

Research on screening of suitable forage grasses in coastal saline - alkaline soil

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Abstract: The screening of salt-tolerant plants can provide suitable tree species for the afforestation of coastal salinity and maintain biodiversity and ecological stability. The research was based on the study of seven grasses, such as high fescue, the bermuda grass, the thyme, the rye grass, the precocious grass, the third leaf, and the red three leaves. Each pasture was planted in three different kinds of soil, such as salt alkali soil, salt alkali soil + ecological bag and non-saline alkali soil. The effect of salt alkali soil on germinating time, germination rate and grass growth was analyzed. The effects of ecological bag on soil salt and the growth and germination of grass was also analyzed in order to provide the reference basis for the widespread and systematic selection of salt-tolerant plants, with the grass being selected for the suitable ecological bag.

1. Introduction

Soil salinization is a worldwide problem about resource and ecology. There are about 1 billion hectares of saline soil in the world, spreading across more than 100 countries and regions. At the same time, the global salinity field is growing at a rate of $1 \times 10^6 \sim 1.5 \times 10^6$ hm² per year. Saline soil area in China is 3.47×10^7 hm², widely distributed in various coastal solonchak, with a total area of up to 5×10^6 hm². The soil salt content of the coastal saline area is higher, the land productivity is low, the vegetation is difficult to be established, and the quality and quantity of afforestation are seriously restricted. The monotony of tree species limits the development of forestry in coastal salinity. The urgent task is to select a number of green plants that are suitable for the growth of coastal salinity by means of introduction, domestication and cultivation.

Liu et al. investigated the application of saline-alkaline soils afforesting plants in Tianjin Tanggu District, Shandong Dongying City and Hebei Huanghua City, pointing out that there were 87 kinds of green plants of saline-alkaline soils in the area. Of these, only 27.5% were able to tolerate moderate saline, and most plants had only mild saline. The ability of salt tolerance of plants under different saline conditions was evaluated by Lu et al, and 24 species of salt-tolerant plants were selected for the soil salt content of 6kg. The leaves of six species of monocotyledons in the gold coast natural reserve were dissected in the study of Zhang et al. Xie et al. defined the nine representative salt-tolerant plants' salt-tolerant ability on the Yellow River delta coastal solonchak through the salt pond water brine field simulation test and field test. Zhang et al. screened 8 kinds of strong salt resistance of plants and 7 kinds of moderate salt-tolerant plants through hydroponic experiment and according to these factors such as the growth of the new tip and the number of new roots and the leaves color. Kang et al. authenticated salt tolerance of 57 kinds of plants in coastal saline areas, screening 36 kinds of



groundcover plants suitable for coastal saline area application such as Eight baojing, yarrow, blue butterfly iris et al. John. A study the salt-tolerant responding to white bone in red tree plants shows that the porosity and photosynthetic capacity of the gas under the stress of salt are combined to limit the rate of assimilation. Xie et al. indicated that the relative conductivity and plant survival rate can be used as a target for the screening of salt-tolerant plants by using the salt stress test of 12 varieties of alfalfa. Wang and others believe that biological and biochemical indicators are more meaningful than genetic markers for salt tolerance of tree species. Vasudevan.D and other people think that under the conditions of salinity, the plants can be alleviated or avoided by osmosis. This experiment is mainly about the suitability of soil grass species in the coastal salinization area, and screening the pasture that is suitable for the cultivation of ecological ditches in the coastal area.

2. Designs and methods of experimental

2.1 Materials and methods of experimental

The use of ecological bags is a method of ecological channel construction, and it is widely used, but it is used less in coastal salinity. Therefore, this experiment is mainly to select the pasture that is suitable for planting in the ecological bag and is resistant to salt and alkali. The main materials of this experiment are flowerpots, watering can and testing soils (moderate saline soils near from Tianjin Beidagang reservoir, the non saline soil from Tianjin agronomy test base of farmland water cycle as a contrast), ecological bags, grasses (high fescue: GYM, bermuda grass: GYG, Poa pratensis: BXC, rye grass: HMC, precocious grass: ZSH, White clover BSY, red trifoliolate: HSY.) cultivate environment (laboratory culture), thermometer. The experimental materials are prepared to be carried back to the water resources institute of Tianjin Agricultural University.

2.2 Experimental designs

The experiment was carried out from October 2015 to April 2016 at the experimental teaching and demonstration center of water resources Institute of Tianjin Agricultural University. The experiment was set up for 21 treatments (Table 1), each processing contains three repetitions. There are seven species of grass, each of which is grown in three different soils.

Table 1. Test treatment

Grass species	High fescue	Cynodon dermatitis	Poa pratensis	Poa pratensis	Ryegrass	White clover	White clover
Ecological bag of saline soil	GYM1	GYG1	ZSH1	BXC1	HMC1	BSY1	HSY1
Saline soil	GYM2	GYG2	ZSH2	BXC2	HMC2	BSY2	HSY2
Test soil	GYM3	GYG3	ZSH3	BXC3	HMC3	BSY3	HSY3

2.3 Observation projects

The main observation projects are: high plant, soil salt content, soil moisture content and environmental temperature. Soil salt content, soil moisture content and soil temperature are measured by soil three-parameter measuring instrument (USA). The ecological bag is made On November 19, 2015, then being soiled. Tall fescue, Cynodon dactylon, Paspalum notatum, ryegrass and Poa pratensis are planted on November 20. White clover and red three Leaves are planted on November 27, labeled in the corresponding cultivation pots to observe the growth status and test the ambient temperature (15.2 °C).

3 Results and analysis of experiment

3.1 Effects of Different Treatments on Forage Germination Time

Table 2 shows the comparison of germination time for different pastures under different treatments. As you can see from the table, HMC3 germinated in the sixth day after planting, in the eighth day, the

HMC2 germinated, and the GYM3 also germinated at the same time. In the 11th day, GYM2, HMC1 germinated, and ZSH3 began germination, when the HMC3 grew in length between 7 and 10mm, as shown in figure 2. GYM3 shoot height is around 7mm, the bud area is considerable. Until the 13 days of trial, GYM all sprouted under three cultivating soil, growing fast and the order of germination are the non saline soil, the saline soil, ecological bag of saline soil. In the same period, ZSH2 had sign of germination, with about 5 mm height of ZSH3 at this time.

Table 2. Comparison of germination time for different pastures

Germination time	Day 6	Day 8	Day 11	Day 13
Processing	HMC3	HMC2	HMC1	
		GYM3	GYM2	
			ZSH3	ZSH2

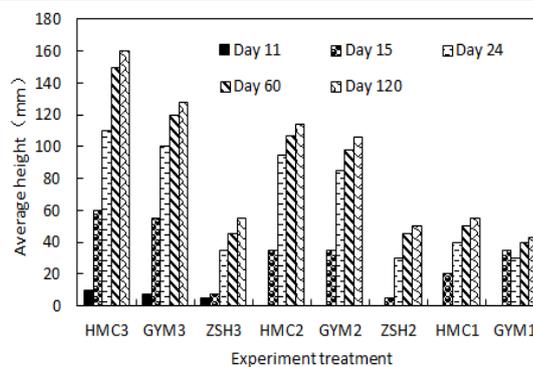


Figure 1. Comparison of plant height in different treatment conditions

Test for 15 days, average plant (HMC3) height is recorded 60 mm, HMC2 is 35mm, number HMC1 out of ecological bag quantity is less, there are seven or eight root, average plant height is 20 mm. The order of budding rate under three kinds of cultivating soil is the non saline soil > the ecological bags saline soil > the saline soil. In the experiment, ZSH3 was high in bud, 7mm in plant height and ZSH2 plant height is 5mm. BSY and HSY germinated in the fifth day of planting, and because of their own properties, they were unable to grow out of ecological bag. In the 24th day of planting, plant high of HMC3, HMC2, HMC1 are 110mm, 95mm, 40mm, plant high of GYM3, GYM2, and GYM1 are 100mm, 85mm, 30mm, plant high of ZSH3, ZSH2, ZSH1 are 35mm, 30mm, 0mm.

With the passage of time, the forage plant height were higher, the germination in the non saline soil treatment is earlier. For saline soils, pasture growth has certain inhibitory effect; the effect of the inhibition of perennial ryegrass is minimum, followed by Kentucky bluegrass and tall fescue. From the experimental results, the tall fescue and perennial ryegrass can not only grow in saline soil, also can grow in ecological bags filled with saline soil, the seedling can penetrate the ecological bag. Although Kentucky bluegrass, red trilobites and white clover can also grow in saline soil, but its penetration ability is weak, not appropriate in ecological planting in bag, the rest of the pasture are not sprout due to temperature.



Figure 2. Day 15 GYM3



Figure 3. On the 15th day of the HMC from the inside out 3 and 2

3.2 Variation of soil salinity in different treatments

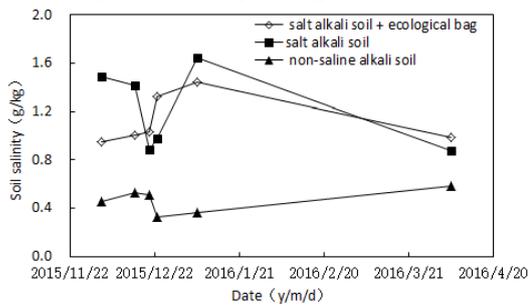


Figure 4. Variation of soil salinity in Poa pratensis

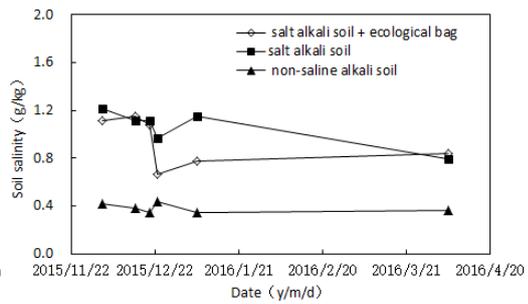


Figure 5. Variation of soil salinity in Bermuda grass

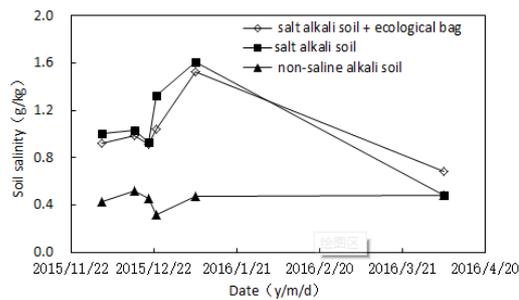


Figure 6. Variation of soil salinity in tall fescue

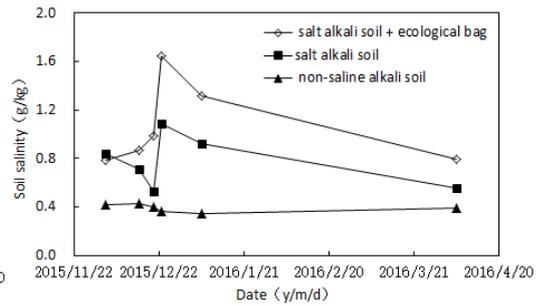


Figure 7. Variation of soil salinity in Paspalum notatum

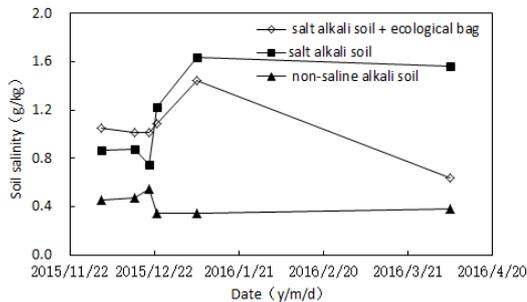


Figure 8. Variation of soil salinity in ryegrass treatment

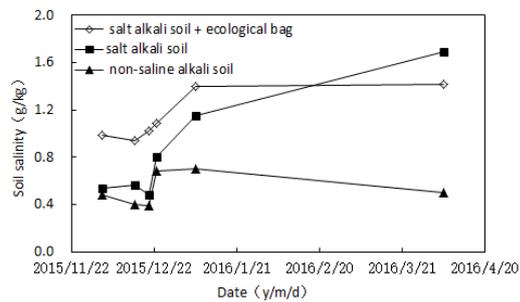


Figure 9. Variation of soil salinity in red clover

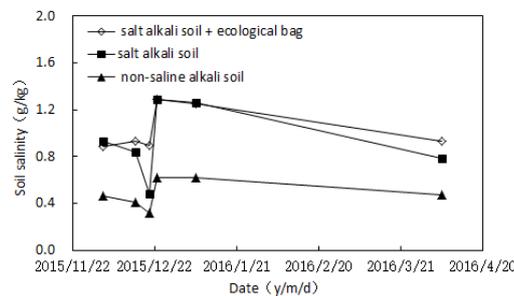


Figure 10. Variation of soil salinity in White clover

Figure 4 - Figure 10 depicts the variation in the amount of salt in the soil under different treatment. It can be seen from the figure that the non-saline soil from the agricultural water circulation base of Tianjin Agricultural College has changed the soil salinity during the whole experiment, but less than 1g / kg, which belongs to non-saline soil. The salt content of saline soil from the port and the saline soil in the ecological bag also fluctuated during the whole test period, but the average salt content was reduced, which was due to the control of irrigation during the test, To ensure that after irrigation soil moisture and salt does not seepage, to ensure the characteristics of saline soil. It can be seen from the figure that during the experiment, the soil salinity fluctuates mainly due to the effect of irrigation on soil salinity, and the salinity of the surface soil will decrease after irrigation, and then the soil salinity will be affected by the evaporation showing an increasing trend. It can be seen from the figure that the ecological bag has little effect on the soil salt.

4. Conclusions

Based on the experimental study on the cultivation of seven pastures in saline soil, saline soil + ecological bag and non - saline soil, combined with the growth habit of different forage, the following conclusions can be drawn:

- (1) Saline soil had some influence on the germination time, germination rate and growth status of forage, and the soil salinity could inhibit the germination time and growth of forage.
- (2) Ecological bags have no barrier to soil salinity, and there is no significant difference in soil salinity between inside and outside the ecological bag.
- (3) Ecological bags affect the growth of pastures, especially germination, *Poa pratensis*, red clover and white clover, although suitable for growth in saline soil, but it cannot penetrate the ecological bag.

In summary, it is recommended to plant ryegrass and tall fescue, both in the growth of saline soil and penetrating the ecological bag.

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