wiley & Sons. Inc. New York, USA.

Griffing, B. 1956. Concept of general and specific combining ability in relation to diallel crossing system. Aust. J. Biol. Sci., 9: 463-493.

Guttieri, M. J., J. C. Stark, K. O'Brien and E. Souza. 2001. Relative sensitivity of spring wheat grain yield and quality parameters to moisture deficit. Crop Sci., 41: 327-335 .

Hassan, U. A., V. B. Ogunilele and T. D. Sinha. 1987. Agronomic performance of wheat (*Triticum aestivum* L.) as influenced by moisture stress and seeding rate. J. Agron. and Crop Sci., 158 : 172-180.

Hendawy, F. A. 1994. General and specific combining ability estimates in a diallel cross of seven bread wheat varieties. Monofiya J. Agric. Res., 19: 75-93.

Jana, P. K. and H. Sen. 1978. Effect of different stages of irrigation on the growth and yield of wheat. Indian J. Agron., 23 : 19-22.

Kheiralla, K. A, M. M. El-Defrawy and T. H. I. Sharif. 1993. Genetic analysis of grain yield, biomass and harvest index in wheat under drought stress and normal moisture conditions. Assiut J. Agric. Sci., 24: 163-183.

Kheiralla, K. A. and A. A. Ismail. 1995. Stability analysis for grain yield and some traits related to drought resistance in spring wheat. Assiut J. of Agric. Sci., 26: 253-266 .

Kheiralla, K. A., M. A. El-Morshidy and M. M. Zakaria. 2001. Inheritance of earliness and yield in bread wheat under favorable and late sowing dates. The Second P_1. Breed. Conf., October 2nd , Assiut Univ., 219-239.

Kobata, T., J. A. Palta and N. C. Turner. 1992. Rate of development of post–anthesis water deficit and grain filling of spring wheat. Crop Sci., 32: 1238-1242.

Li, I. Z., D. B. Lu and D. Q. Cui. 1991. Study on the combining ability for yield and quality characters in winter wheat. Acta Agric. Univ. Henanesis, China, 25: 372-378 (C.F. Plant Breed. Abst., 1994, 64 No.1).

Muhammad, G. I. A. 1992. Genetic studies on some economical characters in wheat. M. Sc. Thesis, Assiut Univ., Egypt.

Pal, M., K. K. Saxena, J. P. Aggarwal and R. P. Singh. 1979. Scheduling of irrigation for wheat under restricted water supply in Bundelkhond region . Indian J. Agron., 24 : 58-60 .

Patil, H. S., B. S. Manake, V. W. Chavan and U. G. Kachole. 1995. Diallel analysis in bread wheat. Indian J. Genet. 55: 320-323.

Rab, A., H. E. Jensen and V. O. Mogensen. 1984. Dry matter production of spring wheat subjected to water stress at various growth stages. Cereal Res. Comm., 12: 19-25.

Salem A. H., H. A Rabie, M. A. Mohamed and M. S. Selim. 1990. Genotypes x environment interaction for wheat grain yield and its contributing characters. Proc. 4th Conf. of Agron., Cairo, 15-16 Sept., Vol. 1-11.

Schonfeld, M. A., R. C. Johnson, B. F. Carver and D. W. Morhinweg. 1988. Water relation in winter wheat as drought resistance indicator. Crop Sci., 28: 526-531.

Singh, K. P., C. S. Tyagi, D. Singh and V. Singh. 1980.Combining ability analysis in wheat. Ind. J. Agric. Res. 14: 247-253.

Tammam, A. M. 1989. Inheritance of yield and aphid resistance in some wheat crosses. M. Sc. Thesis, Fac. Agric., Assiut Univ., Egypt.

Turner, N. C. 1979. Drought resistance and adaptation to water deficits in crop plants. In: Stress physiology in crop plants.

Mussel, H. & Staples, R. C. (eds.) .Wiley & Sons, N. Y. PP. 343-372.

Zaied, H. M. M. 1995. Combining ability in diallel cross of wheat (*Triticum aestivum* L.). Ph. D. El-Minia Univ., Egypt.

دراسة القدرة على الائتلاف وتحليل الثبات في القمح الربيعي تحت أربع مستويات من ماء التربة الميسر

د.محمد أحمد على

قسم المحاصيل – كلية الزراعة بقنا – جامعة جنوب الوادى-مصر

تم تقييم ستة وثلاثون طراز وراثي عبارة عن (ثمانية آباء وهجنها الثمانية والعشرون) لصفات التزهير وارتفاع النبات ووزن الألف حبة ومحصول الحبوب للنبات الفردي تحت أربع مستويات من ماء التربة الميسر (25، 50، 75، 100%) خلال سنتين . ولقد أوضحت النتائج وجود اختلافات معنوية جدا بين الآباء وهجن الجيل الأول وكذلك الآباء ضد الهجن عبر السنوات لكل الصفات المدروسة تحت مستويات الري المختلفة . أيضا كان تفاعل الطرز الو راثية x الري معنوي جدا . كذلك كان التفاعل الثلاثي السنوات x الطرز الو راثية x الري معنوي جدا لكل الصفات تحت الدراسة ماعدا صفة التزهير . لوحظ أيضا أن نقص مستوى ماء التربة الميسر يؤدى لنقص عدد الأيام من الزراعة إلى التزهير وكذلك ارتفاع النبات ووزن الألف حبة ومحصول الحبوب للنبات الفردي . ولقد تم تقدير معامل تحمل الجفاف ومعامل الحساسية للجفاف لمحصول الحبوب للنبات الفردي . وكان الأب الأول والأب الخامس متحملا ن نسبيا للجفاف تحت المستويات75.50.25% من ماء التربة الميسر . كما أظهرت الهجن (P_1 x P_5) ,

(P_1 x P_8) , (P_3 x P_8) , (P_4 x P_6) قيما لمعامل الحساسية للجفاف اقل من الواحد وكانت متحملة نسبيا للجفاف .

وكانت تأثيرات القدرة العامة والخاصة على الائتلاف معنوية جدا لكل الصفات تحت الدراسة . وأوضحت النسبة بين القدرة العامة والقدرة الخاصة على الائتلاف لصفة التزهيرأن القدرة العامة على الائتلاف أكثر أهمية من القدرة الخاصة على الائتلاف وأن فعل الجين الاضافى يلعب دورا رئيسيا في التوريث لهذة الصفة .

واتضح من تحليل الثبات لمحصول الحبوب للنبات الفردي أن الآباء متوسطة المحصول وهى الأب الثاني والثالث والرابع كانت ثابتة للمحصول وتراوح محصولها من 13.51 إلى 17.29 جرام/نبات . كما أتضح أيضا أن كل الهجن التي يدخل في تركيبها الأب الثاني أو الأب الرابع كانت ثابتة للمحصول .

أخيرا كان الهجين (P_4 x P_6) متحملا نسبيا للجفاف وثابتا للمحصول وعلاوة على ذلك يعتبر هذا الهجين أفضل تركيبه وراثية خاصة تحت المستويات المختلفة من ماء التربة الميسر لكل الصفات المدروسة ولهذا يمكن أن يستخدم هذا الهجين في برنامج التربية لتحمل الجفاف.