Study on the Growth of Alfalfa Seeds Under Different Salt Concentration

Hongquan Liu [a], Hua Fan [c], Da Fan [b], Renqiang Chen [d,*]

School of urban and rural construction, Agricultural University of Hebei, Baoding 071000, China

[a]50081999@qq.com, [d]517656726@qq.com

Abstract

Soil salt stress has an important effect on crop root growth, and seed germination and seedling growth are also the most critical stages of plant growth, which determines the subsequent growth of plants. In order to investigate the germination and growth process of alfalfa seeds under different salt stress conditions and the physiological mechanism of salt tolerance, this experiment takes Medicago sativa L.cultivars:zhongmu No.3 as the research object, using NaCl as the stress salt of seed germination, With distilled water as the control (CK,NaCl concentration 0 mmol/l), 6 different NaCl concentration treatments (25,50,100,150,200,250 mmol/l) were set up, with 4 repetitions per treatment setting. Seed germination test was carried out in the inner constant temperature illumination incubator of the petri dish, and the number of seeds sprouted under each treatment was observed and recorded at a fixed time point on a daily basis. After a 10-day test, the index of root length, embryo axis length, leaf area and dry matter amount of bud was measured and analyzed. The results showed that when the salt concentration is more than 25 mmol/L, the length of root length and hypocotyl and the leaf area of seedlings decrease with the increase of NaCl concentration, when the salt concentration reaches 100 mmol. At /L, the growth of the leaves has been completely inhibited. With the increase of NaCl concentration, the accumulation of leaf-light contracted compounds increased first, then decreased and then increased.

Keywords

Salt stress, dry matter quality, root length, hypocotyl length, leaf area.

1. Introduction

Nowadays, the area of saline-alkali land in the world is nearly 9.542238 billion hm2, and its area is still rising, which seriously affects the construction of ecological environment and agricultural production and regional economic development. The problem of land salinization has always been one of the major problems plaguing agricultural development [1]. The impact of salinized land in China is a major problem. China faces the challenge of huge cultivated land area and grain production. Even though China's total cultivated land is the third in the world, the per capita cultivated land is only 0.09 hm2, which is insufficient for the world's per capita cultivated land. Half of [2]. With the continuous increase of China's population and the rapid development of industrial industry, the area of arable land is decreasing sharply, while irrational irrigation has caused secondary salinization of a large number of farmland [3] [4]. Therefore, the restoration and reconstruction of saline-alkali land has become the main task of scientific research and production.

Planting and breeding high-quality leguminous grasses with high salt tolerance and high protein content is one of the feasible ways to solve the shortage of protein feed and improve saline-alkali soil [5]. Alfalfa has the reputation of “king of grass”. Alfalfa is the perennial herbaceous forage in the world. It is the preferred forage to increase the protein content of forage, and the salt tolerance of alfalfa is stronger in legumes. Long-term planting can promote the accumulation of soil organic matter in the soil and thus improve the soil. During the process of growth and development of plants, the period of seed germination and seedling growth is highly sensitive to the environment and is one of the most important stages of plant survival [6]. This experiment was conducted to study the salt

tolerance of NaCl during the long period of seed germination, which will provide an effective theoretical basis for the cultivation and development of alfalfa under salt stress. The salt content of irrigation and the salt content in soil are one of the key factors affecting the growth of crops. The suitable salt concentration range for seed germination and growth is to prevent damage caused by excessive salt ions on seed germination and emergence, and also in agricultural production. The prerequisite for improving the utilization of seed resources.

2. Materials and Methods

2.1 Experimental Materials

The experiment was conducted from October 1st to October 15th, 2018 at the Jujube Central Laboratory of Hebei Agricultural University. The experimental materials were selected from the seeds of Zhongmu No. 3 alfalfa germinated after treatment with 6 different NaCl concentrations. The instruments, equipment and software required for the experiment include: millimeter calculation paper; camera; computer CAD software; electronic balance; laboratory drying oven (DHG-9030A).

2.2 Experimental Design and Method

In the experiment, NaCl was used as the stress factor salt for seed germination, and a total of 7 treatments were set. Distilled water was used as control (CK, NaCl concentration 0 mmol/L), and 6 different NaCl concentrations were treated (T1-T6: 25, 50, 100, 150, 200, 250 mmol/L, respectively), as shown in Table 1. Set 4 repetitions per process. (Additional experiments were carried out in clean water to germination of 50 seeds, after which the seed coat was removed, dried and weighed, and four replicates were performed.)

Tab.1 Concentration of NaCl with identifier of different treatments

Processing number	NaCl concentration
CK	0 mmol/L
T1	25 mmol/L
T2	50 mmol/L
T3	100 mmol/L
T4	150 mmol/L
T5	200 mmol/L
T6	250 mmol/L

On the 10th day of the experiment, the germination was stopped, and 15 germinated seeds in each dish were separated, and the buds, hypocotyls, and roots were separated, placed on a millimeter grid, and imaged by image method. The CAD software measures the long leaf area and other indicators; the number of germinations is less than 15 and all of them are recorded and measured, and finally the average is obtained. Finally, the germinated cockroaches collected in different culture dishes were placed in envelopes, and the dry matter was measured after drying. The experiment was then carried out in clean water to germination of 50 seeds, after which the seed coat was removed, dried and weighed for four replicates.

2.3 Experimental Measurement Index

Root length, hypocotyl length, leaf area, dry weight.

2.4 Statistical Analysis of Data

Adopt SPSS19. 0 Statistical software One-way analysis of variance was performed on seed leaf area, root length and dry weight of different NaCl concentrations. Linear regression analysis was performed on germination rate, germination index and Na Cl concentration, and Excel was used for mapping.

3. Results and Analysis

3.1 Effects of Different Concentrations of NaCl on the Radicle Length of Zhongjing No.3 Seed Hypocotyl

Table 2 and Table 3 are the test tables for the variance of the length of the hypocotyl and the root length of the Zhongqi No. 3 germinated under different concentrations of NaCl. Among them, the variance of the data between the treatments of the hypocotyl length did not satisfy the homogeneity hypothesis (P=0.036<0.05), and the variance analysis can be performed by Tamhane's T2 test.

Tab.2 Homogeneity test of variance of hypocotyl length

VAR00002			
Levene Statistics	df1	df2	Significant
3.209	5	15	.036

The variance of the data between the root lengths satisfies the homogeneity hypothesis (P=0.100<0.05), and the Duncan method can be used for variance analysis.

Tab.3 Homogeneity test of variance of root length

VAR00002			
Levene Statistics	df1	df2	Significant
3.003	2	9	.100

The seed embryo length, root length and one-way analysis of variance of each treatment seed are shown in Fig.1. It can be seen from the observation image that the root length and the length of the hypocotyl are decreasing with the increase of NaCl concentration. When the concentration reached T3 (100 mmol/L), the seed germinated with a sprout (hypocotyl), but the seed did not develop root due to the inhibition of salt concentration; when the concentration reached T6 (250 mmol/L), the seed had already There was no germination due to the inhibition of salt.

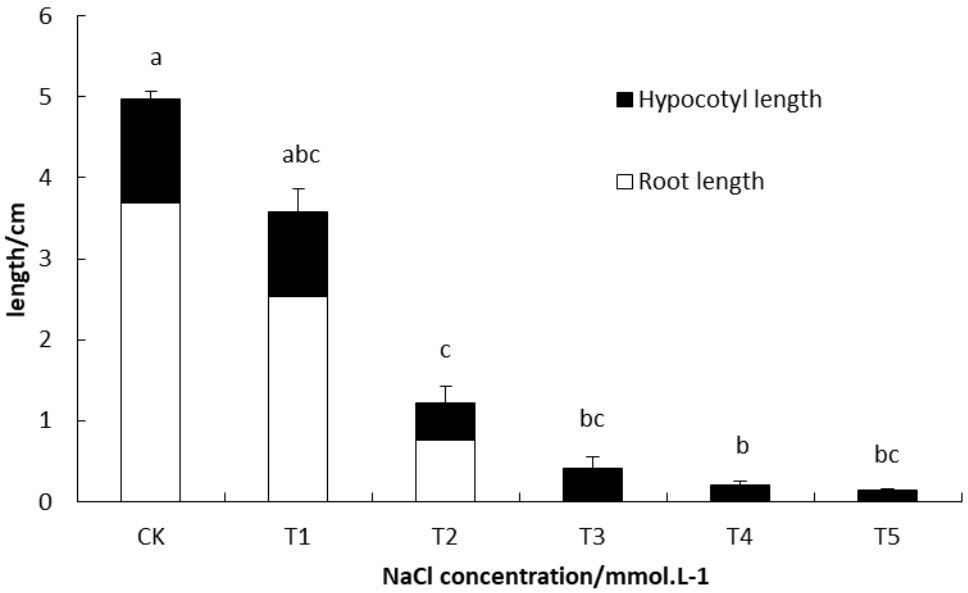

Fig.1 Effect of concentration of NaCl on seed hypocotyl and root length in Medicago sativa

Note: Different letters within the picture mean significant difference between the treatments at the 5% level. The same as below.

3.2 Effects of Different Concentrations of NaCl on the Leaf Area of Zhongjing No.3 Seed after Germination

By observing the change of leaf area after seed germination in Fig. 2, it can be concluded that the leaf area under CK treatment is smaller than the leaf area value under T1 treatment, and under T2 treatment, the leaf area value is greatly reduced, which indicates that When the salt concentration is low, a small amount of ions will promote the growth of the leaves, and when the salt concentration is greater than 50 mmol/L, the salt will inhibit the growth of the leaves. As the salt increases, the salt concentration reaches 100 mmol/L. At the time, the growth of the leaves has been completely inhibited.

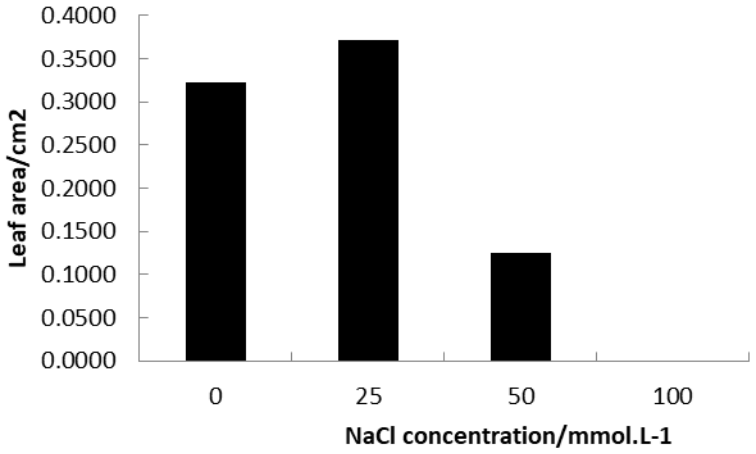

Fig. 2 Effect of different NaCl concentrations on the leaf area of alfalfa seeds

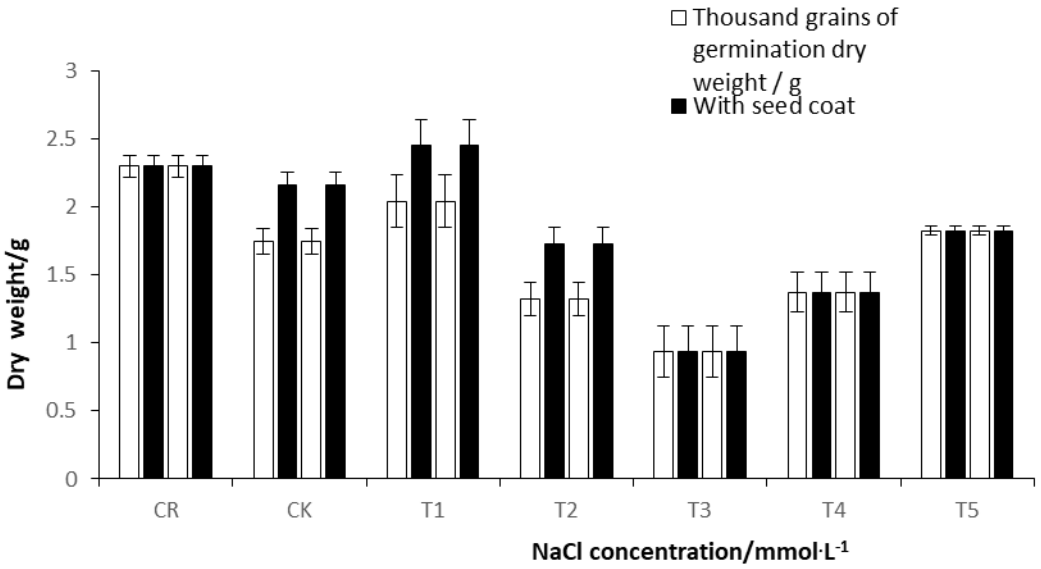

Fig.3 Effect of different NaCl concentrations on the dry matter accumulation of alfalfa seeds

3.3 Effects of Different Concentrations of NaCl on the Dry Matter Accumulation of Zhongmu No.3 Seed

Under different NaCl stresses, the accumulation of photo-contracted ruthenium is shown in Fig. 3. With the increase of NaCl concentration, the accumulation of photo-contracted samarium increased first and then decreased, and the germination of single germination was too small, which was converted into 1000 tablets. The value is compared. Under CK treatment, the seed consumes

assimilates, and its dry matter decreases; CK-T1 stage, dry matter increases, medicago lacks ions under the action of distilled water, and its growth needs to absorb a part of Na^+, Cl^-, Na^+, Cl^- regulates plant growth. As the salt concentration continues to increase (T2), the germination process is delayed. On the seventh day, the cotyledon is just opened, and the photosynthesis is affected by the salt concentration, but the photosynthesis is slower, and the photo-contracted product is higher than the seed germination process. In the T3-T5 stage, photosynthesis could not be carried out because no cotyledons were grown. Under the toxic effect of salt, the amount of roots and hypocotyls consumed by assimilates decreased, and the dry weight increased.

4. Discussion and Conclusion

This study showed that the germination growth of plant seeds under different NaCl concentrations was affected to varying degrees, and the low concentration (less than or equal to 25mmol/L) had a certain promoting effect on the germination and growth of forage seeds. With the increase of salt concentration, the length of root length and hypocotyl of alfalfa seeds and the leaf area value of seedlings showed a downward trend. When the salt concentration reached 100 mmol/L, the growth of leaves was completely inhibited. With the increase of NaCl concentration, the accumulation of leaf-light contracted compounds increased first, then decreased and then increased.

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