Cumhuriyet Üniversitesi Fen Fakültesi
Fen Bilimleri Dergisi (CFD), Cilt:36, No: 3 Özel Sayı (2015)
ISSN: 1300-1949

Cumhuriyet University Faculty of Science
Science Journal (CSJ), Vol. 36, No: 3 Special Issue (2015)
ISSN: 1300-1949

Assessment of the performance correlation, agronomic characteristics, and drought tolerance indices in corn hybrids under late season moisture stress conditions

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Received: 01.02.2015; Accepted: 05.05.2015

Abstract. This study aimed to investigate the performance correlation, agronomic characteristics and drought tolerance indices in sorghum hybrids under late season moisture stress conditions in a randomized complete block design with four replications. In both normal irrigation and drought stress conditions, the number of kernels per corn showed the highest correlation with seed yield by (r= 0.977) and (r= 0.952), respectively. The results of the describing data indicate that there was a positive and significant correlation between GMP, MP, STI and TOL indices with YP and YS at 1% probability level, Whereas, SSI index had negative and non significance correlation to Yp and Ys.

Keywords: Yield, Corn, Drought tolerance indices and Correlation

1. INTRODUCTION

Drought has major implications for global food supply because of the expected effects of gradual climate change over the next century, and the variation in climatic extremes in the short term that it is expected to bring. Although increased temperature is a more predictable outcome than changes in rainfall patterns accompanying climate change, it is generally considered that major maize producing areas will become warmer, drier and subject to an evolving array of maize diseases and pests that are new to those areas.Corn could be grown in a wide range of environmental conditions due to its high adaptation property and its seed yield per unit area is higher than other products in the same conditions(Ehdaie and Cress, 1973).Drought is the most common environmental stress that has limited almost 25% of the world's agricultural lands. Yield losses due to drought, salinity and other factors involve more than two-thirds of the total damages of abiotic stresses (Bohnert and Bressan, 2001). Drought is a widespread phenomenon and unpredictable in many areas, which can severely reduce performance and stability of grain yield and forage (Yadav et al., 2002).

The rate of progression as a result of selection for a given trait needs to know the its correlation with other traits and the nature of this correlation(genetic linkage, pleiotropy, or Epistasia) (Dudley and Moll, 1969). The simple correlation measures the linear relationship between two variables and correlation coefficient (r) determined the direction and intensity of this relationship. In the study of some field crops simple correlations have been used to obtaining information on the relations between yield and yield components with other traits (Ahmad et al., 1991). However, when there are cross-correlations among the multiple attributes, simple correlation coefficients provide incomplete information from the nature of the relationship. Partial correlation coefficients by considering the constant effect of other variebles

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Special Issue: The Second National Conference on Applied Research in Science and Technology

measure the linear relationship between two variables(Corke and Kannenberg, 1989; Dwyer et al., 1994). Salami et al (2007) conducted an experiment on corn and conclude that there was a positive and significant relationship between plant and naize height with grain yield. Cross (1991) reported there was a positive and significant correlation between seed yield and thousand grain weight as well as between seed yield and number of kernels per row. Also, Sharma and Makherjee (1985) reported that there is a positive correlation between grain yield and the number of seed per corn and corn weight and thousand grain weight. Shiva and Jagannath (1991) concluded that there was a significant and positive correlation between thousand grain weight and grain number per corn and thousand grains weight and grain number directly influence the grain weight per corn. Zadtut Aghaj and et al (2000) in the study of correlation between traits in corn hybrids found that under non-drought stress conditions there was a significant correlation between thousand grain weight, corn length, number of kernel per row and pollen distance to tassel emergence ant grain yield, respectively, 0.88, 0.78, 0.77 and 0.67. as well as in drought stress conditions in grain filling stage there was a significant correlation between thousand grain weight, green cover percentage, grain depth, corn length, number of kernels per row and number of leaves above the ear, respectively, 0.91, 0.85, 0.84, 0.78 and 0.62. According to them, in drought stress conditions, grain weight (r=0.51), green cover percentage (r=0.38), corn length (r=0.36) and plant height (r=-0.22) had maximum effect, and corn length, green cover percentage and plant height had highest indirect effect on grain yield.

Moghadam and Hadizade (2002) using different stress tolerance indices investigated the reactions of corn hybrids and their parental lines to drought and results showed that among four calculated indices STI, MP, TOL, SSI, STI index had more benefits for the selection of desirable kinds under normal and stress conditions. As well as correlation between hybrids and parental lines was negative and weak in normal conditions which by changing conditions to tension mode, correlations were stronger and positive. So, regard to the importance and limitation of water resources and the expansion of cultivated area aimed to increasing field crops production, become more clear the importance of achieving to tolerant genotypes under difficult conditions with high water-use efficiency.

In Moghan and zones with same climatic conditions due to variations in cultivations and sowing crops as second cropping after harvest of wheat, barley, canola, corn at some phenological stages, especially during the grain filling stage, had been suffering from water deficiency. Therefore, achieving to tolerant hybrids under water stress conditions will result in increasing water use efficiency and area under corn cultivation and finally increasing yield per unit area, which these tests were conducted to determine the traits relationship in non moisture stress and moisture stress in grain filling stage as well as their effects on grain yield.

2. MATERİALS AND METHODS

This experiment came into force in field seasons of 1391 and 1392 in the research farm of natural resources and agricultural research center of Ardabil (Magi) in factorial split plot and based on randomized complete block trial design with 3 replications. Main plots consisted of 3 levels of irrigation: 1- complete irrigation based on water requirements of plant and customs of area 2- cut irrigation at vegetative stage (cut irritation after emergence to tassel emergence and continuing from appearance of tassel flower until the end of the reproductive period) 3- cut irrigation during grain filling stage (irrigation from planting until pollination ad seed formation and cutting off water to physiological maturity).

Sub plots consisted of a combination of two maize hybrids factors (S.C700, S.C647, S.C704) and hormonal treatments (no use of hormones, eight-leaf stage sprayed with 50 ppm kinetin) (Zare and et al., 2006 ; Hamidia and et al., 2014) eight- leaf stage sprayed with gibberllin detected at 50 ppm, and eight-leaf stage sprayed with gibberellin and kinetin detected 25 ppm of each) were conducted.

- Measurement of catalase (CAT)

To measure the activity of catalase (CAT) photochemical method (Cakmak and Horst. 1991) were used. 3 ml mixture of reaction containing 1.0 Mm bafrtys (8.6=pH), 10Mm H_2O_2 andenx=zyme extract were obtained and was read at a wavelength of 240 nm.

- Measurement of peroxidase (POD)
- Preparation of extraction buffer

For this purpose, phosphate buffer mM (pH=7) was used. How to prepare it is based on following.

Solution 1: 0.68 gr potassium dihydroen phosphate salt dissolved in a few ml of distilled water and then 0.0186 gr EDTA added to the solution and brought to the 100 ml volume.

Solution 2: 0.87 gr mono hydrogen phosphate potassium salt dissolved in a few ml distilled water and then 0.0186 gr EDTA added to the solution and brought to 100 ml volume with distilled water.

Both solutions are as storage solutions that 39 ml of solution 1 for every time mixed with 61 ml of solution 2 and then the pH regulated between 6.8- 7.we used of this solution as buffer of extracting peroxidase enzyme.

3. ENZYME EXTRACTION

0.5 gram from comminuted fiber leaves with liquid azoth was transferred into the 2 milliliter microtubules and 1 milliliter of extraction buffer is added to it, then it is centrifuged with circuit of 14000 (rpm) at the temperature of 4 C as long as 15 minutes. After finishing centrifuge, the extraction above it, is been transferred to another microtubule and again been centrifuges with 14000 rpm as long as 10 min and then the extraction above it, after recording the volume, is transferred to the microtubule and is been conserved at the temperature of -70 in the freezer. Then the act of enzyme was computed by using formula of Birlambert codeand with the GayakulPeroxides black out modulus $\mu m^{-1} cm^{-1}$. Finally the act of enzyme computed at U/mg protein.

Analysis of combined variance according to the level of significance of square mean, interactions of the main factors (irrigation, hormones and hybrids), calculate and the F test and also resulted means are combined in the level of five percent by using danken test. Figures were drawn using software EXCEL2010 and statistical analysis has been done by using software MSTATC (Alizadeh and Tarinejad, 2012) and SAS.19.

4. RESULTS AND DISCUSSION

Corn hybrids evaluation was done using randomized complete block design with four replications in both normal and stress conditions; in two separate experiments involving eight genotypes (Table 1). Irrigation in two separate experiments was done as follow: A. full irrigation based on crop water requirements and zone conventional consumption. B. Irrigation termination at grain filling stage (Irrigation from sowing until the completion of anthesis and then cutting off water from completion of anthesis up to physiological maturity). Each plot consisted of five lines with distance of 75 cm and an area of 21.6 m, respectively. Each genotype in each plot consists of five lines, each line containing 32 hills with distance of 18 cm were planted manually. By into account sowing line spacing as well as considering one plant per hill, plant density was selected 75,000 plants per ha.

Drought indices

Drought tolerance/susceptibility indices were calculated for each genotype using the following relationships:

1. Stress Susceptibility Index (SSI)= $[1-(Ysi-Ypi)]/SI$ (Fischer and Maurer, 1978)
2. Stress Tolerance Index (STI) = $[Ypi \times Ysi]/(Yp)^2$ (Fernandez, 1992)
3. Tolerance Index (TOL)= $Ypi-Ysi$ (Hossain et al., 1990)
4. Geometric Mean Productivity (GMP)= $\sqrt{(Ypi \times Ysi)}$ (Fernandez, 1992)
5. Mean Productivity (MP)= $(Ypi + Ysi)/2$ (Hossain et al.,1990)
6.Yield index (YI)= Ysi/Ys (Gavuzzi et al., 1997)
7. Yield stability index (YSI)= Ysi/Ypi (Bouslama and Schapaugh, 1984)

where, Ysi, is the yield of cultivar in stress condition, Ypi,the yield of cultivar in normal condition, SI that is stress intensity, where:

SI= $1-(Ys/Yp)$; Ys, is total yield mean in stress condition,Yp, the total yield mean in normal condition. Among the stress tolerance indices, a larger value of TOL and SSI represent relatively more sensitivity to stress, thus a smaller value of TOL and SSI are favorable. Selection based on these two criteria favors genotypes with low yield potential under non-stress conditions and high yield under stress conditions. On the other hand, selection based on STI and GMP will be resulted in genotypes with higher stress tolerance and yield potential will be selected (Fernandez, 1992).The simple correlation coefficient between studied traits for examined genotypes in normal and stress conditions was calculated separately. MSTAT-C and SPSS software were used to data analysis.

Table 1. List of genotypes stufied in this experiment.

No	Genotype	No	Genotype
1	Single cross 700	5	BC 582
2	Single cross 704	6	BC 666
3	Single cross 647	7	ZP 434
4	BC 678	8	BC404

5. RESULTS AND DISCUSSION

In this experiment, in terms of SSI index, among the studied hybrids, hybrid SC704 with SSI equal to 0.897 had more tolerant to cutting off water stress at seed filling stage and genotype BC404 with SSI equal to 1.788 had more sensitivity to late season moisture stress (table 2). According to TOL index among the studied hybrids, SC704 with TOL equal to 3.140 was known as the most tolerant hybrids. BC666 hybrid with 4.951 was more sensitive (Table 2). According to MP index among the studied hybrids, hybrids SC704 and SC 647 had more tolerant to cutting off water condition in grain filling stage (Table 2). Use of the geometric mean productivity (GMP) indicate that hybrids SC704 and SC647, respectively, with values of 7.366 and 7.071 were most tolerant hybrids to cutting off water at grain filling stage. Whereas BC582 by 1.214 had less Stress Tolerance (Table 2). Use of the STI index in cutting off water condition at grain filling stage indicate that SC704 and SC700 hybrids with STI, 1.811 and 1.692, respectively, were stable and high performance hybrids and BC582 with STI equal to 0.039 was most susceptible genotypes (Table 2). In the study of Moghadam and Hadizadeh (2000) it was found that in selection of stress tolerant corn genotypes stress tolerance index (STI) was more efficient than stress susceptibility index (SSI). In this study it was found that SSI index had only acceptable efficiency for removing sensitive genotypes, but not suitable for selection of tolerant genotypes under difficult conditions. Farzi (2005) by investigating the efficacy of moisture stress tolerance indicator in corn stated that SSI index choses hybrids which had high performance in stress environment, but had low performance in non- stress environment. He also stated that SSI index is not successful in separation of genotypes in Group A from other groups and concluded that SSI index has very high performance to finding resistance genes. According to his report to performance prediction under moisture stress and non-stress conditions, MP, GMP and STI indices than the TOL and SSI indices and GMP and STI indices than other indices of drought resistance are extremely effective. In general, according to the results of this research and other researchers, the index STI, a hybrids selectivity is better than the other indexes, and the selection of high-yielding varieties had been successful in both normal and stress conditions.

Table 2. parameters of drought tolerance indices studied genotypes

Genotype	Y_P	Y_S	TOL	STI	MP	GMP	SSI
SC700	10.32	5.39	4.942	1.692	6.848	6.455	1.399
SC704	10.15	7.01	3.140	1.811	7.521	7.366	0.897
SC647	10.03	6.59	3.537	1.412	7.261	7.071	0.986
BC678	4.312	2.66	3.756	0.307	2.425	2.313	1.123
BC582	1.361	1.21	3.281	0.039	1.221	1.214	1.539
BC666	4.482	2.66	3.951	0.307	2.464	2.343	1.458
ZP434	3.660	3.11	3.554	0.293	2.271	2.260	1.428
BC404	3.611	2.7	3.829	0.251	2.106	2.054	1.781
Mean	5.991	3.916	3.748	0.764	4.014	3.885	1.326

TOL - Tolerance Index, GMP - Geometric Mean Productivity, MP - Mean Productivity, SSI - Stress Susceptibility Index, STI - Stress Tolerance Index

Based on calculated phenotypic correlation coefficient for performance and stress tolerance indices it was observed that there was a significant and positive correlation between indices GMP, MP, STI and TOL with YP and YS at 1% level, whereas there was a non significant correlation between SSI with YP and YS (Table3). In review of drought tolerance indices, the biggest significant and positive correlation coefficient was observed between TOL and STI indices. Rosielle and Hamblen (1981) showed that in most of experimental performance comparison there is a correlation between MP with YP and YS. Therefore, according to their comments, selection based on MP index generally will result to grain yield average increase in both normal and stress conditions.

Table 3. Correlation coefficients of yield and drought tolerance indices in the studied genotypes

	Y_P	Y_S	TOL	STI	MP	GMP	SSI
Y_P	1						
Y_S	0.946**	1					
TOL	0.922**	0.81**	1				
STI	0.955**	0.963**	0.85**	1			
MP	0.974**	0.965**	0.902**	0.965**	1		
GMP	0.970**	0.975**	0.873**	0.967**	0.977**	1	
SSI	0.566 n.s	0.367 n.s	0.747 *	0.407 n.s	0.499 n.s	0.470 n.s	1

ns, * and ** mean significant and non-significant at the probability level of 5%, 1%, respectively.

Simple correlation coefficients of studied traits in normal conditions indicated that there was a significant and positive correlation between grain yield and number of kernels per row, kernel depth, plant height, corn height, number of kernels per corn, corn length, days to topknot and the number of grains per in 1% probability level. Also there was a significant and negative correlation between grain yield and, stem diameter, number of nodes per shoot, number of leaves above the ear, hectolitre weight, days to topknot, corn leaf area, and hectolitre weight in 5% probability level (table 4). Among the three components of yield components, thousand grain weight and number of grain rows had non-significant correlation with grain yield. In this study, kernel depth had positive correlation with the number of grains per corn. As well as there was a significant and negative correlation between kernel depth and number of days to anthesis and days to topknot in 1% probability level(table 4). In addition, there was a significant and positive correlation between plant height with corn height, stem diameter, hectolitre weight, grain number per corn and corn length as well as there was significant and positive correlation between leaf area and thousand grain weight at 5% probability level (Table 4). The highest correlation coefficient related to grain yield, was yield correlation with number of kernels per row under normal condition (0.997) (Table 4), namely the effect of this trait on grain yield was more than number of kernels per corn and corn length and is of importance. Under stress condition, simple correlation coefficients indicates that there was a significant and negative correlation between grain yield and grain number per row, plant height, corn height, number of leaves above the ear, days to anthesis, days to topknot, number of grains per corn and corn length in 1% probability level, and there was significant and positive correlation between grain depth and stem nodules and corn leaf area in 5% probability level (table 5). In this study, grain depth had positive and significant correlation with number of leaves above the corn, number of kernels per corn, corn length, as well as there was positive and significant correlation between number of days to anthesis and days to topknot. There was positive and significant correlation between number of days to topknot and the number of kernels per row, kernel depth, number of leaves above the corn. Also there was positive and significant correlation between corn leaf area and tassel *length* in 1% probability level. Highest correlation coefficient with the yield stress was performance correlation with number of kernels per row (0.952), (Table 5). So, According to the results we can said that irrigation termination treatments in grain filling stage by affecting leaf photosynthesis result in reducing material transfer to grain and finally degraded performance relative to the normal condition. Thus in irrigation termination treatments in grain filling stage genotypes can be selected based on the number of kernels per row and corn length for drought tolerance. Muhammadi et al (1998) by performing a trial in Delhi and Hyderabad said that in both environments between the number of kernel rows, number of kernels per row; there was a high correlation between plant height and corn height. Vaezi et al (1998) in their study on corn indicated that grain yield per plant had significant and positive correlations with most traits which are known as yield components, especially with corn weight, corn diameter and circumference, weight of 300 seeds and number of kernels per row and correlation between grain row and corn diameter with number of kernels per row was not significant, but causality analysis indicate that both have significant indirect effects, that through summation with indirect effects of trait correlation was not significant, and conversely, corn length and grain width had not significant direct effect, but through indirect effects of other traits, showed a significant genotypic correlation with the number of grains per row. Although determination of relationship between important traits and grain yield is important, however, calculating the correlation coefficient does not specify the nature of relationship between traits, and by using causality analysis identification of direct effects of different characteristics and their indirect effects on performance will be possible (Moghaddam et al, 1996). Based on this study, it can be concluded that with respect to variety of relationships between traits, simple correlation can not be used as good basis to determine the factors associated with high performance.

6. CONCLUSİON

There was a significant difference between traits for most studied traits in both normal irrigation and cutting off water conditions in grain filling stage. This means that in terms of examined traits there is enough variety between studied genotypes and there is a possibility of selecting, modify, and introducing high yielding genotypes.

- Using stress tolerance indices hybrid SC704 was selected as moisture stress tolerant hybrid.
- STI index in selectivity of stress tolerance hybrids and high performance hybrids was more effective than other indices be able to separate the groups from each other.

Table 4. Correlation coefficients of phenotypic traits in studied genotypes under normal conditions

No	صفات	1	2	3	4	5	6	7	8	9	10	11	12
1	Y	1	-	-	-	-	-	-	-	-	-	-	-
2	R.P.E	0.407**	1	-	-	-	-	-	-	-	-	-	-
3	K.P.R	0.977**	0.369n.s	1	-	-	-	-	-	-	-	-	-
4	1000.K.W	0.438n.s	-0.441n.s	0.400n.s	1	-	-	-	-	-	-	-	-
5	K.D	0.870**	0.633n.s	0.853**	0.220n.s	1	-	-	-	-	-	-	-
6	P.H	0.933**	0.244n.s	0.881**	0.534n.s	0.770*	1	-	-	-	-	-	-
7	E.H	0.946**	0.447n.s	0.885**	0.467n.s	0.792*	0.940**	1	-	-	-	-	-
8	T.B.N	0.488n.s	0.051n.s	0.547n.s	0.547n.s	0.534n.s	0.373n.s	0.369n.s	1	-	-	-	-
9	L.T.B	0.495n.s	0.051n.s	0.484n.s	0.531n.s	0.682n.s	0.453n.s	0.348n.s	0.759*	1	-	-	-
10	E.S	0.786*	0.376n.s	0.706*	0.510n.s	0.645n.s	0.800*	0.903**	0.160n.s	0.233n.s	1	-	-
11	S.N	0.762*	0.839**	0.726*	-0.107n.s	0.740*	0.612n.s	0.790*	0.148n.s	0.062n.s	0.673n.s	1	-
12	T.N.L	0.507n.s	0.558n.s	0.556n.s	-0.092n.s	0.346n.s	0.356n.s	0.574n.s	0.067n.s	-0.314n.s	0.556n.s	0.775*	1
13	N.L.A.E	0.748*	0.820*	0.745*	-0.157n.s	0.756*	0.533n.s	0.702n.s	0.253n.s	0.140n.s	0.538n.s	0.966**	0.732*
14	N.L.B.E	0.456n.s	0.137n.s	0.437n.s	0.176n.s	0.219n.s	0.302n.s	0.436n.s	-0.167n.s	-0.133n.s	0.578n.s	0.482n.s	0.482n.s
15	H.W	0.814*	0.375n.s	0.801*	0.438n.s	0.570n.s	0.711*	0.871**	0.339n.s	0.096n.s	0.851**	0.764*	0.806*
16	D.P	-0.641n.s	-0.685n.s	-0.599n.s	0.059n.s	-0.909**	-0.515n.s	-0.516n.s	-0.415n.s	-0.685n.s	-0.344n.s	-0.616n.s	-0.088n.s
17	D.S	-0.79*	-0.792*	-0.775*	0.025n.s	-0.84[illegible]**	-0.647n.s	-0.783*	-0.162n.s	-0.240n.s	-0.753*	-0.923**	-0.684n.s
18	D.P.M	-0.363n.s	-0.547n.s	-0.382n.s	0.520n.s	-0.299n.s	-0.352n.s	-0.367n.s	0.324n.s	0.387n.s	-0.195n.s	-0.643n.s	-0.582n.s
19	A.S.I	-0.392n.s	-0.333n.s	-0.397n.s	-0.030n.s	-0.154n.s	-0.323n.s	-0.517n.s	0.244n.s	0.451n.s	-0.674n.s	-0.599n.s	-0.872**
20	K.P.E	0.904**	0.740*	0.889**	0.090n.s	0.924**	0.765*	0.861**	0.449n.s	0.406n.s	0.673n.s	0.920**	0.621n.s
21	E.L	0.912**	0.052n.s	0.892**	0.747*	0.716*	0.918**	0.873**	0.543n.s	0.572n.s	0.789*	0.472n.s	0.317n.s
22	LA	0.714*	0.340n.s	0.687n.s	0.628n.s	0.700n.s	0.597n.s	0.736*	0.590n.s	0.564n.s	0.803*	0.529n.s	0.440n.s

Table 4

No	صفات	13	14	15	16	17	18	19	20	21	22
13	N.L.U	1	-	-	-	-	-	-	-	-	-
14	N.L.L	0.485 ns	1	-	-	-	-	-	-	-	-
15	W.H	0.699*	0.663 ns	1	-	-	-	-	-	-	-
16	N.D.P	-0.675 ns	-0.045 ns	-0.230 ns	1	-	-	-	-	-	-
17	N.D.S	-0.899**	-0.543 ns	-0.726**	0.718*	1	-	-	-	-	-
18	N.D.M	-0.601 ns	-0.152 ns	-0.281 ns	0.272 ns	0.537 ns	1	-	-	-	-
19	I.A.S	-0.496 ns	-0.722*	-0.768*	-0.133 ns	0.588 ns	0.448 ns	1	-	-	-
20	N.S.C	0.924**	0.342 ns	0.741*	-0.784*	-0.909**	-0.513 ns	-0.384 ns	1	-	-
21	L.C	0.442 ns	0.437 ns	0.764*	-0.415 ns	-0.561 ns	-0.056 ns	-0.318 ns	0.671 ns	1	-
22	LA	0.505 ns	0.498 ns	0.777*	-0.441 ns	-0.646 ns	0.202*	-0.408 ns	0.648 ns	0.757*	1

* and ** indicattes significant at the 5% and 1% levels of probability, respectively

Y – Yield, RPE – Row per ear, KPR- Kernel per row, KW- 1000-Kernel weight, KD- Kernel depth, PL- Plant height, EH-Ear height, LMTB- Length of main axis Tassel branch, TBN- Tassel branch No, ES- Ear Stem, SN- Stem nodules, TNL- Total number of leaves,NLAE- Number of leaves above the ear, NLBE-- Number of leaves blow the ear, HW- Hectoliter weight, DP- number of days till pollination, DPS- number of days till silking, DP- number of days till pollination, ASI- Anthesis- silking interval, KPR- Kernel per ear, EL- Ear length, LA- Leaf area

Table 4. Correlation coefficients of phenotypic traits in studied genotypes under water scarcity during grain filling stage

No	صفات	1	2	3	4	5	6	7	8	9	10	11	12
1	Y.S	1	-	-	-	-	-	-	-	-	-	-	-
2	N.R.S	0.445 ns	1	-	-	-	-	-	-	-	-	-	-
3	N.S.R	0.952**	0.523 ns	1	-	-	-	-	-	-	-	-	-
4	W.1000	0.492 ns	-0.058 ns	0.321 ns	1	-	-	-	-	-	-	-	-
5	D.S	0.764**	0.687 ns	0.816*	-0.047 ns	1	-	-	-	-	-	-	-
6	H.P	0.907**	0.241 ns	0.877**	0.567 ns	0.567*	1	-	-	-	-	-	-
7	H.C	0.928**	0.360 ns	0.904**	0.655 ns	0.555*	0.955**	1	-	-	-	-	-
8	N.T.T	0.574 ns	0.190 ns	0.591 ns	0.527 ns	0.517 ns	0.590 ns	0.613 ns	1	-	-	-	-
9	H.T	0.529 ns	0.045 ns	0.465 ns	0.212 ns	0.627 ns	0.361 ns	0.337 ns	0.744*	1	-	-	-
10	G.S	0.492 ns	0.136 ns	0.422 ns	0.493 ns	-0.005 ns	0.420 ns	0.608 ns	-0.005 ns	-0.121 ns	1	-	-
11	N.G.S	0.758*	0.404 ns	0.724*	0.688 ns	0.355 ns	0.681 ns	0.866**	0.529 ns	0.235 ns	0.814*	1	-
12	N.T.L	0.451 ns	0.704 ns	0.440 ns	0.325 ns	0.253 ns	0.285 ns	0.518 ns	0.033 ns	-0.193 ns	0.755*	0.766*	1
13	N.L.U	0.899**	0.727*	0.875**	0.480 ns	0.765*	0.780 ns	0.856**	0.579 ns	0.391**	0.402 ns	0.770*	0.640 ns
14	N.L.L	0.404 ns	0.246 ns	0.333 ns	0.393 ns	0.038 ns	0.191 ns	0.433 ns	-0.020 ns	-0.017 ns	0.895**	0.760*	0.786*
15	W.H	0.618 ns	0.315 ns	0.544 ns	0.030 ns	0.619 ns	0.547 ns	0.481 ns	0.124 ns	0.337 ns	0.241**	0.241 ns	0.217 ns
16	N.D.P	-0.842**	-0.679 ns	-0.850**	-0.180 ns	-0.968**	-0.665 ns	-0.677 ns	-0.650 ns	-0.680 ns	-0.092 ns	-0.503 ns	-0.337 ns
17	N.D.S	-0.945**	-0.505 ns	-0.908**	-0.414 ns	-0.720*	-0.760*	-0.862**	-0.465 ns	-0.477 ns	-0.648 ns	-0.832*	-0.617 ns
18	N.D.M	-0.379 ns	-0.215 ns	-0.530 ns	0.143 ns	-0.231 ns	-0.443 ns	-0.484 ns	0.096 ns	0.277 ns	-0.540 ns	-0.390 ns	-0.392 ns
19	I.A.S	0.147 ns	0.448 ns	-0.210 ns	-0.240 ns	0.640 ns	0.102 ns	-0.014 ns	0.456 ns	0.486 ns	-0.680 ns	-0.251 ns	-0.250 ns
20	N.S.C	0.883**	0.768*	0.941**	0.241 ns	0.887**	0.750*	0.816*	0.577 ns	0.420 ns	0.329 ns	0.692 ns	0.549 ns
21	L.C	0.928**	0.367 ns	0.965**	0.330 ns	0.737*	0.932**	0.916**	0.561 ns	0.425 ns	0.418 ns	0.661 ns	0.323 ns
22	LA	0.778*	0.275 ns	0.625 ns	0.811*	0.495 ns	0.718*	0.759*	0.751*	0.651 ns	0.323 ns*	0.697 ns	0.330 ns

ABBREVİATİON

TOL - Tolerance Index, GMP - Geometric Mean Productivity, MP - Mean Productivity, SSI - Stress Susceptibility Index, STI - Stress Tolerance Index

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