A Research on Different Ecological Soil Condition on Level of Catalase Enzyme of Corn Plant

Mina Karimi¹, Ramin Ezati²*

¹. Plant Physiology Msc. Stu. University of Kharazmi, Faculty of Biological Science, Department of Plant Biology. No 43. Mofateh Ave. Tehran/Iran
². Academic Staff, Assist. Prof. University of Kharazmi, Faculty of Biological Science, Department of Plant Biology. No 43. Mofateh Ave. Tehran/Iran

*Corresponding Author email: ezati2000@yahoo.com

ABSTRACT: To study the effect of different levels of salinity on physiological characteristics and the amount of antioxidant enzyme of corn leaves as an indicator of resistance to salt stress, a study in 2013 in agricultural Research Laboratory of Kharazmi University was performed as a factorial experiment and completely randomized with three replications. The experiments consisted of four different levels of salinity (35, 46, 19, 16 dS m). Corn is considered as one of most important crop plants in Iran. And the area under cultivation is 0.25 million hectares and its production is 1.65 million tons. And it allocates the production of 2.8% of all cereal productions. In many areas of agriculture in the world, salinity is considered as one of limiting factors of agricultural production. And it affects 30% of world’s land and in Iran, about 50% of lands under cultivations are faced with the salinity problem. By increasing salinity levels, stomatal conductance, leaf’s relative water content are decreased. Treated samples were trained with system scattering and in perlite medium. The effect of salt stress was observed on the amount of antioxidant enzymes of leaves as meaningful changes. Treated corn shows the highest growth rate compared to other treated samples with Libyan desert, despite having the highest level of salinity.

Keywords: salt stress, physiological characteristic, Corn, antioxidant enzymes

INTRODUCTION

Several environmental factors influence on the growth and finally the production of plants. Drought, salinity and mineral imbalance (component toxicity or lack of it) are the most important factors that influence on their production. Only 10 percent of arable land in the world is free from environmental stress (1,2). Salt and drought are the most extensive factors that create stress in plants in the world. For example, more than 45% of agricultural grounds of world are affected by drought, permanently or frequently (in part of world that about 38% of world population are living in this part). And a large part of the world, more than 3×10⁶ square kilometers with approximately 6% of world’s arable lands are affected by salinity. About one-third of world’s agricultural lands are considerably saline. Annually, about 2 million hectares of world’s agricultural land (about 1 percent) are converted into saline lands which lack of efficiency in crop production or crop production decreases in it, (3). Therefore, the amount of suitable lands for agriculture is reduced. But the human need for food is increasing day by day. Salt as an environmental factor influenced on all stages of plant growth, from seed’s germination to seed or fruit production, more or less. But the plant response to salinity depends on plant type, plant developmental stages, intensity and stress duration (4). Corn is a plant from cereal family with relatively short growing duration and high performance that allocated the second place after wheat of the production rate in surface level and third place of the cultivation surface after wheat and rice. (5). Its adaptation power with different climate conditions is high and is considered one of the main products of temperate and subtropical products. The share of corn in human food supply is about 20-25% and in animal feed is about 60-75% and as a raw material for industrial products is about 5%. In recent years, considerable efforts have been made to develop the production of maize in the country, so the area under maize cultivations from 60000 hectares from 1992 with average yield 4.1 tons reaches to 354000 hectares and average 7.5 tons of grain per hectare in 2007. But, still significant amounts of corn annually imported from abroad. Therefore, it is expected that by using appropriate strategies and due to the climate conditions in different regions of the country, increasing the strategic production is made possible. The purpose of this study was to investigate the effect of soils with different salinity which are collected from different parts of the world that
influence on the growth of Corn plant by using system scattering. The purpose of this study is to study the effect of different salinity soils that are collected from different parts and its effect on corn plant growth by using system scattering.

MATERIALS AND METHODS

Tests were done by providing similar climate conditions in plastic pots with a diameter of 27 cm and a capacity of 8 kg. Perlite was used as the medium. To strengthen and providing required basic elements, 92 g of urea fertilizer plant, 138 grams triple super phosphate and 92 grams potassium sulfate were added to pots containing perlite. Also, in fourth or fifth leaf stage, urea fertilizer was sprayed in pots. The method and calculation style of the amount of fertilizer were conducted according to the pot's area and required seeds per each plant. The seed was prepared as varieties of maize single cross hybrids (KSC704) from the research institute of seed and seedling of alborz province. In each pots, 8 disinfected seeds with TiramaniKarboksin toxin with a depth of 3 to 5 cm in 2013/7/13. Irrigation was conducted until applying salt stress 3 times a week due to the capacity of field for all pots, uniformly. By using 250 grams of Libya soil with 29.95°N and 47.51°E coordinate and India 21.76°N and 78.87°E and Iraq E 32 52 , N 43 3 were taken. In homogenized situations, and by using a 8-liter reactor and 2 projectors with a value of 33000 m²/m³, atmospheric situations were established in research school of biological sciences, university of Kharazmi. Environmental conditions of laboratory with a temperature 25 °C and humidity was 65% and water temperature was 25 ° C, for uniform cultivation of corn plant, perlite medium was used. Medium was placed in darkness for 12 hours and in lightness for 12 hours. In addition, the growth of control samples was conducted by Hoagland solution. By putting the soil in the reactors and put enough light for 120 minutes, and activation of the available bacteria in this solution, the irrigation by using system scattering method was continued.

RESULTS

PH and EC of plant were shown in the sample of desert and Iraq and India and Karaj and Shahed, the largest amount of salinity of soil can be observed in desert example.

<table>
<thead>
<tr>
<th>sample of soil</th>
<th>pH</th>
<th>EC (ds/m)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Libyan Desert</td>
<td>8/2</td>
<td>46</td>
</tr>
<tr>
<td>Iraq</td>
<td>7/73</td>
<td>35</td>
</tr>
<tr>
<td>India</td>
<td>7/44</td>
<td>19</td>
</tr>
<tr>
<td>Karaj</td>
<td>7/39</td>
<td>16</td>
</tr>
<tr>
<td>Control</td>
<td>7/5</td>
<td>27</td>
</tr>
</tbody>
</table>

By conducted measurement, it was obvious that desert soil with PH 8.20 and EC 46 is compared with Karaj soil which has the lowest amounts of PH 7.39 and EC 16. Despite this issue that desert soil has the maximum amount of PH and EC and there was not any negative effect of plant growth.
Table 2. measuring Co$_2$ in the corn plant treated with dust collected from different regions

<table>
<thead>
<tr>
<th>Sample of Soil</th>
<th>Co$_2$ (ppm)</th>
<th>Co$_2$ in Free Air (ppm)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Karaj</td>
<td>490</td>
<td>450</td>
</tr>
<tr>
<td>Libyan Desert</td>
<td>476</td>
<td>450</td>
</tr>
<tr>
<td>India</td>
<td>480</td>
<td>450</td>
</tr>
<tr>
<td>control</td>
<td>481</td>
<td>450</td>
</tr>
</tbody>
</table>

![Figure 2](image2.png)

Figure 2. measuring Co$_2$ in the corn plant treated with dust collected from different regions

It was observed that the sample of Karaj has the highest amount of dioxide carbon than other samples and desert sample which has the maximum amount of salinity degree than other samples, has the lowest amount of pure carbon dioxide and in free air.

Table 3. measuring the average length of corn plants treated with dust collected from various countries

<table>
<thead>
<tr>
<th>Sample of Soil</th>
<th>Length (cm)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Libyan Desert</td>
<td>34</td>
</tr>
<tr>
<td>Iraq</td>
<td>28</td>
</tr>
<tr>
<td>India</td>
<td>24</td>
</tr>
<tr>
<td>Karaj</td>
<td>20</td>
</tr>
<tr>
<td>control</td>
<td>25</td>
</tr>
</tbody>
</table>

![Figure 3](image3.png)

Figure 3. measuring Co$_2$ in the corn plant treated in free air with dust collected from different regions

In this research, desert plant with high salinity was placed in the row of table from the perspective of average length growth. And the soil of Karaj with low salinity should have a better growth. But the results showed that salinity of desert’s soil not only doesn’t reduce the plant growth but increasing the length of plant in this method was observed in compare with other samples of Iraq, India, Karaj and shahed.

![Figure 4](image4.png)

Figure 4. measuring the average length of corn plant treated with dust collected from different regions
The average length growth of treated corn plant from different regions show that despite the desert soil has the maximum amount of PH and EC, and has the maximum length 34 cm, and Karaj sample with lowest amount of PH and EC has the lowest length growth about 20 cm.

Table 4. Chemical and Physical analysis of collected dust from different regions

<table>
<thead>
<tr>
<th></th>
<th>Fe</th>
<th>NO₃</th>
<th>Zn</th>
<th>Cu</th>
<th>Na</th>
<th>Ca</th>
<th>Cr</th>
<th>SO₄²⁻</th>
</tr>
</thead>
<tbody>
<tr>
<td>Libyan Desert</td>
<td>1.07</td>
<td>170.1</td>
<td>0.68</td>
<td>0.07</td>
<td>41</td>
<td>30.1</td>
<td>0.27</td>
<td>2.4</td>
</tr>
<tr>
<td>Iraq</td>
<td>0.44</td>
<td>165.8</td>
<td>0.52</td>
<td>0.05</td>
<td>31</td>
<td>26.1</td>
<td>0.22</td>
<td>2.1</td>
</tr>
<tr>
<td>India</td>
<td>0.12</td>
<td>130.8</td>
<td>0.33</td>
<td>0.04</td>
<td>28</td>
<td>29.3</td>
<td>0.13</td>
<td>1.7</td>
</tr>
<tr>
<td>Karaj</td>
<td>0.1</td>
<td>155.5</td>
<td>0.21</td>
<td>0.04</td>
<td>23</td>
<td>20.1</td>
<td>0.09</td>
<td>1.8</td>
</tr>
<tr>
<td>control</td>
<td>0.9</td>
<td>155.7</td>
<td>0.2</td>
<td>0.03</td>
<td>29.4</td>
<td>20</td>
<td>0.7</td>
<td>1.8</td>
</tr>
</tbody>
</table>

Desert soil falls under stress, less because it has appropriate foods of treated plant and it has a better growth. In the graph, the amount of these elements is specified. Catalase and GPX in plants treated with dust of Libyan desert show a greater amount in compare with treated plants with dust of other regions.

As it can be seen in table 3, the amount of available components in the Libyan desert soil is higher than other soils. So, the soil of Libyan desert has better nutrients to grow plants.

**Catalase enzyme**

The results of this catalase in corn samples showed that the catalase activity of treated plant with Libyan desert dust is more than all the treatments, therefore, the activity of treated enzyme with Libya is about doubled in the control treatment. After this treatment, the enzyme's activity in conducted treatment with dust of Iraq and India are close together and there are not significantly different.
Studies (6) show that increasing salinity leads to significant reduction of catalase activity.

**Oxygen And Reactive Oxygen Species**

During respiration, molecular oxygen accepts four electrons to produce two molecules of H20. However, because of spin restrictions, O2 cannot accept four electrons at once but accepts them one at a time (7). Thus, during the one-electron (univalent) reduction of O2, stable intermediates are formed in a stepwise fashion (Fig. 7).

![Figure 7](image)

**DISCUSSION**

Studying salinity stress was lead to reducing growth parameters in corn plant. Similar to this result, a decrease in growth parameters in many plants such as tomatoes (8), Lentils (9), and Joe(10) have been reported in salinity stress. Generally, salinity stress among plants can lead to drought stress and toxic ion stress. It means that salinity is a combination of two osmotic and ionic salinities. In addition, these two tension lead to secondary stress as oxidative stress (11, 12). Plants in their life environment are influenced by different stress such as salinity, drought, tissue damage (scarring), ozone gas, UV and so on. Salinity stress is one of the most important environmental factors in reducing plant productions (13). This is due to the salinity effect on the physiology, growth and development of plants (14). High salinity is one of the main agricultural problems in many parts of the world and more than half of irrigation systems in the world are affected by salinity (15). In general, the effect of different soils with different salinity degrees on wet and dry weight and plant’s length were significant (16). By increasing, the salinity of soil, the root’s performance is decreased, also, the shoot dry weight shows a positive correlation with soil’s salinity. (17). By increasing the salinity level of soils, the plant growth will be reduced and one of its reasons is reduction of photosynthesis per unit area. Also, decreasing the leaf area of plants caused by salinity stress is another reason to reduction of plant’s growth. Dry weight of plants by increasing the salinity degree of soil shows a descending trend and this is due to the impaired absorption of nutrients required for plant growth. It should be noted that growth of shoots is less affected by salinity (18). Catalase action in plant and animal tissues was first observed in 1818 by Thenard, who noted that such tissues readily degraded hydrogen peroxide, a substance he had also discovered some years earlier (19, 20) first established that the degradation of H2O2 in tissues was due to the effect of an individual, separable enzyme, which he named “catalase.” (21) suggested that catalase is an iron-containing enzyme, because it is inhibited by cyanide. Evidence for its hematin prosthetic group was presented (22). Catalase was first purified and crystallized from beef liver, and its identity was made clear (23). The earliest genetic studies on catalase were reported (24), who demonstrated that blood catalase levels in several animal species are inherited and segregate according to Mendelian rules. Catalase has been found in all plants examined, and has been most thoroughly studied biochemically, genetically, and molecularly in the agronomically important
species *Zea mays* L. (25). That catalases can exist in multiple molecular forms or isozymes encoded by multiple genes, in any organism, was first demonstrated (26) with the maize catalases and has since been found to be the rule rather than the exception, as originally perceived. Plants in their life environment are affected of different stresses such as salinity, drought, tissue damage (scarring), ozone, UV, etc. salinity stress is one of the most important environmental factors to reduce the plant production. (27). This is due to the effect of salinity on physiology, growth and evolution of plants (28). High salinity is one the most important problems of agriculture in most points of world and more than half of irrigation systems in the world are affected by salinity (29).

REFERENCES