The Research of Drought Resistance of the Artificial Grass in Northern Arid Zone

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Abstract:Moisture is the important factor for growth and survival of the plants, so the choice of the forage varieties is the key issues for the artificial grassland. Under environmental stress, a series of physiological and biochemical reactions occurs to eliminate or alleviate the physiological damage induced by the stress. The drought resistance and cold tolerance of different species or even the different varieties of the same species are quite different. This paper described the resistance of the pastures including Medicago sativa, and Leymus chinensis, and we discuss and summarize the adaptive mechanisms of the plants to the drought stress including morphological structure, production, physiological and biochemical characteristics, antioxidase system, osmoregulation substrate and molecular genetics. Accordingly, this paper summarized the research advances during recent years and its development in future. We need to form a comprehensive index system of resistance and reveal the resistance mechanism efficiently and comprehensively. This paper will provide practically valuable basic data for the selection of the pastures in the artificial grassland.

Keywords: Artificial Grass; Drought Resistance; Osmoregulation System; Antioxidant System

1.Introduction

Grassland is the largest terrestrial ecosystem in China. There are nearly 400 million hectares of natural grassland in China, accounting for about 40% of the land area [1]. In recent years, due to the unreasonable development and utilization of grassland by human beings and the impact of global climate on the greenhouse effect, grassland resources have been destroyed, and degradation and desertification have generally occurred in different degrees, resulting in soil erosion, land salinization and ecological environment deterioration, and resulting in a sharp decline in grassland productivity [2]. Coupled with long-term overgrazing, the contradiction between grass and livestock is increasingly intensified, which seriously restricts the rapid development of animal husbandry production, and the traditional production mode of using natural grassland natural productivity has come to an end [3]. The construction of artificial grassland has become one of the main measures to solve the contradiction between grass and livestock and improve the ecological environment, so it is imperative to build a large area of artificial grassland. However, the temperate grassland in arid region accounts for 78% of the grassland area in China, and the problems of drought and low temperature wintering are the key problems restricting the construction of artificial grassland. Therefore, the selection of varieties is one of the key problems in the construction of artificial grassland in arid and cold areas.

The resistance of plants is the result of long-term genetic and environmental effects of plants, and it varies from time to time and place to place, so it is difficult to measure accurately and quantitatively at present [4]. But generally speaking, the comprehensive resistance indexes of forage include growth and development indexes, morphological indexes, physiological and biochemical indexes, yield traits and so on. The response of plants to adversity is a complex phenomenon, and adaptations take many forms. In general, when plants encounter drought stress, they will first undergo morphological changes. For example, the growth of roots makes it easier to absorb water, and the quantity and biological quality of root chemical components will also undergo corresponding changes, which will affect above-ground photosynthesis and biomass [5]. Drought had a great effect on plant photosynthesis, and the photosynthetic capacity of plants decreased under the stress of adversity. During drought, plants will reduce transpiration rate to maintain the water budget balance in the body, which is a manifestation of plant adaptation to avoid drought [6]. From a physiological point of view, there are antioxidant systems in plants that are responsible for eliminating the production of reactive oxygen species. When plants encounter drought, low temperature and other stresses, the balance between production and scavenging of reactive oxygen species in plants is easily broken, so antioxidant enzymes such as superoxide compounds (SOD), catalase and ascorbate peroxidase are used in leaves to remove free radicals [7]. At the molecular level, the molecular performance of plants with

different resistance is different, and the coding region of different varieties is different.

The varieties selected for artificial grassland should be drought-resistant, cold-resistant and adaptable pasture varieties. At present, in the vast areas of north China, the most common forage varieties selected for artificial grassland include alfalfa, leymus chinensis and old aemonth [8]. Different forage species have different resistance. In order to ensure the high efficiency of artificial grassland construction, it is urgent to carry out in-depth research on the mechanism of drought resistance and cold resistance of forage. Based on the previous work, this paper summarized the physiological and morphological indexes of these three common grasses, and summarized the resistance mechanism and adaptability of different varieties, so as to provide a basis for production practice in arid areas and alpine areas.

2.Drought resistance of Medicago sativa

Medicago sativa, a perennial leguminous forage, is the largest artificial forage in China and has the reputation of "king of forage" [9]. The arid and semi-arid region in northwest China is the main planting area of alfalfa, so selecting suitable drought-resistant varieties is of great significance for alfalfa production in this region [10]. When alfalfa is subjected to drought stress, the main change is reflected in the form, the roots, stems, leaves and so on will have different degrees of change. It has been found that soil water content not only affects the water absorption function of roots, but also affects the growth direction of roots. When the water content of the surface soil is high, the water absorption area of the root system is mainly distributed in the area with a large surface root density. As the water content of the surface soil decreases, the water absorption area of the root system moves down [11]. In terms of photosynthetic apparent phenomena, the net photosynthetic rate (P), transpiration rate (E), stomatal conductance (G) and leaf green content (Cht) of two alfalfa species, Longdong alfalfa (strong drought resistance) and BL-02-329 alfalfa (weak drought resistance), all decreased in different amplitude under drought stress. Chloroplast ultrastructure was destroyed. With the deepening of drought stress, the net photosynthetic rate of alfalfa with strong drought resistance decreased slowly, and the chloroplast shape and grana structure were less affected [12]. Yu Ling et al. [13] studied several alfalfa varieties and found that the change process of free proline content of all varieties showed a rapid accumulation trend during drought stress, and began to decline after reaching the peak value, but the peak value in the morning and evening and the peak accumulation amount were different among varieties. Zhang Xinlan [14] studied the antioxidant enzyme system in alfalfa and showed that several varieties with good drought resistance had higher activities of catalase (CAT), peroxidase (POD) and superoxide dismutase (SOD) in leaves, which could clear the reactive oxygen species produced in the body and prevent alfalfa from being affected by drought stress. When faced with drought stress, different alfalfa varieties have similar molecular, physiological and biochemical reactions, indicating that they take the same measures to resist drought, but there are differences in quantitative responses at different levels. Drought-tolerant varieties have lower stomatal density and conductance, higher material accumulation and delayed leaf senescence [15]. Some studies have also found that wild alfalfa has higher drought resistance performance than artificial alfalfa [16].

3.Conclusion

Drought is the key factor limiting the establishment of artificial grassland, so it is very important to study the variety resistance of artificial grassland in the northwest of China and the Qinghai-Tibet alpine region. Previous studies mainly focused on the planting efficiency, external morphology, internal physiological and biochemical indicators of forage. Studies on photosynthesis, water physiology and ecology, and molecular mechanisms are still insufficient. Photosynthesis physiology and ecology are the most direct apparent phenomena in response to stress and should not be ignored in resistance studies. The molecular and genetic level of many grasses is poorly studied. In the past, drought resistance of plants was always studied in one aspect. However, drought resistance of plants is a complex mechanism, and different varieties of herbage have different stress response and feedback mechanisms. Therefore, future studies on grass resistance should be more comprehensive and specific, and the drought resistance of forage grass should be evaluated comprehensively from all aspects, including production practice, growth, morphology and photosynthetic apparent phenomena. The internal physiological and biochemical mechanism, combined with the molecular mechanism research, will form a comprehensive resistance identification index system, which will reveal the resistance mechanism of plants more quickly, efficiently and comprehensively.

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