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Physiological Separation of Cultivars Tolerant and Sensitive to Salt Stress of Wheat (*Triticum aestivum*) by Cluster Aanalysis

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Introduction

Salinity stress affects 20 % of arable land worldwide and is continuously increasing due to climate change and human activities. After China, India and Pakistan, Iran, having 6.8 million hectares of saline land, is considered the top of the threatened countries in terms of saline tension. Among the environmental stresses in arid regions, salinity has the greatest effect on crops. Salinity stress is considered as a factor limiting the growth and development of plants in arid and semi-arid regions of the world. Salinity is defined as a condition whose electrical conductivity is four ds/m per meter or more. Many studies show that there are significant differences between plant species in terms of sensitivity and tolerance to salinity. Salinity stress causes the accumulation of salt in plant organs, followed by production of active oxygen, production of toxicity, reduction of cell division, ionic imbalance, reduction of water absorption (secondary drought stress), disruption of element absorption, and closing of stomata and finally Reduction of photosynthesis and plant growth. In the conditions of salinity stress, the accumulation of proline and soluble carbohydrates in rice seedlings increased the relative water content and reduced the negative effects of salinity stress on the health of cell membranes. In this study, various traits including root and stem dry weight, leaf water potential, electrolyte leakage, chlorophyll a, chlorophyll b, total chlorophyll, soluble sugars and amino acid proline with the aim of identifying and distinguishing tolerant and sensitive cultivars to salinity stress at the seedling stage. It has been considered on 15 wheat cultivars at three different levels of salinity.

Material and Methods

This research includes greenhouse and laboratory studies, all stages of which were carried out in the research greenhouse and laboratories of Payam Noor Sabzevar University. In this research, 15 varieties and genotypes of wheat (Roshan, Bam, Arum, Pishtaz, Zare, Chamran, Parsi, Behbar, Gascogen, Sirvan, Sivand, Gaspard, Mihan, C-88-4, Sepahan) were studied. The experiment was conducted as a factorial in a completely randomized design with three replications. Root and stem dry weight, leaf relative water content, electrolyte leakage, chlorophyll a, b and total, soluble sugars and amino proline content were measured in different cultivars. Data analysis was done with SAS and Excel statistical software and averages were compared with LSD method (least significant difference) at a statistical level of 5 %. Excel software was also used to draw graphs.

Result and Discussion

Different wheat cultivars do not have the same tolerance to salt stress and this research showed that among the 15 wheat cultivars tested, Mehen, Bam, Pishtaz cultivars have the highest levels of proline, soluble sugars, chlorophyll a, b and carotenoids. They had the tolerance against salinity stress and Gosgogen and Roshan cultivars had the lowest tolerance to salinity stress. The highest amount of chlorophyll a was recorded in Bam and Mihan cultivars and the lowest in Gasgogen and Bahar cultivars. The highest amount of chlorophyll b was observed in Mehen cultivar and the lowest in Gosgogen cultivar. The highest amount of total chlorophyll was recorded in Mihan and Bam cultivars and the lowest in Bahar and Roshan cultivars. Increasing salinity stress in most cultivars caused a decrease in chlorophyll a, chlorophyll b and total chlorophyll. In general, with increasing salinity, the dry weight of root and stem decreased in different wheat cultivars.

In the comparison of the average cultivars in the control treatment, Pishtaz cultivar with 214 and C-88-4 cultivar with 93.65 mmol of proline per kg of dry leaf weight had the highest and lowest proline content, respectively. In the treatment of 5 ds/m, Pishtaz variety with 596 and Gasgogen variety with 108.99 mmol of proline per kg dry weight of leaves respectively had the highest and lowest proline and under 10 ds/m stress, Pishtaz variety with 600 And the variety C-88-4 with 189.87 mmol of proline per kilogram of leaf dry weight had the highest and lowest amount of proline, respectively. The results showed that Pishtaz cultivar had the highest leaf proline content under stress and non-stress conditions. Considering that in this study, several physiological traits were used, therefore, to select the best tolerant and sensitive cultivars to salinity stress in the seedling stage, the method of decomposition into principal components was used. Bam and Mihan cultivars were placed in the first cluster, which indicates the cultivars tolerant to salinity at the seedling stage. Sepahan, Gaspard, Sivand and Pishtaz were placed in the second cluster, Sirvan, Zaria, Erom, c-88-4 and Parsi cultivars were placed in the third cluster, and finally, cultivars

sensitive to salinity stress in the seedling stage were placed in the fourth and last cluster. The names of Gascogen, Chamran, Bahar and Roshan were placed.

Conclusions

The results showed that salinity increased the dry weight of root and stem and decreased the chlorophyll concentration. In salt stress condition, the lowest amount of leaf relative water belonged to Gasgozien cultivar with 15.61 % and the highest amount was Bam with 62.34 %The Mihan and Bam cultivars had the highest levels of chlorophyll a and b. The highest content of relative water content, proline amino acid and soluble sugars was observed in Pishtaz, Bam and Mihan cultivars. The results of cluster analysis showed that Mihan and Bam cultivars had the highest and Roshan, Gasgogen, Bahar and Chamran cultivars had the least tolerance to salinity stress.

Keywords: Amino acid, Soluble sugar, Electrolyte leakage, Stem dry weight, Electrical conductivity.

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Declaration of conflict of interest

The authors of the article declare that there is no conflict of interest in relation to the publication of the presented article.