Evaloation of Droght Tolerance Indices of Lentil Varietes

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ABSTRACT

Indicators to assess drought tolerance in lentil cultivars Ardabil region factorial experiment based on randomized complete block design with three replications in the 2010 Farm Agricultural Research Station University, Ardebil, was performed. Factors including two levels of planting conditions (irrigation and no irrigation) and lentil cultivars with five levels (ILL1180, ILL1324, ILL1251, local varieties and ILL1237) were. Results showed that, in dryland cultivar in 1180, about 308.22 kg per hectare (23.31 percent) and the 1324 cultivar of about 448.53 kg per hectare (35.51 percent) than irrigated had a yield reduction. The 1180 cultivar with the lowest and highest index value of TOL and SSI MP, GMP and STI in 1324 was also the highest value of TOL, SSI and STI and the 1237 cultivar with the lowest index was MP and GMP. Therefore, according to 1180 cultivars that the stress conditions and water conditions had the highest yield and lowest yield reduction in stress conditions than normal and has had a high resistance to drought is the best cultivar (in Among the studied cultivars) for culture in both irrigated and rainfed conditions is also the cultivar in 1324, is the most sensitive cultivars.

Key words: Lentil, yield and drought tolerance index.

Introduction

One of the important factors in plant drought resistance ability of cells to tolerate high levels without the loss of water damage restoration is inevitable. Dry cell with typically condensed vacuoles is more walls to rupture, so protoplasm leads. It seems that structural damage such cells is the main cause of cell death that has no ability to drought resistance [7]. Plant yield reduction under water deficit is one of the major problems facing plant breeders and plant them on yield improvement in these conditions but the difference in emphasis higher yield potential plant adaptation to stress factors related to their stress tolerance is, therefore, indices tolerance to drought resistant genotypes to determine the conditions used [8]. Amount and seasonal distribution of precipitation, temperature difference and the most important factors are soil conditions on yield and yield components of sesame in arid and semi arid regions of influence [9]. Rosielle and Hamblin [11] Resistance to stress (TOL) as the difference in yield under stresses (Ys) and non stress (Yp) and the average production capacity (MP) as the average production of stressful and non-stress conditions expressed. Fischer and Maurer [4] index called stress susceptibility index (SSI) be defined. Fernandez [3] also called an indicator of stress tolerance index (STI) can be defined that determine genotypes that both stress and non-stress conditions, have high yield, applied. Clark et al. [1] to determine the SSI index of drought resistance were used. Guttieri et al. [6] using SSI indicators suggested that higher doses of 1, indicating higher sensitivity and lower values indicate a lower susceptibility to drought is. Ramirez and Kelly [10] reported that GM and SSI indices derived from mathematics yield data and selecting varieties based on a combination of

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both criteria could be suitable indicators for evaluation of drought resistance in plants. SSI index and grain yield stability as parameters and plant genotypes resistant to drought stress have been used [12]. Fredrick et al. [5] in an experiment on soybean growth found that drought stress limited effect on grain yield of main stem does not, although this section of the yield, an important part of total plant yield is the ratio of grain yield to total yield per plant and main stem stress conditions was less than irrigation. In these conditions, the irrigation of soybean harvest index in the lower main stem had. Fredrick et al. [5] found that drought stress on the number of main stems and main stem of the number of grains per unit area, did not affect. Correlation between grain yield and grain weight of main stem and main stem was not significant. Shortage of water stress in soybean reduces the number of flowers, number of pods per pod size, seed number per pod and seed weight is [2].

The aim of this study include: determine the best varieties of lentils in the water deficit stress. Measurement of various indices of drought tolerance varieties of lentils in water deficit and determine the most resistant and susceptible cultivars of lentil (among the studied cultivars) to water deficit.

**Materials and methods**

To evaluate drought tolerance indices in the region of Ardabil lentil cultivars a factorial experiment based on randomized complete block design with three replications in 2010 Agronomic Research Station, Agriculture University, Ardebil, was performed. Ardebil and cold winter with spring and summer is mild. Altitude of about 1350 meters long term mean annual precipitation is about 400 mm. The geographic area within 38 degrees and 15 minutes and longitude 48 degrees 15 minutes is located. Factors including two levels of planting conditions (irrigation and no irrigation) and lentil cultivars with five levels (ILL1180, ILL1324, ILL1251, local varieties and ILL1237) were. Each experimental plot consists of five lines with the planting distances between rows and between rows 25 cm and 3 cm in length was 4 meters. 0.5 m between two plots was marginal. 2 blocks away from each other depending on m and depth of planting soil conditions between 5-3 cm were considered. Planting density was 133 plants per square meter.

Tillage including deep plowing (25-30 cm), disk and the trowel. In order to meet nutrient requirements according to tests conducted, 40 kg zinc sulphate per hectare, 100 kg ha super phosphate fertilizer and phosphorus of the type of animal manure was added to the soil.

How different traits measured in this experiment were as follows:

Yield and yield components: To determine the total yield per hectare, after the accumulation of dry material in the seeds reached their maximum yellow leaves and branches were before drying, and branches when the leaves were quite yellow, two lateral lines as considered marginal effect of three lines in the middle of planting the harvest was used to remove the margin from the beginning and end of every plot of about half a meter around two lines, was picked up. Other plant maturity at harvest and after drying in air to separate the natural and plant seeds of grain yield per unit area were measured.

Finally, the drought tolerance index based on the following formulas was measured:

Stress susceptibility index (SSI) based on the proposed relationship Fischer and Maurer [4] was calculated:

\[
SI = 1 - \frac{Y_s}{Y_p} \quad \text{and} \quad SSI = \frac{1 - (Y_{si} / Y_{pi})}{SI}
\]

Where, \(Y_{pi}\) yield stress of each genotype in the environment, \(Y_{si}\) yield stress of each genotype in the environment, \(Y_s\) = average yield of all genotypes in stressful environments, and \(Y_p\) = average yield of all genotypes in the environment is no stress. SSI means smaller amount is higher drought resistance. Stress tolerance index (STI) and tolerance index (TOL) based on the relationship Fernandez [3] was calculated:

\[
TOL = \frac{(Y_p - Y_{si})}{(Y_{pi})} \quad \text{and} \quad STI = \frac{(Y_{pi})(Y_p) / Y_{pi}}{(Y_{pi})}
\]

STI index higher for genotype represents a higher stress tolerance and yield potential is higher than the genotype. Geometric mean fertility (GMP) and the mathematical average of production (MP) were also calculated as follows:

\[
\text{GMP} = \sqrt[2]{Y_{si}Y_{pi}} \quad \text{and} \quad \text{MP} = \frac{(Y_{si} + Y_{pi})}{2}
\]

Finally, the data by SAS software for analysis and graphing software Excel was used.

**Results and discussion**

**Drought tolerance indices:**

Values of yield stress \(Y_{si}\) and lentils in optimum conditions and other parameters evaluated \(Y_{pi}\) resistance to moisture stress (Table 1) are shown. The dendrogram obtained from cluster analysis based on yield under dryland obtained (Fig. 1) indicated that the cultivars indicated that 1180 and 1251 under dryland conditions, and the highest amounts were in one group and other the cultivars were the second group, while the table (a) 1180 and 1251 the cultivars also under dryland and irrigated conditions than other cultivars, having had more practice. Cultivars used in the evaluation index, TOL, the high value of this index, a sign of susceptibility to stress and low doses selected based on index numbers is...
TOL. According to this index, the lowest cultivar in 1180 with TOL (resistant cultivar) and in 1324 the cultivar had the highest amount of TOL (most susceptible cultivar) is. MP index was also observed for the opening cultivar in 1180 had the highest amount and the cultivar in 1237 was the lowest value of this index. Using indices and TOL MP Resolution allowing cultivars only in stress conditions have high yield of the cultivars only in stress conditions have higher relative yield, there are [11]. GMP was observed for the index cultivar, which opened in 1180 with the highest and the lowest cultivar in 1237 was the value of this index. Much less stress susceptibility index (SSI) showed little variation in the yield of a genotype to stress and optimal conditions in which genotype result is more stability. Using index SSI, genotypes in both normal and stressful environment of superior yield and function have higher relative had, are significant differentiation [4]. According to index SSI, it was observed that in 1180 and 1251 cultivars with 1324 cultivars as the lowest and highest value was the index. Guttieri et al. [6] using SSI indicators suggested that higher doses of 1, indicating higher sensitivity and lower values indicate a lower susceptibility to drought is. Ramirez and Kelly [10] reported that indices derived from mathematics GMP and SSI data selection and yield cultivars based on a combination of both indicators can be a more appropriate criterion for evaluation of drought resistance in plants is. For the STI index was observed in 1180 and 1251 cultivars with 1324 cultivars and the highest and lowest value in 1324 also had this index. According to STI stress tolerance index Fernandez [3], cultivars with stable values are higher STI. Using this index, which can detect both cultivars and without drought stress conditions, in terms of yield, and had superior yield relative to high production, exist.

Conclusion:

In general it was observed that grain yield under irrigated and rainfed, dryland cultivar in 1180, about 308.22 kg per hectare (23.31 percent), 1324 cultivar of about 448.53 kg per hectare (35.51 percent), cultivar of about 1251 kg per hectare of about 388.74 (29.25 percent), local varieties of about 435.13 kg per hectare (34.0 percent) and the 1237 cultivar of about 388.9 kg per hectare (32.21 percent) than irrigated, yield losses were (Table 1). The indices are calculated for the 1180 cultivars indicated that the lowest index value and the highest amount of TOL and SSI MP, GMP and STI were also highest in 1324 with TOL, SSI and STI and the 1237 cultivar with the lowest index was MP and GMP. Therefore, according to 1180 cultivars that the stress conditions and water conditions had the highest yield and lowest yield reduction in stress conditions than normal was also calculated according to the indicators also have high resistance to stress Drought is the best varieties (among the studied cultivars) for cultivation in both irrigated and rainfed conditions is also the 1324 cultivar according to the results, is the most sensitive cultivars.

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Table 1: Indices of drought tolerance cultivars studied.

<table>
<thead>
<tr>
<th>Cultivars</th>
<th>Ypi</th>
<th>Ysi</th>
<th>SSI</th>
<th>TOL</th>
<th>STI</th>
<th>GMP</th>
<th>MP</th>
</tr>
</thead>
<tbody>
<tr>
<td>ILL1324</td>
<td>1321.7533</td>
<td>1013.5333</td>
<td>0.7578344</td>
<td>308.22</td>
<td>0.817485</td>
<td>1157.4286</td>
<td>1167.643</td>
</tr>
<tr>
<td>ILL1237</td>
<td>1262.9667</td>
<td>814.43333</td>
<td>1.1541619</td>
<td>448.5333</td>
<td>0.627681</td>
<td>1014.2003</td>
<td>1038.7</td>
</tr>
<tr>
<td>Native variety</td>
<td>1329</td>
<td>940.26667</td>
<td>0.9505845</td>
<td>388.73333</td>
<td>0.762548</td>
<td>1117.8615</td>
<td>1134.633</td>
</tr>
<tr>
<td>ILL1180</td>
<td>1279.7667</td>
<td>844.63333</td>
<td>1.1049827</td>
<td>435.13333</td>
<td>0.659615</td>
<td>1039.6796</td>
<td>1062.2</td>
</tr>
<tr>
<td>ILL1251</td>
<td>1207.1667</td>
<td>818.26667</td>
<td>1.0469709</td>
<td>388.9</td>
<td>0.602773</td>
<td>993.87335</td>
<td>1012.717</td>
</tr>
</tbody>
</table>

Fig. 1: Chart dendrogram based on the yield of varieties of lentil cultivars, under drought stress conditions.
References