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## "Study on hybrids maize response for drought tolerance index"

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Pasha Hejazi, Seyed Mohamad Nasir Mousavi, Khodadad Mostafavi, Mahmod Shahreza Ghomshei, Shieda Hejazi, Seyed Mohammad Navid Mousavi: "Study on hybrids maize response for drought tolerance index"

**ABSTRACT**

To survey and study the reactions of maize hybrids to dry tension and evaluation of tolerating indices with respect to dryness and the cause and effect relationship in quantitative and crop attributes as well as the seed function have been performed with 7 species of experimental corn samples in the form of designing the random blocks with three cases/categories of replications in the investigation farm of Islamic Azad University (Karaj branch). The species effect for all attributes except height of the bush and the function per acre was significant in variance analysis of dry condition. The solidarity was calculated between the resistance indices to dryness and the function in normal condition in addition to the dryness tension. They were introduced as the superior indices since the mean indices of efficiency mean geometric and harmonic as well as the Fernandez indices showed a great solidarity with the function in normal condition and the dryness tension. The three first factors allocated 84.3 percent of the changes to themselves with dissolution of the factors based on disintegrating to the main components. Mean while, the first factor was with 47.4 percent, the second factor with 22 percent and the third one with 14.8 justified the diversification between the data.

***Key word:*** drought tolerance index, maze, factor analysis.

### Introduction

Because of the food and economical value as “the Corn” (Zea Mays L.), it is called ‘The King of Agricultural Products’. The using instances of maize, as in human meals, nourishment of the poultry, and its industrial application as well as pharmaceutics has raised its position to such a degree. It was placed at third rank [7] after wheat and rice from under cultivation areas across the world in the year of 2007. The mean function/yield of the maize in 2007 has reached 9000 kilograms per hectare. In Iran, the entire under cultivation maize is hybrid like the other developed countries. By the morphological and crop points of view, the produced hybrid forms of maize and the similar imported hybrids enjoy a verification/authentication, so the knowledge and investigating on these species in the existing hybrids will be of so much importance to meet the needs of breeders.

It has been anticipated that in the world and around the year of 2050, the population of the world will increase to 10 billions of people and because of many useful characteristics of the maize specially its adaptation with the various geographical conditions around the world, will have been spread quickly all over the earth and acquire the third place after wheat and rice from under cultivation area. This allocated area is 226 thousands of hectares in Iran. The maize with 159.9 million hectares of under cultivation area all around the world and a mean production of 5120 kilograms per hectare in addition to a total production of 817.1 millions of tons represent the importance and superior position of this plant. [3]

Zeinali *et al* [6] conducted an investigation on 25 maize hybrids and after measuring of 24 attributes and agent analysis of the main components and Remax circulation on the temporary factor, showed that the seven independent factors totally justified 79.5 (%) of the changes. They declared that for the existence of these high factorial coefficients for the attributes as per the number of days passing by, the first factor with a totally justifying 24.8 percent of the data variance, 50 percent of the pollination days until the emergence of peak and the flower crown is called the phonological specification. The other factors such as the maize leaf, was named: growth of the plant, the ingredients of the functionality, number , maize wood species and the interval between pollination and the

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appearance of the silky threads. They concluded that the attributes like maize leaf, the thickness of the stem, height of the plant, the number of seeds in a row, the depth of seed, diameter of maize, the number of seed rows, number of seeds in bush and the weight of 300 seeds are the most important features for selecting the maize hybrids with the high functionality.

The attributes such as diameter of the maize wood, percent of the maize wood, the distance of the released nodes until appearance of silks and number of maize are deemed to be of less importance. Gardner *et al* attributed the functionality of the hybrids in new maize to increase the leaf area, number and weight of seeds, the speed of seed fulfillment and glorying as well as the growth rate. In the studies of Kerk and Gunenreg, the number of seeds in the plant had a high and positive solidarity with the seed function, and generally the difference of function between the populations under investigation was the result of seeds number diversification in the selected bush. Also they acknowledged that it is better for breeders to focus on indirect selection of maize seeds number instead of their direct selection (1)

In 1987, Anderson suggested that there is a negative solidarity in the case of humidity tension emergence between the seed function and the length of the stem. Meanwhile, in case of dryness tension appearance which starts at the beginning of the season and ends before flowering, the dilatory function variations will have the relational high functionality to the earlier specimens.

During 2008, Khalili Mahalleh *et al* with comparison between the functionality of elements in function and the function of the elements in 7 maize species in the Khoy region (north west of Iran) showed that there is a over 1 percent significant difference among function and elements of function, and species of SC647 have reached a maximum amount of function.

## Material and Method

This study was carried out in the Islamic Azad University farm of Karaj. This station is located in a longitude of 50 degree and 66 minutes and the latitude of 35 degree and 68 minutes with a mean rainfall of 250 mm per year and 15 degree of mean temperature.7 early genotypes, of intermediate and dilatory types/ones consisted of 7 combinations of (KSC250, KSC500, DC370, KSC647, KSC704, KSC700 and KSC604) were studied in this experiment.

This test was conducted in the form of completely random blocks with 3 repetition/replications in early may of 2011. The aforementioned patch/land area of farm was plowed in the autumn of 2010, and the other supplementary farm operative crop such as semi-deep plow, disk and troweling were performed before cultivation procedure. Every acre was comprised of four rows, each row 5.6 meters in length, while the row spacing was 75 cm from each other. There were 16 heaps with 20 centimeters spacing distance in each rowand 4 seeds were cultivated in every heap. After assurance of growing sparse plants and getting sure of saving two bushes out of four in each heap, the seeds were disinfected with Cut aquamarine and Tyram. The morphological attributes were consisted of heights of bush and maize, maize length, maize diameter, number of seeds per maize row, number of seed rows in the plant, number of seeds in maize, weight of 100 seeds, weight of maize wood, weight of seed in maize and the seed function in squared meter, were measured at the time of experiment. Irrigating with caring and without tension was repeated once a week, but in tension caring, dryness was applied with dismissing irrigation in the flowering and blooming of the seed to the kurts. The toleration indices under study were comprised of STI, SSI, TOL, GMP and MP calculated by means of the following formula:

$$SSI = \frac{1 - {}^{Ys}/_{Yp}}{SI} \text{ و } SI = 1 - \left(\frac{Y\bar{s}}{Y\bar{p}}\right)$$

$$TOL = y_P - y_s \qquad MP = \frac{Ys+Yp}{2}$$

$$GMP = \sqrt{(Ys)(Yp)}$$

$$STI = \left(\frac{Yp}{Y\bar{p}}\right)\left(\frac{Ys}{Y\bar{s}}\right)\left(\frac{Y\bar{s}}{Y\bar{p}}\right) = \frac{(Yp)(Ys)}{(Y\bar{p})^2}$$

In this formula, SSI = sensitivity to stress index. SI = stress intensity, how the value of SSI got less, the more amount of tolerance to dryness.

GMP = the mean geometric, whatsoever its value is greater, reflects the more tolerance in relation to the amount of tension. MP = the mathematical mean value, the more tolerant to dryness and more favorable, the value of the MP will be greater. TOL = tolerance index, in which it's higher values reflect more sensitivity to dryness, and the less the value of this index, it is favorable. STI = stress tolerance index, the more is its value for a genotype, represents the more tolerance to dryness and the more its potential function. $Y_P$ = the potential function of each genotype in a tensionless environment, $Y_S$ = the potential function of each genotype in a tensional environment. $Y_P$ = the mean function of all genotypes in the tensionless environment. $Y_S$ = the mean function of all genotypes in the tensional environment. In this study we have used SAS and Minitab for statistical analysis.

*Conclusion & Discussion:*

The variance analysis showed that all the attributes in the dry condition had a meaningful discrepancy, except for height of the bush and the function of kurt. Also in normal condition, except for height of bush and the height of the plant, they have been a meaningful difference with each other. By analyzing the factors based on the disintegration of the main components, three first factor assigned 84.3 percent of all the changes observed, in which the first factor justified with 47.4 percent of data diversity and positive coefficients for the attributes, number of seed rows in maize, its diameter and length, the second factor with 22 percent both by the aspect of changes in data acquired and practical positive coefficients for the functional attributes of seeds and their number in a maize plant, and finally the third factor also justified with 14.8 percent of the changes in respective data. These coefficients were called the stature factors with respect to positive and high ranking values for the attributes: height of bush, height of maize plant and weight of maize wood (Table 1).

The causality analysis (Table 2) of seed function in squared meter and height of bush in direct effect with the seed function showed the value of 0.58 , weight of 1000 seeds with the value of 0.68 , here should note that the weight of 1000 seeds has a strong value. Also the length of maize in an indirect way through the height of bush accessed the value of 0.46, which in turn is a moderate one. In this statistical model also the weight of 1000 seeds has showed 0.34 of the value by indirect effectiveness with respect to the amount of length of maize,, that means a weak potential for that. In justifying the acquired results it might say that so as to increase the seed function in the tensional conditions, between these elements, seed function is being compensated because of the dry condition appearance. On the other hand, with regard to step-by-step variance regression analysis, the number of seeds in a maize row and number of seed rows in maize should be increased so as to be able to compensate the seed function in dry weather condition. by the way, the seed function in hectare unit is in the direct weight effect of 1000 seeds, in which on its turn it has direct effect on the weight of 1000 seeds and height of the maize bush, this has been led to study and increase of the maize length in tensional and dry conditions will cause the increase of biological function.

The cluster analysis has been obtained according to significant data have been made in the variance analysis table and based on the 'Ward' method. In this analysis, data divided to three clusters. In the first one, there was only KSC604 species. This cluster was selected as the best cluster with the most seed function, number of seeds in maize and number of seeds in row maize, and from the point of production of seeds. Also in the second cluster, there were DC370, KSC500 and KSC700 species in which the attributes had the best performance and function consisting of height of bush, length of maize and weight of maize wood. Finally, we had the species of KSC704, KSC647 and KSC250 in the third cluster. This cluster had a lower level with respect to the other two by justifying with most attributes (Fig. 1)

The step-by-step variance regression analysis (Table 3) in statistical level of 1 percent it got to be significant with the mean squared value (165448). As shown in Table 4, and according to this method, the height of bush, seed number in a row of maize, number of seed rows, and seed weight in maize stayed/considered as effective attributes. The amount of bush height (7.99) and seed number in the row of maize with (56.03), number of seed rows in maize (21.80), number of seed per maize (1.17), and seed weight of (2.02) had its own effects on the seed function per square meter. As we know, the explanation coefficient shows the penetration value of effective attributes in seed function per square meter. This coefficient is about 0.85 with respect to the attributes of bush height, number of seed in each row, number of seeds per row, number of seed in maize, and the weight of seed in maize. The regressive equation of these values with the width of the coordinate axis intercept equals to:

$$Y= -29.29+7.99X_1+56.06X_2+21.80X_3+1.17X_4+2.02X_5$$

The simple solidarity of the attributes as illustrated in Table 5, also has coalition/correlation? Among length of seed, seed diameter, weight of 1000 seeds, and seed function in every squared meter in statistical level was 1% and number of seeds in maize in this level got meaningful with 5% with the reverse and negative effect. Also the coalition between amounts of weight for 1000 seeds with respect to the seed function per square meter in the statistical level of 1% along with value (0.59) and the coalition between height of bush and its function in squared meter in the 5% level with value (0.38) became significant in this experiment.

Factor analysis with principal components analysis was accounted for based on first three factors of 84.3% of variation. The first factor explained 47.4% of the variation coefficients and high positive traits of seed rows per ear and ear diameter and ear length, the second factor explained 22% of the variation between the coefficients and high positive action for grain yield and number of grains per ear while the third factor is 14.8% of the variation between data and coefficients justify the high positive factor for plant height, ear height and plant height factor is called a cob weight (Table 6).

The coalition between the toleration to dryness and function might be assumed as an appropriate criterion for selecting the best hybrids and indices. This above coalition has been calculated in normal conditions (Table 5), functionality in the normal condition with the mean efficiency indices, geometric mean, the Harmonic average and tolerance index with respect to tension has shown positive and significance of 1% in the probability level (Table7 & 8). In dryness tension, no positive and significant coalition was observed between sensitivity to tension and tolerance to tension with regard to functionality. Hence the mean efficiency, geometric average, harmonic average and Fernandez indices showed a high coalition with function in the normal condition and the tension in dry situation, they are recognized as the superior indices. Yahooeian *et. al*, by assessing soya hybrids, mentioned mathematical average, geometrical average and Fernandez index as the superior indices in both the function in normal condition and dryness tension (6). Fernandez believes that the indices in both tensional environment and normal condition have a high level of coalition will be selected as the best known indices.

**Table 1:** Analysis of variance table of the 7 varieties of maize

| S.O.V | Degrees of freedom | Plant height | Ear height | Ear length | Ear diameter | Number of kernels per ear row | The number of kernel rows per ear | Number of grains per ear | 100 grain weight | Cob weight | Grain weight per ear | Yield of Crete |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Rep | 2 | 297.30 | 11.18 | 0.49 | 0.33 | 0.38 | 1.42 | 1034.97 | 0.04 | 0.58 | 141.45 | 9765.9 |
| Genotypes | 6 | 100.79$^{ns}$ | 8.32** | 29.7** | 9.2** | 10.19** | 85.8** | 31771.7** | 87.41$^{**}$ | 81.48$^{*}$ | 5562.5$^{**}$ | 202491.9$^{ns}$ |
| Error | 12 | 97.49 | 4.36 | 0.96 | 0.2 | 0.48 | 3.39 | 1733.7 | 2.09 | 4.45 | 340.29 | 6723.9 |

**, *, ns: respectively, indicating no significant difference statistically significant at the 5 and 1 percent level

**Table 2:** Direct and indirect effects of various traits on grain yield in wheat under drought stress

| Indirect effect through | | | | Direct effect | Treats |
|---|---|---|---|---|---|
| 1000 grain weight | Ear diameter | Ear length | Plant height | | |
| 0.24 | 0.04 | -0.15 | - | 0.58 | Plant height |
| 0.05 | 0.12 | - | 0.46 | 0.19 | Ear length |
| 0.07 | - | 0.10 | -0.02 | 0.01 | Ear diameter |
| - | 0.03 | 0.34 | 0.11 | 0.68 | 1000 grain weight |

**Table 3:** Stepwise regression analysis of variance (model 2)

| S.O.V | Degrees of freedom | Mean of squares | Specify the coefficients |
|---|---|---|---|
| Regression | 2 | 165448$^{**}$ | |
| Error | 36 | 12175 | 85% |
| Total | 38 | | |

**, *, ns: respectively, indicating no significant difference statistically significant at the 5 and 1 percent level

**Table 4:** traits effective and remaining in regression model

| Topics in Regression Model | Symbol | Values |
|---|---|---|
| Intercept | A | -29.29 |
| Plant height | $X_1$ | 7.99 |
| Number of kernels per ear row | $X_2$ | 56.03 |
| number of kernel rows per ear | $X_3$ | 21.80 |
| Number of grains per ear | $X_4$ | 1.17 |
| Grain weight per ear | $X_5$ | 2.02 |

$Y= -29.29+7.99X_1+56.06X_2+21.80X_3+1.17X_4+2.02X_5$ Regression equation

**Table 5:** simple correlation

| | Ear height | Ear length | Ear diameter | Kernel rows per ear | Kernel rows per ear | Number of grains per ear | 100 grain weight | Cob weight | Grain weight per ear | Yield of Crete |
|---|---|---|---|---|---|---|---|---|---|---|
| Plant height | 0.45$^{*}$ | 0.10$^{ns}$ | 0.23$^{ns}$ | 0.27$^{ns}$ | 0.20$^{ns}$ | 0.22$^{ns}$ | 0.12$^{ns}$ | 0.12$^{ns}$ | 0.17$^{ns}$ | 0.38$^{*}$ |
| Ear height | | 0.47$^{**}$ | 0.33$^{*}$ | 0.14$^{ns}$ | 0.20$^{ns}$ | 0.07$^{ns}$ | 0.22$^{ns}$ | 0.53$^{**}$ | 0.50$^{**}$ | -0.23$^{ns}$ |
| Ear length | | | 0.57$^{**}$ | 0.04$^{ns}$ | 0.28$^{ns}$ | 0.26$^{ns}$ | 0.88$^{**}$ | 0.25$^{ns}$ | 0.79$^{**}$ | -0.41$^{**}$ |
| Ear diameter | | | | 0.05$^{ns}$ | 0.29$^{ns}$ | 0.09$^{ns}$ | 0.66$^{**}$ | 0.53$^{**}$ | 0.29$^{ns}$ | -0.46$^{**}$ |
| Kernel rows per ear | | | | | 0.22$^{ns}$ | 0.46$^{*}$ | -0.17$^{ns}$ | -0.11$^{ns}$ | 0.32$^{ns}$ | 0.14$^{ns}$ |
| Kernel rows per ear | | | | | | 0.18$^{ns}$ | 0.38$^{*}$ | 0.02$^{ns}$ | -0.05$^{ns}$ | -0.26$^{ns}$ |
| Number of | | | | | | | 0.21$^{ns}$ | 0.33$^{*}$ | 0.88$^{**}$ | -0.36$^{*}$ |

| | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| grains per ear | | | | | | | | | | |
| 100 grain weight | | | | | | | | 0.73$^{**}$ | 0.71$^{**}$ | 0.59$^{**}$ |
| Cob weight | | | | | | | | | 0.14$^{ns}$ | -0.13$^{ns}$ |
| Grain weight per ear | | | | | | | | | | -0.32$^{ns}$ |

**, *, ns: respectively, indicating no significant difference statistically significant at the 5 and 1 percent level

**Table 6:** Factor 7 traits in maize lines for first three factors

| | Plant height | Ear height | Ear length | Ear diameter | Number of kernels per ear row | The number of kernel rows per ear | Number of grains per ear | 100 grain weight | Cob weight | Grain weight per ear | Yield of Crete |
|---|---|---|---|---|---|---|---|---|---|---|---|
| The first factor | 0.166 | 0.138 | 0.403 | 0.395 | 0.284 | 0.309 | 0.338 | 0.288 | 0.328 | 0.385 | 0.079 |
| The second factor | -0.372 | -0.547 | -0.131 | -0.018 | 0.113 | 0.218 | 0.330 | -0.338 | 0.152 | -0.013 | 0.488 |
| The third factor | 0.408 | 0.221 | -0.065 | 0.177 | 0.430 | -0.388 | -0.079 | -0.367 | 0.252 | -0.315 | 0.333 |

**Table 7:** Correlation coefficients between indices of drought tolerance yield of maize genotypes under drought stress

| STI | GMP | TOL | $Y_s$ | $Y_p$ | |
|---|---|---|---|---|---|
| | | | | 0.776$^{**}$ | $Y_s$ |
| | | | -0.271$^{ns}$ | 0.390$^{ns}$ | TOL |
| | | 0.052$^{ns}$ | 0.951$^{**}$ | 0.947$^{**}$ | GMP |
| | 0.981$^{**}$ | 0.084$^{ns}$ | 0.939$^{**}$ | 0.954$^{**}$ | STI |
| -0.038$^{ns}$ | -0.056$^{ns}$ | 0.974$^{**}$ | -0.385n$^{s}$ | 0.279$^{ns}$ | SSI |

**, *, ns: respectively, indicating no significant difference statistically significant at the 5 and 1 percent level

**Table 8:** Correlation coefficients between indices of drought tolerance yield of corn genotypes in normal conditions.

| STI | GMP | TOL | $Y_s$ | $Y_p$ | |
|---|---|---|---|---|---|
| | | | | 0.848$^{**}$ | $Y_s$ |
| | | | -0.314$^{ns}$ | 0.412$^{ns}$ | TOL |
| | | 0.363$^{ns}$ | 0.989$^{**}$ | 0.986$^{**}$ | GMP |
| | 0.983$^{**}$ | 0.346$^{ns}$ | 0.985$^{**}$ | 0.964$^{**}$ | STI |
| 0.230$^{ns}$ | 0.239$^{ns}$ | 0.878$^{**}$ | 0.182$^{ns}$ | 0.283$^{ns}$ | SSI |

**, *, ns: respectively, indicating no significant difference statistically significant at the 5 and 1 percent level

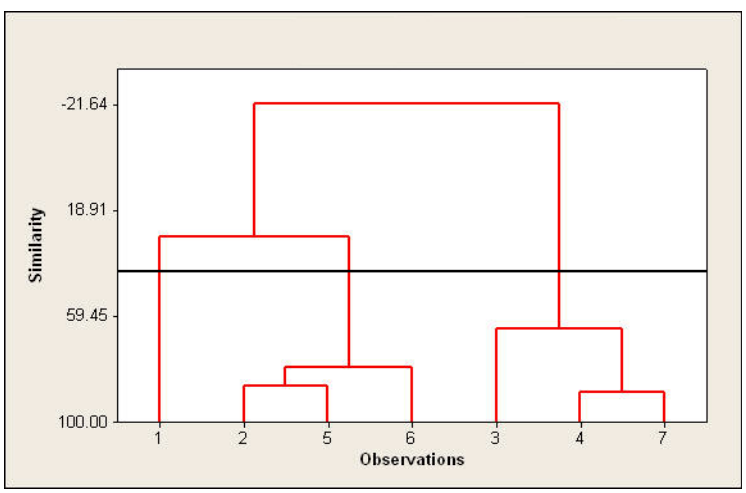


**Fig. 1:** Finally, Dendrogram resulting from a cluster analysis

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