Effect of Different Levels of Salinity on Leaf Characteristics and Chlorophyll Content of Commercial Varieties of Maize (Zea Mays L.)

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Abstract: Salinity is one of the environmental limiting factors in agricultural product producing. So the investigation of the plants and finding some method to resist the plants against salinity stress is very important. For the aim of investigation the effects of salinity stress in leaf characteristic and chlorophyll content of commercial varieties maize, seven varieties of maize (SC301,SC704,SC302, Zp684, SC700, Bc 662, Simon) and zero salinity level (control), 50, 100 and 150 mM chloride sodium in 3 replication experimentally in RB design in pot and the salinity related apply were done after full experiment of soil. The analysis of variance of under investigated characteristics was done in coincidently blocks design on normal data. The comparison of the average of under investigated characteristics in genotypes showed that there is significant differences between genotypes. The comparison of under investigated characteristics of chlorophyll A with Duncan test showed significant differences between treatments. The highest amount of chlorophyll A was seen in Bc662 that hadn't significant differences with Sc301-Zp684-SC302-SC700-S.C704 Genotypes. From the chlorophyll B characteristic point of view, it wasn't seen any significant differences between under investigated genotypes. But the highest and lowest amounts of chlorophyll B were seen in BC 666 and Simon respectively. There was seen a correlation positive and significant between chlorophylls characteristic and the length and width of the leaf in %1 probability level. Also, there was correlation positive and significant between the length and width of the leaf and chlorophyll A and chlorophyll B and the width of the leaf and chlorophyll A and B and the chlorophyll A/B proportion. It was seen positive and significant relation between chlorophyll A and B. At least it was revealed that these varieties that have large leaves also have high chlorophyll content and can easily compound with salinity stress.

Key words: Maize-chlorophyll content-salinity stress-maize leaf.

INTRODUCTION

Maize is of primary cultivated kinds that had been by mankind. Ghalinat believed that maize has originated from (Zea Mexicana) because of mankind’s interference (Rahimian and Banayan, 1996). Till a few years ago, maize had been cultivated in Iran as a secondary corn behind other cultivars, but fortunately chow it was placed as main cultivated product and high attention have been paid to its cultivation with a view to preparing the herbivorous animals food. Many studies have been done about maize. About 500 different genes were recognized in maize and the chromosome plan of each of them was analyzed. Mach of the maize is Hybrid cultivated kind that has high performance by considering the Heterosis phenomenon (Yazdy Samady and Abd mishani, 1991). The main goal in improving the gene of the maize is increasing the yield in level unite and compatibility with environment and the quality of the corn and resistance against diseases. Nowadays, we are witness of main changes in this field by relying on new methods in improving gene such as biotechnology and molecular markers and we hope that we can done our selection on the basis of the marker's related genotypes with special gene that can control the wanted characteristics by using molecular markers (abdmishani, 1993).

Salinity stress is one of the abiotic stresses that decrease the productive potential of cultivated grounds. This stress and control of it is of main subjects that human were thousands of years ago with it until now. We can say that it is one of the main factors in decreasing the productivity of the ground in producing cultivated products. The salinity stress problem begun when the mankind begun to cultivating actions. Speed and unsuitable development of irrigation systems in large scales caused to developing the salinity stress problem in cultivatable fields (Khoshkhogh Sima and Askari, 2001). The salinity stress problem is a worldwide problem and any place and any climate isn't free of soils that are affected by salt. These soils had been concealed about 1 milliard Hectares of earth grounds and 75 million hectare of this figure was located in west-south of Asia. Iran is in first place by 27 million Hectares of salty grounds and after Iran, India and Pakistan are in second and third place by 23.8 and 10.5 million Hectares of salty grounds respectively (Ozturk et al., 1995). The sensivity threshold of the maize to salinity of the water is 1.1 and soil 1.7 ds/m and the amount of crop decreasing per one unit increasing of the soil salinity is 12 percent (Alizadeh, 1985). So the maize is of plants that are relatively sensitive to salinity. Weak correlation had seen between salinity resistance in sprouting stage and other growing stages. Maize is very sensitive to salinity in sprouting stage and salt increasing cause to decreasing of sprouting and the numbers of crucibles that are placed on level unite. It was seen significant decreases in growing and performance.
by salinity increasing. In EC higher than 8 ds/m, the main limiting factor for plant is accessible water (Heidari Shrifabad, 2001, mozaifar and godin, 1986). Miri et al., (1970) showed that the upper part of the plant is affected more than root. In plants that their fruits are growing parts, or in plants such as maize that their product is on relation with the weight of dry material of the plant, the products will be decreased as the size of the plant decreases. Diminishing the area of the leaf with increasing the salinity of the soil is proved, that is influential factor in the amount of the product by decreasing the amount of photosynthesis. It is interesting that the sensitivity of the processes such as transfer of stomatal and leaf growth show high correlation with the salinity of the not but it wasn't seen any correlation with the amount of the salt of the leaf It seems that root must be a valuable intermediate to take consider of the soil condition changes and their transformation to aerial branches (ziaetabar Ahmadi et al., 2002, Mirmohammadi Meibodi and Ghare Zäæ, 2002). The results of the analysis of variance investigations of Lavijani and Molla hosseini (2006) showed that the yield of dry and wet Forage in various salinity level are at 5 and 1 percent level respectively and each of two cultivation pattern at 1% level has Significant differences with each other Also the characteristics such as the indicator of the leaf area and the length and stem diameter and the leaf length between salinity treatment have Significant differences with each other in 5% level.

Decreasing the chlorophyll content was reported as the result of increasing the salinity increasing in Ashraf et al., (2005) tests. Levent et al., (2007) showed in an investigation the effect of Gibberellic acid and salinity stress on the activity of some antioxidant enzyme and developmental parameters in maize that the salinity stress has been caused to decreasing the dry weight, chlorophyll content and (RWC) but increasing proline superoxide dismutase and peroxidase collection.

By considering the aforementioned statements, recent investigation was conducted by the aim of investigating the salinity stress on leaf characteristics and the chlorophyll content of commercial variety maize in Ardabil.

MATERIALS AND METHODS

The study was began spring of 2010 in investigational region of Ardabil branch Islamic Azad university near the Hassan Baroagh village by geographical coordinates 48 and 30 of east length and 38 and 15 of North width with the height of 1350 meter above sea level.

The climate of this region was cold and semidry. It has a long dry season specially in summer. The soil of the region is clay that is poor with respect of organic material. For the purpose of investigating all factors, the analysis of soil was conducted, to determine the limiting factors of growth in pot and to be sure that there isn't any primary limit in EC.

<table>
<thead>
<tr>
<th>%Dw</th>
<th>%C</th>
<th>%Silt</th>
<th>Sand %</th>
<th>Clay %</th>
<th>Potassium ppm</th>
<th>Phosphorus ppm</th>
<th>% Organic carbon</th>
<th>% Organic carbon</th>
<th>Chlorophyll A</th>
<th>Chlorophyll B</th>
<th>Ratio Chlorophyll A/B</th>
<th>Ec</th>
<th>Mmols/cm</th>
<th>SP%</th>
</tr>
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<tbody>
<tr>
<td>18</td>
<td>30</td>
<td>36</td>
<td>15</td>
<td>49</td>
<td>453</td>
<td>9.3</td>
<td>0.091</td>
<td>0.86</td>
<td>13.3</td>
<td>7.8</td>
<td>0.52</td>
<td>46</td>
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7 kind of maize on zero salinity level and 50, 100, 150 mM of chloride sodium were cultivated on pot coincidently of the form of factorial test on 3 replications.

That include: Simon, BC662,SC700, ZP684,SC302,SC704,SC301.

For the aim of growth limiting factors determination, the percent of it's juice was determined and the amount of the needed salt to reach to investigated salinity was calculated by using saltcalc software. To do the test, it was used of plastic pots by dimensions of $25 \times 35$ that all of them were filled with leaf soil and sandy soil and fertilizer and cultivated soil by the ratio of 3:2:2:1

To do drainage the bottom of the pots were pierced.

And a thin layer of clay was used. To avoid the salt content decreasing all pots were placed in another container simultaneously with doing the cultivated salinity, the cultivation was done on 13.5.2010. Irrigation was conducted on normal environmental condition. Among growth period, handle weeding was conducted to avoid the growth of loose grasses. It was used of fertilizers twice in this period by considering the feeding needs of the plants in pot condition, in all pots. And at least the characteristics such as leaf length, leaf width, the amount of leaf chlorophyll, chlorophyll A, chlorophyll B and the ratio of chlorophyll A/B were calculated.

The chlorophyll A and B were calculated one week ago of fully controlling in 1 on the Ashraf et al., (1994) and Arnon (1975) method. To calculate the chlorophyll of the leaf, first 0.5g of the fresh leafs of the plant was taken and was mixed with distilled water that it created a uniformity heap and resulted solution was spilled in a balloon until it reach to 25 ml. 0.5 ml of the sample was taken and was mixed with 4.5 ml of aseton 30 percent. The resulted solution was centrifuged 3000 rpm for 10 minute. The upper layer of the solution was separate and...
the amount of photo absorption was read by using spectrophotometer on 663 wave length and 645 nanometer and the concentration of the chlorophyll was determined on the basis of existence relation.

**Milligram Chlorophyll A Per one Gram of Wet Weight:**
\[ 12.7 \times (\text{absorption at 663}) - 2.69 \times (\text{645 absorption}) \] \[ \times 0.5 \]

**Milligram chlorophyll B at each gram of wet weight**
\[ 22.9 \times (\text{645 absorption}) - 4.69 \times (\text{absorption at 663}) \] \[ \times 0.5 \]

All calculations were done on the form of RB three replication by using MSTATC and SPSS software. After data normalization, the analysis of the variance was done about calculated characteristic separately and the change's coefficients were calculated. If these coefficients be high, the comparison of the means of treatment is conduct on the basis of Duncan test on 5% level of probability.

**RESULTS AND DISCUSSIONS**

The table of variance analysis is come in table2. The combined effects between salinity and genotype were Significant. Farahbakhsh and shamsoldin saeid (2006) studies showed that the majority of the characteristic such as stem height and the number of leaf and dry weight and the chlorophyll amount have Significant differences under salinity influence. There were Significant differences between the various amounts of salinity in calculated chlorophyll with chlorophyll meter, in 1% probability level. In this characteristic, it was seen Significant differences between genotypes, but there weren’t Significant differences between effects and salinity and genotypes. There were Significant differences between various salinity levels in chlorophyll A characteristic in 1% probability level.

There was Significant differences between genotypes in probability level of 5 but the reciprocal effects wasn't Significant About chlorophyll B characteristic, it was seen Significant differences between various salinity level but there wasn't Significant differences between genotypes and reciprocal effects. The chlorophyll A and chlorophyll B ratio showed Significant differences between various levels of salt. Comparison of the means of the characteristics, in various salinity levels showed that the majority of the characteristics had Significant differences. Of course because some of genotypes were destroyed in 100 ml mol, so the whole mean was diminished and also the Significantly bing of the characteristics was diminished, too. So, the Duncan mean comparison method was used to cover this fault. With respect of the leaf length, it was not seen any Significant differences between 0 And 50 salinity level. But 100 salinity caused to diminishing the Significantness of leaf length. The soil salinity caused to decreasing of the leaf width, with respect of this characteristic, it was seen Significant differences between various doses with control.

The highest amount of the leaf width in control was obtained with 8.452 cm and width the lowest amount of the leaf width was obtained in 100 ml mol salinity with 6.476 cm width.

The number of the leaf showed Significant diminishing by increasing the Salinity amount in comparison with control. The lowest number of leaf was obtained in 100 ml mol salinity near 6.476. The proportional content of the leaf water showed Significant decrees by increasing the salt. But between the 50 mM dosage, it wasn't seen any Significant relation. By increasing the salinity of the soil to 150 mM, the salt Content of the leaf showed Significant decreasing. The amount of a chlorophyll showed Significant relation with increasing the salinity of the soil in comparison with control. It wasn't seen Significant relation between 50 to 100 salinity but the lowest amount of chlorophyll A was obtained in 100 mM salinity with 0.3481 mlg of chlorophyll per each gram of wet leaf. By increasing the salinity the amount of chlorophyll B showed Significant decreasing. The highest and lowest amount of chlorophyll was obtained in zero salinity and 100 mM with 0.5705 and 0.2210 mlg of chlorophyll per each gram of wet leaf. Thuna et al., (2008) showed in the investigation of Gibberellic acid effect and salinity on anti oxidants and plant growth parameters of maize that there is Significant decreases in characteristics such as dry weight and the amount of chlorophyll and proportional content of leaf water with increasing the salinity concentration the amount of the chlorophyll that calculated by chlorophyll meter showed that by increasing the salinity amount the amount of the chlorophyll increase too. The lowest amount of chlorophyll was obtained in 100 ml mol salt that had significant differences with others.

The proportion between two chlorophyll in various dosages didn't show significant differences. The amount of the soil salt in leaves increase by increasing the salinity of the soil. The highest amount of sodium was obtained in 100 ml mol salinity. Mourate et al., (2010), in a study of RX947 maize in four salinity levels (25-50-75-100) ml along with one level of salt in control group founded that there is Significant decreases in dry weight of the plant except normal level and 25 ml mol in another levels with increasing the level of soil salinity. In this investigation the chlorophyll A amount showed significant decrees with increasing the amount of the salinity. The amount of chlorophyll B showed significant differences by increasing the salinity, but there weren’t any significant differences between salinity levels. The total chlorophyll amount showed significant differences by

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increasing the salinity amount in both Varieties. Under investigated genotypes showed significant differences with respect of leaf length.

The highest amount of leaf length in 100SC with 00.33 cm was seen. That hadn't significant differences with BC662- S.C 704-SC 301. The lowest amount of the length of the leaf was calculated in Simon with 19.67. Leaf width mean comparison by using Duncan test showed that there wasn't any significant difference in under investigation genotype except simon. The highest amount of leaf width was obtained in SC700 with 8.5 cm.

From the leaf number point of view, there wasn't seen any Significant relation between SC700-SC302-BC666-ZP684-SC301.

The lowest leaf number was seen is simon stem. There were Significant differences between al genotypes with respect of the proportional Content of leaf water except simon. The highest amount for proportional content of leaf water was obtained in SC700 with 84.08.

Chlorophyll A characteristic mean comparison with Duncan test showed a Significant differences. The highest amount of chlorophyll A was seen in BC662 that hadn't Significant differences with SC301-Zp684-SC302-SC700-SC704 genotypes. The calculated Figures showed that there aren't Significant differences between genotypes except simon. The highest amount was seen in Zp684 with 12.58 and the lowest in Simon with 1.556. The lowest amount of chlorophyll A was obtained in Simon with 0.3022 mlg chlorophyll per each g of wet weight of the leaf. From chlorophyll B characteristic point of view, there weren't any significant differences between under investigated genotypes but the highest and lowest amount of chlorophyll B was obtained in Simon and Bc662 respectively. From the proportion between chlorophyll B and chlorophyll A, there wasn't any significant difference between genotypes. The highest proportion was related to ZP684 with 4.262 and the lowest proportion was related to simon with 1.313.

The salinity condition causes to decreasing the leaf length. The highest leaf length was obtained in salt conclusion of 50 mmol to SC 700 with 70 cm length that hadn't significant differences with normal Condition for that variety of 69.33 and salt condition of 100 mmol.

The lowest leaf length was obtained in third salt stress condition in Sc 704 with 19 cm length. From the leaf width point of view there wasn't significant differences between genotypes in normal condition. 100 ml mol salinity causes the decreasing in leaf length of all genotypes. The highest leaf width was obtained in normal condition and in BC662 with 9.8333 cm length and the lowest leaf width was obtained in 100 ml mol salinity in SC 704 with 3 cm width. The highest number of leaf was seen in normal condition in S.C 704 in 100 ml mol salt in soil. The calculated amount of chlorophyll showed that in normal condition there were Significant differences between them except Simon. The highest amount of calculated chlorophyll was in Zp684. The lowest amount of it was in S.C 704 in Salt condition of 100 ml mol. In normal condition, there wasn't Significant there wasn't any Significant differences between genotypes from chlorophyll A characterize tic respect. The highest amount of chlorophyll A was obtained in Normal condition in S.C 704 with 1.27 mlg chlorophyll per each gram of wet weight. The lowest amount of chlorophyll A was seen in salt condition of 10 mmol in S.C 704.

The highest amount of chlorophyll B was obtained in 59 ml mol salinity condition in S.C704 with 0.9987 mlg chlorophyll per each gram of wet weight. The lowest chlorophyll B amount was seen in 100 ml mol salt condition in ZP684 and S.C704. The comparison of reciprocal effect for two chlorophyll's proportion showed that in normal condition, the lowest amount of two chlorophyll was obtained in S.C307 with 0.8167 ml chlorophyll in each g of wet weight. In 50 m mol stress, the highest proportion was obtained in S.C 301 and in 100 mmol stress; the highest proportion was seen in Zp684, per each g of wet weight of chlorophyll.

The table of correlation coefficient between characteristics was calculated and come in table 6. There was positive correlation between chlorophyll meter characteristic with leaf length and leaf width and chlorophyll A, 1% probability level. It means that the amount of chlorophyll meter increase by increasing each of fore mentioned characteristics.

Also there is positive and significant relation between leaf length and leaf width, chlorophyll A and chlorophyll B, between leaf width and chlorophyll A, B and the chlorophyll A/B proportion.

There was significant relation between chlorophyll A and chlorophyll B. In an investigation that had been done by Delaserda et al., (2003, 2005), it was seen Significant relation between A and chlorophyll B. Conducted an investigation about dry stress influence on chlorophyll content of maize. By considering that these characteristics are influential under environmental condition, so they must be repeated in some other places and times. Also, among under invest genotypes in normal condition there was a seen Significant difference in majority of the characteristics that is indicative of high variety of these characteristics.

REFERENCES


Cultivate reformation-university publication centere.


First publication-Esfahan industry university.


Rahimian, Hamid and Mohammad Banaeian, 1996. The physiological basis of plant improvement. The jahd publication of Mashhad.

