Identification of Tolerance of Wheat (*Triticum Aestivum* L.) With Different Ploidy under Salt Stress

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Abstract. In this study, different ploidy wheat were used as experimental materials to explore the effects of different concentrations of NaCl stress on (*Triticum aestivum* L.) of different wheat. The effects of varieties, germination period and seedling growth provide a theoretical basis for the cultivation of salt-tolerant wheat varieties. 3AA6, Chinese Spring and longdon were used as experimental materials to analyze the indexes of wheat germination energy, germination rate, root length and high salt tolerance of wheat under different concentrations of NaCl solution stress. With the increase of NaCl salt concentration, the germination energy, germination rate, plant height, root length, seedling and root fresh quality of the three wheat varieties decreased gradually. The effect of NaCl on the growth of wheat seedlings at germination stage was mainly to inhibit the growth of roots and buds, in which the growth rate of roots was inhibited most strongly by salt stress, followed by the growth rate of buds, and the inhibition on the number of roots was the least. There were significant differences among varieties and concentrations. According to the performance of the three experimental varieties, Chinese spring showed strong salt tolerance at seedling stage, longdon showed poor salt tolerance, and 3AA6 showed the worst salt tolerance at seedling stage.

Keywords: Wheat, Salt Stress, Germination Rate, Seeding Stage

1. Introduction

The growth status of wheat in the process of germination directly affects the later growth and yield of crops [1], and one of the main reasons for the reduction of wheat yield is salt stress. Wheat (*Triticum aestivum* L.) is one of the most important crops in China, and it is a moderately salt-tolerant crop [2-4]. Therefore, the morphological indexes studied in this experiment are germination energy, germination rate, vigor index and germination index, seedling height, root length and seedling dry and fresh weight under salt stress [5-6].
Because common wheat is allohexaploid and its genome is huge and complex (40 times of rice genome and 5.5 times of human genome), the research of functional genomics of common wheat lags far behind that of rice and maize, and the complex genetic background has always been a restricting factor [7-8]. It is the bottleneck of the development of gene cloning and molecular design breeding techniques for important agronomic traits [9-14].

The area of saline soil in the world is about $897.0 \times 10^4$ km$^2$, accounting for about 6.5% of the total land area of the world [15-17]. The cultivation of salt-tolerant crops is of great significance for the effective improvement and utilization of saline-alkali land, ensuring food security and maintaining the sustainable development of agriculture [18]. In addition, in the evaluation and identification of salt-tolerant resources, it is necessary to comprehensively consider the contribution of various identification indicators to salt tolerance, so as to more truly reflect the salt tolerance of different varieties and better serve the development and production of agriculture.

2. Materials and Methods

2.1 Materials

The seeds of different wheat varieties to choose same size 50 grain, chooses to complete, the seeds of the first 3 wheat varieties were selected seeds with 1% HClO solution of 5 min, and then rinse with distilled water, 5 times for germination experiment, (HClO is a weak acid solution, have a very pungent odor, is not stable, easy to decompose, kept at low temperature in the brown bottle, so to match current) now.

2.2 Methods

In the course of the experiment, four kinds of NaCl concentration gradients were set, which were 100, 200, 300, 400 mmol / L respectively, and distilled water was used as the control. Two layers of filter paper are padded at the bottom of the germination box, and the above-mentioned NaCl solution is poured into the germination box when the filter paper is immersed and the seeds can be contacted. First, 50 seeds of different wheat varieties are counted and placed in the previously treated germination box, covered, and then the germination box is placed in a constant temperature incubator. Under the condition of 25°C, light for 16h and darkness for 8h, the germination box is cultured for 3 times. During the period of culture, it was observed and recorded every day that when the height of the seedling reached the top bud cap, the lid should be opened so as not to affect the growth of the seedling in the later stage, and the hydroponic solution that was evaporated and absorbed should be added to prevent the seed from losing water and drying. The corresponding concentration of salt solution was added to the corresponding germination box, and the corresponding indexes were counted on the 8th day.

2.3 Detection of Seed Germination Rate and Identify Phenotype of Wheat Seedings

To determine the germination potential and germination rate of wheat seeds, it is necessary to determine whether the seeds reach the standard of germination. When the germ reaches more than half of the seed length or the radicle reaches the seed length, the germination is regarded as germination. When the seeds germinated to the 4th day, the germination number of each treatment and control was recorded, and the germination energy was calculated. When the seeds germinated to the 8th day, the germination number of each treatment and control was recorded, and the germination rate was calculated.

After the germination experiment, 10 seedlings were randomly selected from each repeat in each treatment, the plant height and root length were measured, and the root number was counted. Form the recorded data into a table.

3. Results and Analysis
3.1 Effects of Sodium Chloride Stress on Germination of Wheat Seedlings

As shown in figure 1, the germination number of different concentrations of NaCl was lower than that of the control group, and decreased with the increase of NaCl concentration. When the salt concentration of 100mmol/L was compared with that of the control group, the difference was not significant, but with the increase of salt concentration, the salt tolerance of longdon was stronger under the high salt stress of 200mmol/L, and the salt tolerance of the other two varieties decreased significantly. There was a significant difference among the three wheat varieties, and different wheat varieties did not germinate when the salt concentration was higher than 300mmol/L, and the time of reaching the maximum germination rate in different treatment groups was delayed with the increase of NaCl concentration.

![Figure 1. Effects of salt stress on germination of wheat seeds of different varieties (A) germination number (B) germination rate](image)

3.2 Effects of Sodium Chloride Stress on the Growth of Wheat Seedlings

The growth status of wheat seedlings also grew slowly and gradually decreased with the increase of salt concentration, and finally stopped growing, indicating that salt concentration had a certain inhibitory effect on the growth of wheat seedlings. Compared with the control group, NaCl solution had obvious inhibitory effect on plant height and root length of seedlings. Under the salt concentration of 100mmol/L, there was no significant difference among the three wheat varieties, but the difference was significant at high salt concentration until they did not germinate and grow. Through the comparison of the two maps, the salt tolerance of 3AA6 among the three wheat varieties was the worst, and it was the most sensitive to salt stress. Chinese spring had the best salt tolerance under low salt concentration, and had a certain resistance to salt stress. High salt concentration significantly inhibited the non-germination of wheat seeds, and there were significant differences among the three wheat varieties (Figure 2).

![Figure 2. Effects of salt stress on seedling length (A) and root length (B) of different wheat varieties](image)
3.3 Effects of Sodium Chloride Stress on Biomass of Wheat seedlings
The dry and fresh weight of wheat seedlings decreased or even stopped growing with the increase of NaCl concentration, and the higher the concentration was, the stronger the inhibitory effect was. The results showed that the damage degree of NaCl to wheat seed embryos increased with the increase of NaCl concentration (Figure 5, 6). And under the salt concentration of 200mmol/L, the salt tolerance of wheat varieties was very prominent, especially in Chinese spring, the salt tolerance was the best, the degree of inhibition was not obvious, and the salt tolerance of 3AA6 and longdon was very poor. The results of combining 4 two diagrams showed that Chinese spring had strong salt tolerance at low salt concentration, while 3AA6 was the most sensitive and inhibitory, and showed significant differences among the three varieties. The salt stress of wheat varieties was the most serious at high salt concentration, and the seeds of different wheat varieties did not germinate (Figure 3).

![Figure 3. Effects of sodium chloride stress on biomass of wheat seedlings(A)fresh weight(B)drying weight](image)

All the measured indexes of different wheat varieties decreased with the increase of NaCl concentration, and the higher the salt concentration, the stronger the inhibitory effect on seeds. Under the salt concentration of 100mmol/L, the three varieties were not significantly inhibited by salt stress, but when the salt concentration was higher than 100 mmol/L, there were significant differences among the three varieties, and finally stopped growing, so the order of salt tolerance of the three wheat varieties was as follows: Chinese spring > longdon > 3AA6.

4. Discussion
4.1 Effect of Sodium Chloride on Germination Percentage of Wheat Seeds
With regard to the effect of salt stress on plant seed germination, some people think that under salt stress, no matter high or low salt concentration, it will inhibit plant seed germination to varying degrees, and then reduce the germination rate [19-23]. Under the salt concentration of 100mmol/L, there was almost no effect on the germination of wheat seeds, and there was no obvious change compared with the control group. With the increase of salt concentration, the salt tolerance of Chinese spring was hardly inhibited under the salt concentration of 200mmol/L, while the salt tolerance of 3AA6 and longdon changed significantly [18,24-25]. The seed germination of three wheat varieties was affected in different degrees, and the higher the salt concentration was, the more significant the decreasing trend of seed germination rate was (Figure 2). The inhibitory effect of low concentration salt stress on seed germination rate was very weak, the performance was not obvious, high concentration salt stress inhibited seed germination significantly, and the seed did not germinate at last.

In the experiment, the concentration of NaCl salt had a certain inhibitory effect on the germination rate of wheat, and different concentrations of salt solution had different inhibition degree on the germination rate of different wheat varieties. When the salt concentration is 0%, all kinds of wheat seeds can germinate normally, and the germination rate is 100%. 3AA6 was extremely sensitive to salt
concentration. Chinese spring showed that salt stress was not obvious at low concentration, but its germination was seriously inhibited under higher concentration of NaCl stress. High concentration of salt stress had obvious inhibitory effect on the germination rate of Longdon. Compared with Chinese spring, the salt tolerance of Chinese spring was better than that of 3AA6 and Longdon.

4.2 Effects of Salt Stress on Germination Potential, Germination Index and Vigor Index of Wheat Seeds

With the increase of NaCl concentration, the decrease of germination energy, germination index and vigor index increases [26-28]. The germination potential, germination index and vigor index of NaCl were inhibited in different degrees under salt stress, and the inhibitory effect on seed germination was significantly enhanced with the increase of NaCl stress concentration. Chinese spring had the best salt tolerance, followed by Longdon, and 3AA6 was the most sensitive to salt stress.

The results of all maps showed that under the salt concentration of 100 mmol/L, the decrease of all measured indexes of wheat varieties was not obvious, and the inhibitory effect of salt stress was weak. Under the salt concentration of 200 mmol/L, the measured indexes of wheat varieties decreased significantly, and the inhibitory effect was significant, while with the increase of NaCl concentration, the three wheat varieties did not germinate at high salt concentration. The higher the ploidy of wheat varieties is, the better the salt tolerance is, the more significant the inhibition of salt stress on wheat seeds is with the decrease of ploidy, and the salt tolerance of high ploidy wheat varieties is the best.

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