Experimental Study on Ecological Restoration of Glycyrrhiza Uralensis in Yulin Sandy Grassland

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Abstract: Aeolian sandy grassland area is the main geomorphic type in the north of Yulin. The ecological environment is fragile and the problem of desertification is serious, which needs to be controlled urgently. The introduction of herbs is considered to be an effective means to control the sandy beach area. In this paper, licorice was selected as the indicator crop, and the introduction performance of licorice under different treatments in Yulin Sandy Grassland was observed through field experiment. The results show that: (1) after treatment, the physical structure of aeolian sandy soil is effectively improved. Compared with the control, the moisture content, temperature and porosity of aeolian sandy soil increased in varying degrees, which were 31.62%, 5.12% and 5.26% respectively, and the soil bulk density decreased by 4.08%. (2) After treatment, the chemical structure of aeolian sandy soil was significantly improved, the electrical conductivity, soil organic matter and nutrients were significantly increased, which were 22.63%, 21.09% and 4.66% respectively, and the pH decreased by 2.51% compared with the control group. (3) The treatment group could effectively improve the plant height, rejuvenation rate and coverage of Glycyrrhiza uralensis by 14.95%, 29.79% and 41.40% respectively.

1 Introduction

Soil is the root of all things, nourishing the whole earth's ecosystem, and more than 90% of human materials come from soil. However, with the continuous development of society, the rapid expansion of industrialization and the emergence of irrational farming and other problems, resulting in a sharp decline in soil quality, soil degradation problems are becoming increasingly serious, of which soil sanding is one of the more serious consequences of degradation [1].

Soil sanding is the process of sanding after the clay particles in the soil become less due to soil erosion. Desanding can lead to a decrease in the physical and chemical properties of the soil and even loss of agricultural use, causing great losses to the economy [2-3]. According to research, soil degradation leads to the release of large amounts of CO2 gas in the soil into the atmosphere, accelerating global warming and causing serious harm to the earth's ecosystem. Therefore, soil degradation is a major environmental problem common to mankind today [4-6]. Yulin city is located at the edge of the Mawusu sandy area, which has significant ecological vulnerability. The wind-sand grassland area is the main landform type in the north of Yulin, accounting for about 42% of the total area of Yulin city, and the ecological environment is relatively harsh. There are a series of problems such as lack of soil colloid in the wind-sand soil, resulting in poor water and fertilizer retention, loose soil texture and low organic matter content, which greatly limit the ecological construction and high-quality development of Yulin. In contrast, herb priming is considered to be an effective means to manage the wind-sand grassland area, and herbs are more suitable for priming because of their easy survival and low maintenance costs compared to trees and shrubs [7-8].

Therefore, this paper aims to provide scientific basis for the introduction and management of Yulin wind-sand grass beach area by observing the performance of coarse hairy licorice in Yulin wind-sand grass beach area under different treatments in field trials.

2 Material and Method

2.1 Experimental sites

The test site is located at the junction of the northern Loess Plateau and the southern edge of the Mawusu Sands (longitude 109°53′12″, latitude 38°36′50″), in the middle temperate zone, belonging to the arid and semi-arid continental monsoon climate, with low rainfall, sufficient sunshine hours, annual sunshine hours up to more than 2,700 hours, and abundant light energy resources, resulting in high evaporation and dry climate. The average temperature in the last 20 years is 8.6℃, the extreme maximum (low) temperature is 39.2℃ (-32.6℃), rainfall is mainly concentrated in July to September, the average annual rainfall is 430.1mm, the annual evaporation is 1770.1mm, much larger than the rainfall, the frost-free period is 150d/a, the average altitude is 150d/a, the average altitude is 150d/a, the average altitude is
1200m. The seeds for testing are from a company in Yulin.

2.2 Experiment design

The experiment was a randomized group design with three replications and two irrigation gradients, one for the control group and one for the treatment group. The control group was watered once a day after sowing and kept for a week and then stopped, while the treatment group was continuously watered twice a week after sowing. The planted crop was coarse hairy licorice, and germination tests were conducted indoors before planting. The seeds were first soaked in 0.5% potassium permanganate solution for 2 h, removed and washed with water, and then applied to the corresponding plots by spreading, and watered promptly after sowing. The seed application rate was 20 g/m², the row spacing was 10 cm, the planting depth was 1 cm, and the sowing time was August 11, 2021, and the rainfall and temperature changes during the trial period are shown in Figure 1.

![Figure 1](image1.png)

Figure 1  Variation of rainfall and temperature during the test period

2.3 Indicator measurement

Indicators are measured once a month, soil moisture content is measured by drying method, soil bulk and porosity are measured by ring knife method (V=100cm³), soil temperature is measured by sensor, soil pH is measured by potentiometer method (soil to water ratio 1:2.5, OHAUS ST210 pH meter), organic matter is measured by sulfuric acid-potassium dichromate external heating method, fast-acting potassium is measured by NH₄OAc leaching - The effective phosphorus was determined by sodium bicarbonate extraction - molybdenum antimony anti-spectrophotometric method, and the hydrolytic nitrogen was determined by alkaline diffusion method. Plant cover was determined by visual inspection, plant height was determined by five-point sampling method, and biomass could be measured by drying the plants at 85°C for 24 hours in an oven.

2.4 Data analysis

Excel 2010 software was used for statistics and plotting.

3 Results and Analysis

3.1 Effect of different treatments on soil physical properties

3.1.1 Soil water content

Soil water content is one of the basic indicators of soil fertility [9-10]. As shown in Fig. 2, the soil water content of the treatment group was significantly increased after the introduction of coarse hairy licorice in the wind-sand soil. Compared with the control group, the water content of the treatment group increased by 17.13%, 44.11%, 31.40% and 33.84% in September, October, November and December, respectively, with the most significant increase in water content in October and substantial increase in the remaining months, indicating that the treatment group can effectively improve the water content of the wind-sand soil.

![Figure 2](image2.png)

Figure 2  Variation of soil water content

3.1.2 Soil temperature

Soil temperature had an extremely significant effect on microbial activity. From the analysis of Fig. 3, it can be seen that the overall soil temperature of the treatment group was higher than that of the control group, and the temperature of the treatment group increased by 1.80%, 4.39% and 9.18% in September, October and December, respectively, and the insulation effect became more and more obvious as time went by, which was conducive to the overwintering of coarse hairy licorice in such cold areas as Yulin and effectively improved the efficiency of vegetation priming.
3.1.3 Soil capacity

Tolerance weight is one of the main indicators of soil quality. From the analysis of Figure 4, it can be seen that compared with the control, the soil capacity of the treatment group in September, October and December decreased by 4.87%, 3.61% and 3.77%, respectively, which effectively improved the physical conditions of the soil and improved the water and fertilizer retention capacity of the soil, with the most significant improvement in September. In general, the treatment group had a more significant effect in improving the capacity.

3.1.4 Soil porosity

Porosity is an important indicator of soil structure, which determines the water holding capacity and air permeability of the soil. From Figure 5, it can be obtained that compared with the control, the porosity of the treatment group improved by 6.48%, 4.84% and 4.45% in September, October and December, respectively, with the most significant improvement in September, and the soil porosity of the treatment group was effectively improved.

3.2 Effects of different treatments on soil chemical properties

3.2.1 Soil conductivity

Soil conductivity can be used as an important data for evaluating soil fertility and production capacity, developing precise fertilizer prescriptions, and to some extent, characterizing soil salinity, texture structure, and other indicators [11]. As can be seen from Figure 6, compared with the control, the conductivity of the treatment group in September, October and November showed some improvement, with the most significant increase in October, which reached 37.7% compared with the control, and the conductivity in September and November increased by 25.5% and 11.3%, respectively, which also showed some improvement, indicating that the treatment can effectively improve the conductivity of the wind-sand soil.

3.2.2 Soil pH

pH is an important chemical property of soil, which directly affects the presence form and effectiveness of various nutrient elements in the soil for plants [12]. The changes of soil pH in the experimental area are shown in Fig. 7. from Fig. 7, it can be seen that soil pH was significantly reduced in September, October, November and December, with the most significant effect in
September, compared to the control, soil pH was reduced by 4.31%, 3.12%, 1.46% and 1.13% in September, October, November and December, respectively, indicating that the treated wind-sand soil pH can be effectively improved.

Figure 7  Soil pH change

3.2.3 Soil organic matter and nutrients

Soil organic matter and nutrients play an important role in soil fertility and material cycling [13]. As shown in Table 1, soil organic matter, effective nitrogen, fast-acting phosphorus and fast-acting potassium were significantly increased in September, October as well as November compared to the control group. In particular, soil organic matter increased by 21.14%, 20.79% and 21.35% in September, October and November, respectively, with the most significant increase in November; compared with the control group, effective nitrogen increased by 2.34%, 3.46% and 8.21% in September, October and November, respectively, with the most significant increase in November; fast-acting phosphorus and fast-acting potassium in the treatment group also increased compared with the control group. The fast-acting phosphorus and fast-acting potassium in the treatment group increased by 6.67%, 6.25% and 5.88% in September, October and November, respectively.

Table 1  Soil organic matter and nutrient changes

<table>
<thead>
<tr>
<th>Month</th>
<th>Organic matter(g•kg⁻¹)</th>
<th>Effective N(mg•kg⁻¹)</th>
<th>Quick-acting phosphorus(mg•kg⁻¹)</th>
<th>Quick-acting potassium(mg•kg⁻¹)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Treatment</td>
<td>Control</td>
<td>Treatment</td>
<td>Control</td>
</tr>
<tr>
<td>9</td>
<td>2.12±0.04</td>
<td>1.75±0.09</td>
<td>2.62±0.24</td>
<td>2.56±0.09</td>
</tr>
<tr>
<td>10</td>
<td>2.15±0.12</td>
<td>1.78±0.05</td>
<td>2.69±0.19</td>
<td>2.60±0.04</td>
</tr>
<tr>
<td>11</td>
<td>2.16±0.23</td>
<td>1.78±0.01</td>
<td>2.90±0.25</td>
<td>2.68±0.06</td>
</tr>
</tbody>
</table>

3.3 Effects of different treatments on plant biological indicators

3.3.1 Plant height of rough licorice

Plant height can directly reflect the growth condition of the plant. In this experiment, plant height was measured once a month from September to December. As can be seen from Figure 8, compared with the control, the plant height of the treatment groups in September, October, November and December increased by 8.51%, 13.5%, 20.0% and 17.8%, respectively, indicating that the treatment groups could effectively increase the plant height, with the most significant effect in November.

Figure 8  Variation of plant height

3.3.2 Rough hairy licorice regrowth rate

As shown in Figure 9, the re-greening rate of coarse hairy licorice in the treatment group was significantly improved compared with the control group, up to 29.79%, probably because the treatment group had good insulation effect, which effectively protected the plants for overwintering re-greening. It indicates that the treatment group has a great promotion and protection effect on the plants to carry out overwinter re-greening.

Figure 9  Changes in overwintering regrowth

3.3.3 Rough hairy licorice cover

It can be seen from Figure 10, compared with the control, the plant cover increased by 13.33%, 38.27%, 57.83%
and 61.18% in September, October, November and December, respectively, and the growth rate increased gradually over time and reached the highest in December, indicating that the treatment could effectively increase the cover of rough licorice and improve its ecological indicators.

**Figure 10** Variation of cover of coarse hairy licorice

**4 Conclusion**

In this paper, we analyzed the performance of coarse hairy licorice introduction in the wind-sand grass beach area of Yulin through field plot experiments, and the main conclusions are as follows:

1. The physical structure of the wind-sand soil was effectively improved after the treatment. Compared with the control, the water content, temperature and porosity of the wind-sand soil were increased to different degrees, 31.62%, 5.12% and 5.26%, respectively, and the soil bulk weight was reduced by 4.08%.

2. The chemical structure of the wind-sand soil was significantly improved by the treatment, and the electrical conductivity, soil organic matter and nutrients were significantly increased to 22.63%, 21.09% and 4.66%, respectively, and the pH was reduced by 2.51% compared with the control group.

3. The treatment group could effectively increase the height, reversion rate and cover of rough licorice plant by 14.95%, 29.79% and 41.40%, respectively.

**References**