Analysis of Drought-Resistant Photosynthesis Characteristics of Different Garden Herbs

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Abstract: with the Acceleration of China's Urbanization Process, Environmental Problems Have Become More and More Serious, Bringing a Series of Problems Such as Shortage of Resources. as an Important Part of Urban Ecological Environment Construction, the Garden Green Space Has Increased Year by Year. Aiming At Plants as One of the Most Important Landscape Elements in Garden Green Space, It Consumes a Large Amount of Municipal Water Every Year. the Current Design Rarely Considers the Coordination of Plant Landscape and Water-Saving. Therefore, When Constructing the Garden Greenland Plant Landscape, How to Maximize the Realization of Water Conservation and Ecological Coexistence under the Premise of Ensuring Its Ornamental Effect is the Key Issue for the Sustainable Development of Garden Green Space. in This Paper, Sedum Spectabile Boreau, Sedum Sarmentosum and Duchesnea Were Used as Materials to Study the Effects of Drought Stress on the External Morphology and Photosynthetic Characteristics of Three Garden Herbaceous Plants by Soil Water Control Method (the Soil Was Not Watered and the Water Was Sprayed At the Right Time).

1. Introduction

Herbaceous Plants Are Important Basic Materials for the Construction of Garden Green Space. They Can Not Only Improve the Urban Ecological Environment, But Also Enrich the Urban Landscape Effect. They Can Also Greatly Satisfy People's Requirements for Urban Green Quantity, and Are an Indispensable Part of Urban Garden Plant Community. Herbs Have a Narrower Meaning in Horticulture and Refer to Ground Cover Plants Other Than Turf Plants, and Broadly Refer to All Plants That Cover the Soil. Herbaceous Plants Have Diverse Application Environments and Can Be Used to Form Different Types of Ground Cover [1]. the Herbaceous Plant Species Available in China Are Rich in Resources. While Abandoning the Single Species, Large Area and High Cost Configuration of the Past Lawn, We Should Adapt to the Needs of the Current New Situation, Actively Develop Wild Resources, and Use a Variety of Herbs to Complement Each Other [2]. the Main Way of Urban Surface Coverage in the Future. At Present, the General Problem Affecting Urban Landscaping Construction is Drought. China's Urban Greening Mostly Uses Tap Water as the Water Source, and the Utilization Rate of Water Resources is Low. the Contradiction between the Demand for Water for Urban Landscaping and Development is Becoming More and More Prominent. Therefore, It is of Great Significance to Screen Water-Saving and Drought-Resistant Herbaceous Plants Suitable for Urban Construction [3].

The Continuous Early Landscape Garden is the Garden Construction Concept Pursued by the Gardening Circles All over the World. It is the First Choice for the Construction of Garden Green Space in Northern Cities and Even Water-Deficient Cities. the So-Called Dry Landscape Garden Refers to the Landscape of Drought-Tolerant Plants, Which Can Not Maintain Water and Use a Very Small Amount of Water to Maintain the Survival of Plants While Achieving the Effect of Landscaping [4]. Dry Landscape Gardens Can Save a Lot of Water Resources in the Construction of Green Space. Therefore, in Urban Garden Design, We Must Focus on the Selection and Application of Drought-Tolerant Garden Plants. Drought-Tolerant Plants Are Mostly Wild Ornamental Plants Distributed in Semi-Arid and Arid Regions. They Can Grow Normally under the Average Annual Rainfall of 400 Mm and Have Good Ornamental Value [5]. Drought-Tolerant Plants Can Maintain Their Normal Growth and Water Balance by Changing Their Own

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Morphology and Regulating the Intensity of Physiological Activities, and Grow in Arid Environment for a Long Time. There is Evidence That Landscape Plants with Strong Drought Tolerance Perform Well in a Variety of Dry Environments and Play an Important Role in the Construction of Dry Landscape Gardens. They Are a New Generation of Value-Added Garden Plants [6]. in Australia's 150-Year-Old Devastating Drought, a Large Number of Lawns and Flower Wells, Trees, Shrubs, Etc. Have Died Due to Lack of Water, While Dry Landscape Plants Rely on Their Own Drought Tolerance, Not Only through the Severe Drought Season, It Also Played an Important Role in Urban Greening.

Sedum plants are perennial fleshy herbs, which can be planted in pieces. They have dense branches and leaves, strong coverage on the ground, high ornamental value and extensive management. They are rare plant materials in urban landscaping in recent years. In this paper, Sedum spectabile Boreau, Sedum sarmentosum and Duchesneaindica (Andrews) Focke were used as materials to study the effects of drought stress on the photosynthetic characteristics of ground cover plants, aiming to clarify the drought resistance of three ground cover plants and to be drought-tolerant garden ground cover plants. The screening and practical cultivation applications provide a scientific basis [7].

2. Study on Drought Resistance Photosynthetic Characteristics

2.1 Photosynthetic Characteristics

Photosynthesis is a unique process of plants. It is the core process of plant carbohydrate synthesis and energy conversion. It also marks the difference in productivity between different types of plants. Photosynthesis efficiency is not only an important indicator to reveal plant physiology and production processes and mechanisms, but also a fundamental factor in determining plant productivity and yield. Photosynthesis determines the level of productivity of plants and is the fundamental source of matter and energy in plants. At present, there are many studies on photosynthesis, and the progress is also very rapid. Many scholars have studied the photosynthesis characteristics of economic tree species, landscaping tree species and fruit trees under different open conditions. Therefore, it is of great significance to study the photosynthetic characteristics of plants themselves and their relationship with environmental factors, to understand the environmental conditions that plants are most suitable for growth, in order to develop management measures adapted to plant growth, so as to maximize economic benefits and Ecological Benefits [8].

2.2 Plant Drought Resistance

Moisture plays an irreplaceable role in plant growth and development. Water deficit has a wide range of effects on plants, which runs through the entire growth process of plants. Due to the increasingly scarce water resources and the contradiction between the urban environment and the demand for landscaping development water, it is particularly prominent in most cities in the country, especially in the northern cities. It has become one of the “bottlenecks” for urban landscaping development in the long run. How to adjust the variety structure of urban landscaping, vigorously promote water-saving garden plants to comprehensively solve the contradiction between urban water shortage and green development water demand has become a critical issue for landscaping construction workers across the country. Therefore, plant drought resistance research has always been one of the important issues of concern to scientists in various countries, and it is a hot topic of current research. The resistance of plants to drought varies with plant species, mainly including drought evasion, drought delay, dehydration and tolerance to drought. The latter two are collectively referred to as drought resistance.

2.2.1 Changes in Leaf Moisture Content

Water potential is a direct indicator of plant water deficit or water status. The lower the water potential, the stronger the water absorption capacity of the plant. On the contrary, the higher the water potential, the weaker the water absorption capacity of the plant. Leaf water potential

represents the level of movement of plant water and is a direct manifestation of tissue moisture. Determination of the water potential of a plant under drought stress conditions can clarify the change in water uptake capacity of the plant.

Under general drought stress, the water condition of plant leaves will change accordingly, and the relative water content, free water and water potential will decrease. A decrease in soil moisture leads to a decrease in the free water content of the plant leaves, an increase in the bound water content, and a decrease in leaf water content and leaf water potential. The decline of plant leaf water potential is an important indicator of plant water shortage. Under the same soil moisture content, the lower the water potential of plants, the stronger the water absorption capacity and the stronger the drought resistance. On the contrary, the weaker the water absorption capacity, the drought resistance. The weaker the sex. In addition, the more drought-tolerant plant species, the less the water potential of the leaves is smaller than the species with weak drought resistance. In the study of resistance to peach rootstocks, Cao Yanping found that the water potential was significantly positively correlated with the soil water content. The water potential of the leaves decreased with the increase of drought degree, and the water potential of the roots with strong drought resistance decreased little and the speed was slow. Zhang Chengjun studied the physiological and ecological responses of four woody seedlings in Quercus liaotungensis under soil drought conditions. It was found that the lowest leaf water potential of Quercus liaotungensis and Daphnia leucocephala appeared earlier than the two-color arborvitae and pilose embroidery line. Chrysanthemum, and at the end of drought stress, the leaf water potential of Quercus liaotungensis and Daphnia leucocephala still showed a certain change of the day-to-day change, but the two-colored Lespedeza and the genus Spiraea had no obvious afternoon water potential recovery. The drought resistance of Quercus liaotungensis and Dayebai wax is strong.

2.2.2 Changes in Cell Membrane

The integrity and order of the membrane system is the basic barrier to maintain the environmental compartmentalization of plant cells. The stability of this compartmentalization is the guarantee for the cells to carry out various complex physiological and biochemical processes. Under drought stress, the selectivity of the membrane is reduced and the permeability is increased. On the one hand, the drought causes the cells to dehydrate, causing mechanical damage to the plants, shrinking the cells, forming a fold on the cell wall, thereby increasing the permeability; on the other hand, under drought stress, occurs. After the membrane lipid peroxidation membrane permeability increases, some important ions and nutrients in the cell are extravasated, and some non-essential elements in the outside also enter the cell, and their components change, which cannot meet the normal physiological needs of the plant. Wu Tao et al. found that under relative stress, the relative conductivity was significantly negatively correlated with the drought resistance of plants. With the extension of drought time, the relative conductivity of leaves showed a trend of increasing gradually. The stronger the drought resistance, the smaller the relative conductivity increase of plants. Therefore, the relative conductivity can be used as an indicator of drought stress in plants to compare the drought resistance of plants.

3. Experimental Study on Drought-Tolerant Photosynthetic Characteristics of Vegetation

3.1 Materials and Methods

The test plants were Sedum spectabile Boreau, Sedum sarmentosum and Duchesnea, all of which were ground-covered plants cultivated by Hengshui College. Select Sedum spectabile Boreau, Sedum sarmentosum and Duchesnea upper basins (wapan basin, upper mouth diameter 21 cm, potting soil according to V (soil): V (sand) = 3 颐 1 ratio), 7 plants/pot. Watering is carried out by soaking the basin so that the soil and the plants are naturally in contact with each other as much as possible, and they are cultured under outdoor natural conditions. After the normal growth of each plant, the soil water control method (the soil is not watered, and the leaf surface is sprayed in time) is subjected to drought stress, and the normal soil watering (watering once a day) is treated as a

control. 1 treatment per pot, 4 repetitions.

3.1.1 Determination of Items and Methods

The external form of the plant. The external morphology of plants will change greatly under drought stress. By observing the growth and development of the tested materials, the sensitivity of the tested plants to drought stress was compared. The external morphological indicators of plants were investigated on the 6th, 9th, 12th, 15th, 18th and 22th day after drought stress treatment, and the drought resistance levels of Sedum spectabile Boreau, Sedum sarmentosum and Duchesnea were evaluated according to the drought grading standards .

3.1.2 Plant Photosynthetic Performance

One potted mature leaf in four directions of east, west, south and north was selected for each pot as a measurement sample. On the 14th day after the drought stress treatment (August 25th), the net photosynthetic rate of the leaves was measured once every 1 h at 9:30 at 9:30 using the TPS-1 portable photosynthetic system. The net photosynthetic rate, transpiration rate and stomatal conductance of the leaves were determined at 11:30 on August 25 and 29 (the 18th day after drought stress treatment).

3.2 Results and Analysis

3.2.1 Effects of Drought Stress on the External Morphology of Ground Cover Plants

Different ground cover plants showed different morphological appearances under drought stress (Table 1). The leaves of Sedum spectabile Boreau showed slight color change on the 12th day after drought stress treatment. On the 19th day, most of the leaves turned yellow and wilted, but no plants died on the 22nd day after treatment. Sedum sarmentosum was treated under drought stress. On the 12th day, a few leaves changed color. On the 19th day, most of the leaves turned yellow and wilted. On the 22nd day, the plants died partially. Duchesnea was most sensitive to drought, and on the 10th day after drought stress, a few leaves had color. On the 12th day, most of the plants were wilting and yellowing. On the 15th day, the plants died partially, and on the 19th day, all the plants died. The drought resistance was evaluated from the degree of wilting and chlorosis of the leaves. It was considered that Sedum spectabile Boreau had the strongest drought resistance, followed by Sedum sarmentosum, and Duchesnea had the same drought resistance. This is due to the thinner and smaller Duchesnea leaves, while the Sedum spectabile Boreau and Sedum sarmentosum are both fleshy, and the Sedum spectabile Boreau is larger than the Sedum sarmentosum leaves and has a stronger water retention capacity.

Table 1 Influence of Different Drought Stress on Plant External Morphology.

Ground cover species	Drought resistance level						Drought resistance evaluation
	6d	9d	12d	15d	19d	22d	
Sedum spectabileBoreau	Ⅰ	Ⅰ	Ⅱ	Ⅱ	Ⅲ	Ⅳ	Strongest
Sedum sarmentosum	Ⅰ	Ⅰ	Ⅱ	Ⅲ	Ⅳ	Ⅴ	Strong
Duchesnea indica (Andrews) Focke	Ⅰ	Ⅱ	Ⅲ	Ⅳ	Ⅴ	Ⅵ	general

3.2.2 Effect of Drought Stress on Net Photosynthetic Rate of Ground Cover Plants

The net photosynthetic rate of leaves treated with drought stress was about CK, and the net photosynthetic rate at the 17th day after drought treatment jumped for the 13th day (Fig. 1). Among them, the net photosynthetic rate of leaves of Sedum sarmentosum decreased most under drought stress, which was 178% lower than that of CK on the 13th day after drought stress, and 146% decreased on the 17th day; the net photosynthetic rate of Sedum spectabile Boreau decreased secondly, drought On the 13th and 17th day after stress, the decrease was 170% and 113%, respectively. The net photosynthetic rate of Duchesnea decreased the least, and the 13th and 17d after drought stress decreased by 123% and 54%, respectively. The net photosynthetic rate of Duchesnea leaves under different drought stresses leaped to Sedum sarmentosum and Sedum

spectabile Boreau. The results showed that the net photosynthetic rate of Sedum sarmentosum and Sedum spectabile Boreau was significantly affected by drought stress, and the drought resistance of the two were stronger. The net photosynthetic rate of Duchesnea was less affected by drought stress and its drought resistance was weaker.

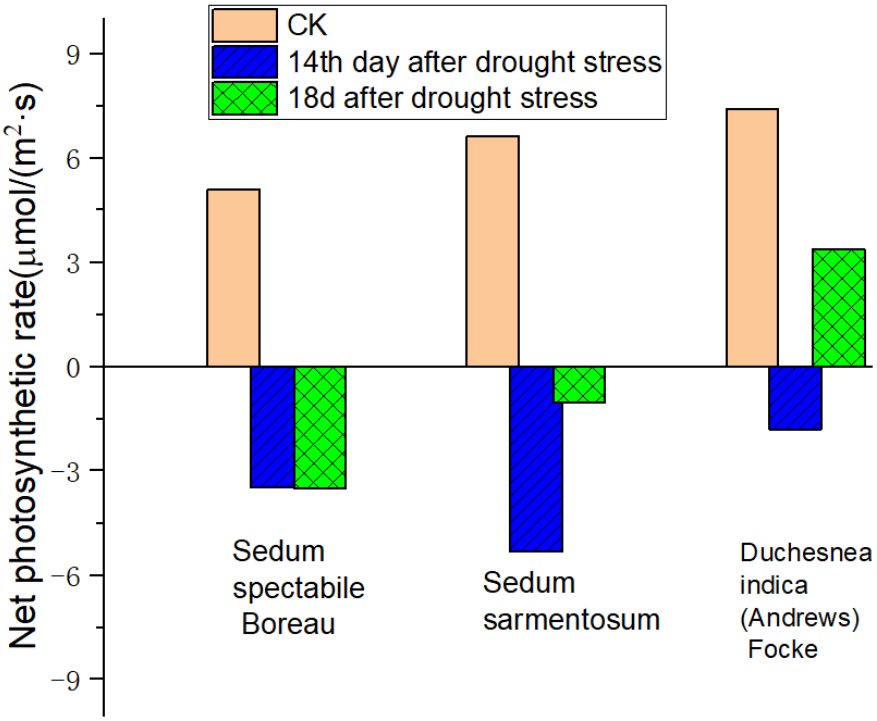

Fig.1 Net Photosynthetic Rate of Different Groundcover Plant Leaves under Different Drought Stress.

Photosynthesis is the main pathway for assimilation of plants, and it is sensitive to environmental factors. The effects of drought stress on the photosynthetic characteristics of plants have been reported. The drought resistance of plants has a great correlation with the photosynthesis ability under drought stress. Previous studies have shown that the photosynthesis rate of plants in water deficit state will decrease, the extent of the reduction depends on the degree of water deficit and the ability of plants to resist drought. The transpiration rate and stomatal conductance affect the intercellular CO2 concentration, which affects plant photosynthesis. In plants under drought stress, the pores are forced to close, reducing the absorption of CO2, and the photosynthesis of the leaves is inhibited, resulting in decreased photosynthetic capacity. At the same time, when the water supply of the plant is tense, the plant generally tends to reduce the transpiration of the water by reducing the openness of the pores, thereby achieving high water use efficiency, which is an obvious adaptation characteristic of the plant. The chlorophyll content of leaves is also an important indicator reflecting the photosynthetic capacity of plants. Water stress affects the biosynthesis of chlorophyll, which hinders the synthesis of chlorophyll, promotes the accelerated decomposition of chlorophyll, which directly leads to the decrease of chlorophyll content, thus affecting the process of photosynthesis. The leaves are yellow.

4. Summary

The drought resistance of plants is a complex trait. There are many indicators for identifying drought resistance, such as morphological structure and physiological characteristics. The comprehensive evaluation of multiple indicators becomes a necessity. Using Sedum spectabile Boreau, Sedum sarmentosum and Duchesnea as materials, the effects of drought stress on photosynthetic characteristics of different ground cover plants were studied. Combined with external morphological characteristics, the drought resistance of three ground cover plants was

preliminarily judged. The results showed that the three ground cover plants showed different drought-resistance modes under drought stress. Sedum spectabile Boreau showed strong drought resistance after 14 days of drought stress, but the leaf color changed slightly; transpiration rate and stomatal conductance The degree is the smallest, and it is the least affected by drought stress, and the drought resistance is the strongest. The leaves of Duchesnea are thinner and smaller, and the water-holding ability is not strong. Under drought stress, the chlorophyll content of leaves is the highest, which leads to higher net photosynthetic rate. At the same time, stomatal conductance and transpiration rate are greatly reduced, but still higher than Sedum spectabile Boreau. And Sedum sarmentosum, the drought resistance is the weakest. Comprehensive evaluation of the drought resistance of the three tested ground cover plants, Sedum spectabile Boreau was considered to have the strongest drought resistance, followed by Sedum sarmentosum, and Duchesnea had the weakest drought resistance. The physiological performance of the perennial plants after their water stress, such as plasma membrane permeability and antioxidant enzyme activity, remains to be further studied.

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