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Full Length Research Paper

Study of yield and yield components of corn (*Zea mays* L.) inbred lines to drought stress

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In order to study the effects of drought stress on yield and yield components of seven corn inbred lines, a field trial was conducted under non-stress and different drought stress conditions (stress at vegetative (6 to 7 leaves), pollination and grain filling stages) at the Agricultural College of Islamic Azad University, Shoushtar branch, Iran, 2010. The experiment was arranged in a split-plot design by a randomized completely block design with three replications. Drought stress in grain filling stage had the minimum grain yield, grain number per ear and grain number per row that showed severe effects of drought stress at this stage of growth. Based on the results of this study, the inbred line K166B produced the highest grain yield, grain number per ear, row number per ear, grain number per row, grain depth, grain width and grain weight. But line MO17 produced the least grain yield, grain number per ear, row number per ear, grain number per row, ear diameter and cob diameter. Therefore, lines K166B and MO17 were the most tolerant and sensitive to drought stress, respectively and could be recommended for use in future breeding programs for production of drought tolerant hybrids. Results show that grain number per ear, grain number per row and grain width traits have the positive and significant correlation with grain yield. The stepwise regression results for grain yield indicated that grain number per ear in the model was the input and 99% determined the variation of the traits grain yield by grain number per ear. Therefore, grain number per ear provided the most useful input for an increase of grain yield in a drought stress condition.

Key words: Corn, correlation, drought stress, stepwise regression, yield components.

INTRODUCTUON

Drought is a major abiotic factor that limits agricultural crop production (Nemeth et al., 2002; Chaves and Oliveria, 2004; Lea et al., 2004; Seghatoleslami et al., 2008; Jaleel et al., 2009; Golbashy et al., 2010). It is reportedly one of the most devastating environmental stresses that affect Iran, with an annual rainfall of 240 mm, and is classified as a dry region (Jajarmi, 2009). Corn (*Zea mays* L.) is one of the most important cereal crops in the world and in Iran its production is second only to wheat and rice crops (Gerpacio and Pingali, 2007).

Corn is drought sensitive (Khan et al., 2004). Loss of yield is the main concern of plant breeders; hence the emphasis of yield in terms of the assessment of water deficit conditions (Golabadi et al., 2006). In corn, reductions in grain yield caused by drought ranged from 10 to 76% depending on the severity and the stage of its occurrence (Bolaòos et al., 1993). Olaoye (2009) reported that efficiency of water utilization from the soil under moisture deficit condition could help to reduce the adverse effects of drought. Biomass yield is also affected by drought conditions and is an indicator of reduced yield; under low moisture regimes biomass yield was reported within the range of 75 to 61% of that obtained under favorable irrigation treatments while pre and post-anthesis moisture deficit significantly reduced grain yield by 49 and 66%. Leta et al. (2001) and Karimian et al. (2005) reported that drought stress at the vegetative growth stage had a minimal effect and that drought stress caused a greater decrease in grain yield at the grain

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Table 1. Pedigree/origin of studied inbred lines of corn.

Inbred line	Pedigree source/origin
Lancaster sure crop (LSC)	
MO17	CI. 187–2 × C103
K18	Derived from MO17 changes in Iran
K19	Derived from MO17 changes in Iran
Reid yellow dent (RYD)	
A679	A B73 back-cross derived line [(A662 × B73)(3)
Extracted from late synthetic (created in Iran)	
K3651/1	SYN-late (Iran)
Lines extracted from CIMMYT originated materials in Iran	
K166A	
K166B	

filling stage. Fatemi et al., (2006) and Khalili et al., (2010) reported that the yield decrease under drought stress at the reproductive stage was greater than that at the vegetative and grain filling stages.

Analysis of the correlation between yield and yield components is a prerequisite in planning an effective breeding program. Estimation of a simple correlation between various agronomic characters will provide necessary information for corn breeders, when selection is based on two or more traits simultaneously. Information obtained from correlation coefficients for these characters could also be useful as indicators of the more important characters under consideration (Sadek et al., 2006). Manivannan (1998) found that the traits of ear diameter, grain rows, 1000-grain weight, grain number per row and ear length all had significant correlation with grain yield. Devi et al. (2001) reported that the traits of ear length, row number per ear and 100-grain weight all had a direct and positive influence on yield. Shoae Hosseini et al. (2008) in a study using simple correlations and stepwise regression reported that in a drought stress condition, the traits of ear diameter, grain number per row and ear length and in normal condition grain depth, grain number per row and plant height were useful for the determination of an increase in grain yield. Khayatnezhad et al. (2010) reported that 500-grain weight had the most positive correlation (r=0.98**) with grain yield. After this trait, grain per row and ear length showed the most significant correlation with grain yield (r=0.94** and r=0.89**). Saed Moshchi et al. (2010) reported that under drought stress, the trait of row number per ear had the most positive correlation and grain number per row had the least correlation with grain yield. Stepwise regression results for grain yield indicated that row number per ear and 1000-grain weight was the most suitable inputs to the model. Screening and selection of plants of different crops with considerable water stress tolerance has been considered as an economically viable and an efficient means of utilizing drought-prone areas to reduce water loss when combined with appropriate management practice (Rehman et al., 2005). The goal of this research was to survey the responses of grain yield and yield components in inbred corn lines in a drought stress condition at different growth stages.

MATERIALS AND METHODS

The present study was conducted at the Agricultural College of Islamic Azad University Shoushtar branch, Iran, 2010. The treatments for the experiment were compared in a split-plot design by a randomized complete block design with three replications. The main factors were (normal irrigation (non-stress), drought stress in 6-7 leaves (vegetative) stage, drought stress in pollination stage and drought stress in grain filling stage). The sub factors were 7 inbred lines (Table 1). The inbred lines were grown in three-row plots of 10 m in length and 75 cm spacing between the rows. Fertilizer was used based on a soil test. Irrigation was applied once every 7 days for non-stress and stress conditions, respectively. A drought stress condition was induced by cutting the second round of irrigation at each stage. Data were recorded for yield components and grain yield from 10 competitive plants from each plot and (kg/ha) was calculated for the entire plot. Data pertaining to grain yield were analyzed statistically. Analysis of variance, correlations and stepwise regression using SPSS software was carried out and mean separation was performed according to Duncan's Multiple Range Test at 5% probability level.

RESULTS AND DISCUSSION

Results of analysis of variance (ANOVA) showed significant differences among the different levels of drought stress for all traits except row number per ear, ear length, cob diameter and grain weight. In the inbred lines, there was significant difference for all traits except grain width, which demonstrated an existence of high diversity among

Table 2. Analysis of variance of traits in corn inbred lines under drought stress condition.

Source of variance	Degree of freedom	Grain yield	Grain number per ear	Row number per ear	Grain number per row	Ear length (cm)	Ear diameter (cm)	Cob diameter (cm)	Grain depth (cm)	Grain width (cm)	Grain diameter (cm)	Grain weight (g)
Block	2	2990**	388.1**	0.7**	23.4^ns	1.2**	0.15^ns	0.09^ns	0.097**	0.00**	0.007*	0.004^ns
Drought stress	3	545**	9586.2**	1.7^ns	67.1**	10.8^ns	0.05**	0.11^ns	0.07**	0.003**	0.003*	0.003^ns
Drought stress error	6	138	2861.2	0.9	6.8	3.7	0.08	0.03	0.14	0.003	0.001	0.001
Inbred line	6	327.8**	30015.8**	32.0**	165.3**	85.5**	0.73*	0.52*	0.45**	0.004^ns	0.028**	0.03**
Drought stress×Inbred line	18	23.5**	4148.2**	4.2**	33.5*	4.6^ns	0.29*	0.08^ns	0.12**	0.002**	0.002**	0.001**
Error	48	2.47	3264.9	1.6	23.4	3.5	0.11	0.05	0.89	0.002	0.003	0.002
Coefficient of variation	-	0.08	54.6	9.7	48.5	10.8	9.2	10.2	22.2	9.4	7.08	11.3
Coefficient of correlation	-	-	0.80**	0.46^ns	0.79*	0.13^ns	0.39^ns	0.18^ns	0.26^ns	0.77*	0.30^ns	0.39^ns

ns, * and **: non significant, significant at 5 and 1% probability levels, respectively.

the inbred lines studied for drought tolerance and differences from the times that stress was induced. In terms of the interaction between drought stress and inbred lines, there were significant differences for all the traits except ear length and cob diameter (Table 2). Among all the inbred lines, K166B (3254.2 kg/ha) had the maximum grain yield, and MO17 at (750.63 kg/ha) had the minimum grain yield from all conditions (Tables 3 and 4). Drought stress at the grain filling stage had the minimum grain yield, an indication of the severe effects of drought stress at this stage of growth, but grain yield at the vegetative stage showed no significant difference in comparison with the non-stress condition.

Drought stress reduced grain yield 15, 40 and 60% at vegetative growth, pollination and grain filling stages than non-stress condition, respectively. In corn, grain yield reduction caused by drought ranges from 10 to 76% depending on the severity and stage of occurrence (Bolaòos et al., 1993). Leta et al. (2001) and Karimian et al. (2005) reported that drought stress at the vegetative growth stage had a minimal effect and that drought stress caused a greater decrease in grain yield at the grain filling stage. Fatemi et al. (2006) and Khalili et al. (2010) reported that the yield decrease under drought stress at the reproductive stage was greater than that at the vegetative and grain filling stages. The other researcher showed that drought stress declined in grain yield (Shiri et al., 2010; Golbashi et al., 2010). Results of this experiment also indicated that some yield components such as grain number per ear and grain number per row were adversely affected in water deficit condition particularly at the grain filling stage.

The least grain depth was obtained in the non-stress condition. Between different levels of drought stress there was no significant difference for the traits of row number per ear, ear length, ear diameter, cob diameter, grain width and grain weight (Table 3). Mean comparison of simple effects of corn inbred lines (Table 3) showed that the maximum grain number per ear was achieved from the line K166B, and that the maximum row number per ear was achieved from all lines except MO17, the maximum grain number per row was achieved from the lines K166B and K19, the maximum ear length was achieved from the line K18, the maximum ear diameter was achieved from the lines K18 and A679, the maximum cob diameter was achieved from the line K3651/1, the maximum grain depth was achieved from the lines MO17, A679, K166A and K166B, the maximum grain diameter was achieved from the lines K18 and K166A and the maximum grain weight was achieved from the lines K18 and K166B. Analysis of the interaction between drought stress and inbred lines (Table 4) showed that the maximum grain number per ear was achieved from the lines K18, A679, K166A and K19 at the non-stress condition and under drought stress at the vegetative stage and also line K166B in four conditions. Maximum row number per ear and the maximum grain width were achieved from the line K166A in the non-stress condition.

The maximum grain number per row was achieved from lines K18, A679 and K166B at the non-stress condition. The maximum quantities achieved for traits by the various lines are shown in Table 4, results are as follows: ear length, line K18 at the non-stress condition; ear diameter and grain depth traits line A679 under drought stress at the grain filling stage, for cob diameter line

Table 3. Mean comparison of simple effects of corn inbred lines.

Treatment	Grain yield (Kg/ha)	Grain number per ear	Row number per ear	Grain number per row	Ear length (cm)	Ear diameter (cm)	Cob diameter (cm)	Grain depth (cm)	Grain width (cm)	Grain diameter (cm)	Grain weight (g)
Non-stress	2748.1^{a}	319.85^{a}	13.23^{a}	24.3^{a}	17.68^{a}	3.53^{ab}	2.26^{a}	0.63^{b}	0.52^{a}	0.71^{a}	0.39^{a}
Drought stress in vegetative stage	2344.6^{ab}	271.14^{b}	13.33^{a}	20.3^{b}	17.07^{a}	3.59^{a}	2.19^{a}	0.7^{a}	0.51^{a}	0.72^{a}	0.39^{a}
Drought stress in pollination stage	1660^{b}	197.86^{c}	13.01^{a}	15.3^{c}	16.22^{a}	3.52^{a}	2.097^{a}	0.68^{a}	0.499^{ab}	0.69^{b}	0.36^{a}
Drought stress in grain filling stage	1092.7^{c}	120.43^{d}	12.83^{a}	11.9^{d}	17.79^{a}	3.63^{a}	2.24^{a}	0.67^{a}	0.499^{ab}	0.70^{ab}	0.37^{a}
MO17	750.63^{d}	118^{d}	9.57^{b}	12.3^{d}	15.59^{c}	3.18^{b}	1.86^{c}	0.598^{a}	0.496^{a}	0.711^{ab}	0.341^{bc}
K18	1828^{bc}	270.25^{b}	13.17^{a}	20.5^{ab}	20.36^{a}	3.82^{a}	2.42^{ab}	0.694^{b}	0.505^{a}	0.772^{a}	0.442^{a}
K3651/1	1384.25^{c}	120.75^{d}	13.73^{a}	8.8^{e}	15.97^{bc}	3.56^{ab}	2.47^{a}	0.562^{c}	0.480^{a}	0.652^{b}	0.341^{bc}
A679	1508.13^{c}	279.75^{b}	14.47^{a}	19.3^{b}	18.95^{ab}	3.52^{a}	2.19^{abc}	0.812^{a}	0.503^{a}	0.671^{b}	0.378^{abc}
K166A	2304.75^{b}	256.75^{b}	13.85^{a}	18.5^{b}	17.95^{abc}	3.68^{ab}	2.15^{abc}	0.754^{a}	0.524^{a}	0.738^{a}	0.397^{ab}
K166B	3254.2^{a}	323.5^{a}	12.89^{a}	25^{a}	19^{ab}	3.62^{ab}	2.24^{abc}	0.717^{a}	0.532^{a}	0.747^{ab}	0.425^{a}
K19	2449.5^{b}	264^{b}	13.92^{a}	19^{a}	12.52^{d}	3.29^{ab}	2.05^{bc}	0.569^{c}	0.499^{a}	0.654^{b}	0.312^{c}

*In each column, means with similar letters do not differ significantly at 5% probability level.

Table 4. Mean comparison of different traits in corn inbred lines under drought stress and non-stress conditions.

Stress condition	Inbred line	Grain yield (Kg/ha)	Grain number per ear	Row number per ear	Grain number per row	Ear length (cm)	Ear diameter (cm)	Cob diameter (cm)	Grain depth (cm)	Grain width (cm)	Grain diameter (cm)	Grain weight (g)
Non-stress	MO17	1121.5^{efg}	196^{c}	9.13^{f}	21.8^{e}	16.2^{cde}	2.8^{g}	1.7^{g}	0.55^{cd}	0.51^{abcd}	0.70^{abcdef}	0.32^{ghij}
	K18	2639^{bc}	364^{a}	12.9^{cdef}	28.2^{a}	22.5^{a}	3.9^{ab}	2.5^{ab}	0.72^{abc}	0.51^{abcd}	0.81^{a}	0.49^{a}
	K3651/1	2250^{c}	204^{c}	13.5^{bcd}	15.1^{ef}	14.6^{efgh}	3.2^{defg}	2.5^{ab}	0.35^{d}	0.48^{abcd}	0.66^{def}	0.32^{ghij}
	^{A}679	2541^{bc}	379^{a}	13.35^{cd}	28.4^{a}	18.8^{bcd}	3.7^{abcd}	2.2^{bcdef}	0.78^{abc}	0.51^{abcd}	0.66^{def}	0.40^{a}-^{h}
	K166^{A}	2887^{b}	370^{a}	17.53^{a}	21^{c}	19.8^{abc}	3.5^{bcdef}	2.2^{bcdef}	0.64^{abc}	0.56^{a}	0.77^{ab}	0.41^{a}-^{f}
	K166B	4026^{a}	363^{a}	12.73^{cde}	28.6^{a}	17.5^{bcde}	3.9^{abc}	2.4^{abc}	0.77^{abc}	0.55^{abc}	0.75^{abcde}	0.45^{ab}
	K19	3772^{ab}	363^{a}	13.5^{bcd}	26.9^{ab}	14.2^{efgh}	3.6^{bc}	2.3^{abc}	0.62^{bcd}	0.49^{abcd}	0.64^{ef}	0.32^{fghij}
Vegetative	MO17	1002^{efg}	150^{d}	9.5^{f}	15.8^{ef}	14.8^{efg}	3.2^{defg}	1.9^{cdefg}	0.6^{bcd}	0.51^{abcd}	0.75^{abcde}	0.37^{b}-j
	K18	2428^{bc}	300^{a}	12.9^{cde}	23.3^{bc}	19.9^{abc}	3.5^{bcde}	2.2^{bcde}	0.66^{abc}	0.52^{abcd}	0.77^{abc}	0.44^{abc}
	K3651/1	1878de	175^{cd}	14.3^{bcd}	12.2^{fg}	16.6^{bcde}	3.8^{abcd}	2.5^{ab}	0.67^{abc}	0.47^{abcd}	0.66^{def}	0.38^{b}-j
	^{A}679	1914de	320^{a}	15.9^{ab}	20.1^{c}	20.1^{ab}	3.8^{abcd}	2.1^{cdefg}	0.86^{ab}	0.52^{abcd}	0.69^{bcdef}	0.39^{b}-i
	K166^{A}	2379^{c}	315^{a}	13.1^{cd}	24.1^{bc}	17.4^{bcde}	3.6^{bcd}	2.1^{cdefg}	0.73^{abc}	0.54^{abcd}	0.76^{abcd}	0.42^{a-e}
	K166B	3793^{ab}	338^{a}	12.7^{cde}	26.6^{ab}	19.5^{abcd}	3.7^{abcd}	2.2^{bcdef}	0.77^{abc}	0.51^{abcd}	0.74^{abcde}	0.42^{a-e}
	K19	3018^{b}	300^{a}	14.9^{bc}	20.2^{c}	11.2^{h}	3.5^{bcde}	2.3^{abcd}	0.62^{bcd}	0.51^{abcd}	0.65^{def}	0.31^{ij}

Table 4. Contd

Pollination	MO17	586^{fg}	100^{de}	9.1^{f}	11^{fg}	14.5^{b}-^{h}	2.9^{fg}	1.8^{efg}	0.51^{cd}	0.48^{abcd}	0.68^{bcdef}	0.33^{e}-j
	K18	1895^{de}	261^{b}	13.7^{bcd}	19^{d}	19.7^{abc}	3.9^{ab}	2.5^{ab}	0.75^{abc}	0.50^{abcd}	0.77^{ab}	0.44^{abc}
	K3651/1	1081^{efg}	89^{e}	13.6^{bcd}	6.5^{ij}k	14.8^{efg}	3.6^{abcd}	2.2^{bcde}	0.71^{abc}	0.46^{abcd}	0.61^{f}	0.32^{f}-j
	^{A}679	997.5^{cd}	270^{b}	14.8^{bc}	18.2^{d}	17.5^{bcde}	3.5^{bcdef}	2.1^{cdefg}	0.69^{abc}	0.52^{abcd}	0.66^{def}	0.34^{d}-j
	K166^{A}	2059^{d}	220^{b}	12.6^{cde}	17.5^{de}	15.9^{def}	3.9^{abc}	2.1^{cdefg}	0.89^{ab}	0.45^{d}	0.72^{abcdef}	0.39^{b}-j
	K166B	3005.8^{b}	300^{a}	13.1^{cd}	23^{bc}	19.1^{abcd}	3.6^{abcd}	2.2^{bcde}	0.69^{abc}	0.46^{d}	0.74^{abcde}	0.42^{a-e}
	K19	1996^{d}	145^{d}	14.1^{bcd}	10.5^{fg}	12.2j^{h}	3.2^{defg}	1.7^{fg}	0.55^{cd}	0.48^{bcd}	0.66^{cdef}	0.30^{j}
Grain filling	MO17	293^{h}	26^{e}	10.5^{ef}	2.6k	16.9^{bcde}	3.8^{abcd}	1.9^{cdefg}	0.73^{abc}	0.48^{bcd}	0.71^{abcdef}	0.35^{c}-^{j}
	K18	350^{gh}	156^{d}	13.1^{cd}	11.9^{fg}	19.3^{abcd}	3.8^{abcd}	2.4^{ab}	0.65^{abc}	0.48^{bcd}	0.74^{abcde}	0.40^{a}-^{g}
	K3651/1	328^{gh}	15^{f}	13.5^{bcd}	2l^{c}	17.9^{bcde}	3.6^{bcd}	2.7^{a}	0.51^{cd}	0.51^{abcd}	0.67^{bcdef}	0.35^{c-j}
	^{A}679	580^{fg}	150^{d}	13.8^{bcd}	11^{fg}	19.3^{abcd}	4.2^{a}	2.4^{abc}	0.93^{a}	0.47^{cd}	0.68^{bcdef}	0.38^{b-j}
	K166^{A}	1894^{de}	122^{de}	12.2^{de}	10^{gh}	18.7^{bcd}	3.8^{abcd}	2.2^{bcdef}	0.74^{abc}	0.54^{abcd}	0.70^{bcdef}	0.38^{b-j}
	K166B	2192^{cd}	293^{ab}	13.4^{cd}	21.9^{c}	19.9^{ab}	3.3^{cdefg}	2.2^{bcdef}	0.65^{abc}	0.51^{abcd}	0.76^{abcd}	0.41^{a-e}
	K19	1012^{efg}	81^{e}	13.2^{cd}	6.2^{ijk}	12.4^{fgh}	2.9^{efg}	1.8^{defg}	0.49^{cd}	0.48^{bcd}	0.66^{def}	0.31^{ij}

*In each column, means with similar letters do not differ significantly at 5% probability level.

K3651/1 under drought stress at the grain filling stage and for grain diameter and grain weight traits line K18. Westgate and Boyer (1985) found that water stress during the critical period of silking to early grain filling inhibited photosynthesis and consequently lowered the carbohydrate reserve to a level that was insufficient to support optimum reproductive development. The measurement of total yield components showed that in drought stress condition total yield decline was mainly due to reduction of kernel number per row and total kernel number per ear (Shoa Hosseini et al., 2008). Monirifar and Moemeni (2010) found that drought stress at reproductive stages (pollination and grain filling) had reduction effects on grain number per row, row number per ear, grain number per ear and 300-weight grain. Cakir (2004) reported significant reduction of grain weight under drought stress at the grain filling stage. Simple correlation coefficients between the studied traits are illustrated in Table 2. Results show that grain number per ear had the most positive and significant correlation with grain yield (r=0.80*).

After this trait, grain number per row and grain width showed positive and significant correlation with grain yield (r=0.79* and r=0.77*). Manivannan (1998) found that the traits of ear diameter, grain rows, 1000-grain weight, grain number per row and ear length all had significant correlation with grain yield. Zadtot Aghaj et al., (2000) with study corn late hybrids in normal and drought stress conditions in grain filling stage reported that in normal condition, 1000-grain weight, ear length, grain number per row and anthesis silking interval (ASI) and in drought condition 1000-grain weight, grain depth, ear length and grain number per row with grain yield has positive and significant correlation. Devi et al. (2001) reported that the traits of ear length, row number per ear and 100-grain weight all had a direct and positive influence on yield.

Marefatzadeh et al. (2010) reported that the most correlation grain yield was with grain number per row. Shoae Hosseini et al. (2008) in a study using simple correlations and stepwise regression reported that in a drought stress condition the traits of ear diameter, grain number per row and ear length and in normal condition grain depth, grain number per row and plant height were useful for the determination of an increase in grain yield. Khayatnezhad et al. (2010) reported that 500-grain weight had the most positive correlation (r=0.98**) with grain yield. After this trait, grain per row and ear length showed the most significant correlation with grain yield (r=0.94** and r=0.89**). The stepwise regression results for grain yield (Table 5) indicated that grain number per ear in the model was the input and 99% determined the

Table 5. Stepwise regression analysis grain yield (dependent variable) with yield components in corn inbred lines under drought stress condition.

Trait	Intercept	B_1	R_2	F	Standard error
Grain number per ear	51.794	8.40	0.997	788.21**	45.16

**: Significant at 1% probability level.

variation of the traits grain yield by grain number per ear. Shoae Hosseini et al. (2008) in a study using simple correlations and stepwise regression reported that in a drought stress condition the traits of ear diameter, grain number per row, ear length and in normal condition grain depth, grain number per row and plant height were useful for the determination of an increase in grain yield. Saed Moshchi et al. (2010) reported that under drought stress the trait of row number per ear had the most positive correlation and grain number per row had the least correlation with grain yield. Stepwise regression results for grain yield indicated that row number per ear and 1000-grain weight was the most suitable inputs to the model.

Conclusion

Results of this study showed that drought stress causes a decrease in yield and some of its components. In this experiment, drought stress at the vegetative stage had the minimum effect on grain yield, grain number per ear and grain number per row but at the grain filling stage it had the maximum effect on this trait, showing the severe effects of drought stress at this stage of growth, results that are in agreement with those of Leta et al. (2001) and Karimian et al. (2005). It can also be confirmed that line K166B produced the highest grain yield, grain number per ear, row number per ear, grain number per row, grain depth, grain width and grain weight; and line MO17 produced the least grain yield, grain number per ear, row number per ear, grain number per row, ear diameter and cob diameter. Therefore, lines K166B and MO17 were the most tolerant and sensitive to drought stress, respectively and could be recommended for use in future breeding programs for production of drought tolerant hybrids. Correlations between grain yield to grain number per ear, grain number per row and grain width were positive and significant. The stepwise regression results for grain yield indicated that grain number per ear in the model was the input and 99% determined variation of grain yield. Therefore, it was determined that grain number per ear had the most positive and significant correlation with grain yield in a regression in model. Therefore, grain number per ear provided the most useful input for an increase of grain yield in a drought stress condition.

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