人工环境下沙冬青水分关系研究*

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〔摘要〕沙冬青是一种特殊的常绿荒漠植物，具有很强的抗热性、抗寒性以及抗旱性。在本文中，我们在人工控制环境下，研究了沙冬青叶片水势与蒸腾作用的关系、沙冬青叶片水势与叶片含水量的关系以及叶片蒸腾作用与叶片温度的关系。

关键词 沙冬青，水分关系，人工环境。

Water Relations of *Ammopiptanthus mongolicus* under Controlled Environment

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Abstract: *Ammopiptanthus mongolicus* is a special species of desert evergreen shrubs with strong tolerance to drought, high temperature, low temperature and lower humidity. In this paper, we researched the relations between water potential and transpiration rates, the relations between water potential and water content of leaves, and transpiration rates and leaves temperature of *Ammopiptanthus mongolicus* under artificial controlled environment.

Key words: *Ammopiptanthus mongolicus*, water relations, controlled environment.

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Introduction

Ammopiptanthus mongolicus is one of two species of evergreen shrubs in temperate desert area of Asia, with 0.5～2 meters height. This species is distributed in desert area of the Inner Mongolia, Ninxia Province and Gansu Province of China, and Mongolia (Liu Yinxin, 1987). In these areas, there is arid climate, very fewer precipitation and large differences of daily air temperature and annual air temperature. The mean temperature is 22℃～25℃ in July and −10℃～−14℃ in January, and the extreme lowest air temperature was −25℃～−35℃ in winter and extreme highest air temperature 30℃～40℃ in summer. The mean annual precipitation is 50～200mm (Fu Li−kuo, 1992). This plant is exposed under water stress in most of growing season. As a desert evergreen plant, this plant has very strong tolerance to low temperature, high temperature and low humidity, which shows this plant might have some special morphology features and eco−physiological characteristics (Liu Jiaqong, 1982). It is very necessary to research the eco−physiological characteristics of this plant. We like to show the water relations of *A. mongolicus* under controlled environment.

Materials and methods

Experimental materials

The seeds of *A. mongolicus* were collected in 1991 from Turpan desert research station which belonged to Xinjiang Institute of Biology, Pedology and Desert Research, Chinese Academy of Sciences, and located in Turpan Basin with −87 meters altitude. The seeds were planted in January, 1992 in greenhouse of National Institute for Environmental Studies, Japan Environment Agency. The seedlings were transplanted in 1.5 L pots containing sand after 4～6 month. These pots were placed in greenhouse in 30/20 ℃ day/night temperature, 60～70% relative humidity and natural light. When it is in winter with short light, additional lighting were supplied 2～3 hours in order to get enough lighting time. These seedlings got twice irrigation per day and twice about 200 ml of a compound nutrient solution (Hyponex, 1000−fold diluted) one week. The experimental plants were seedlings of one−year−old and with 70～80 cm height.

Experimental methods:

Transpiration rates of whole plant were measured using a electric balance (METTLER PM6000, made in Switzerland), the weighted data was recorded by a microcompurter (NEC.

PC－9801) every two minutes. In order to prevent evaporation of pots sand, the pots were sealed in a plastic bag before measuring. The measuring system of transpiration was described by Li Xiaoming (1993). The assimilating box were placed in artificial climatic chamber that can change air temperature from 10～40℃, relative humidity from 20～80%. Water potential of leaves were measured before starting measuring transpiration and at the end of measuring transpiraiton, using a dew point microvoltmeter (HR－22T. WESCOR, made in USA). The different water conditions of experimental plants were gotten by regulating irrigation times. The leaves temperature were measured by three very fine thermocouple attached to the back surface of three leaves at different positions. The value of leaves temperature use the mean value of three leaves. The air temperature in the assimilating chamber was set at 30℃, the PAR was 400μEm^{-2}s^{-1}.

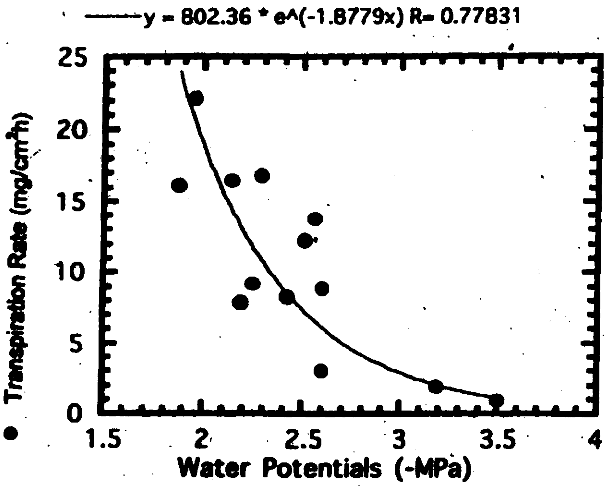

Fig. 1 The relations between water potential and transpiration rate of *A. mongolicus*

Results

1. The relations between water potential and transpiration rates of leaves.

The water potential of leaves had a close relationship with transpiration rate of leaves. The transpiration rates of leaves showed a decreasing tendency with the reduction of water potentials. Fig. 1 shows the relations between water potential and transpiration rate of lesves of *A. mongolicus*.

2. The relations between water potential and water content of leaves.

The water content of leaves had a close relation with the water potential of leaves. Fig. 2 shows their relation between water potential and water content of laesves of *A. mongolicus*. The data in Fig. 2 showed the water content of leaves reducing with water potential decreasing. The highest value of water content was 2.34 corresponding －1.4 MPa of water potential of leaves. The lowest value of water content was 1.41 corresponding the －3.5 MPa of water potential of leaves.

3. The relation between leaves temperature and transpiration rates.

The one of the functions of transpiration is to cool leaves temperature. Fig. 3 showed the air temperature, leaves temperature and transpiration rate and their relations. We can see in Fig. 3 that the values of air temperature is from 29.2℃ to 31.8℃, the leaves temperature is from 28.1℃ to 32.9℃. The differences of air temperature and leaves temperature were not so large. But we can see that there were large difference of the transpiration rates, and transpiration rates increase with the increasing of (Ta－Tl). The values of transpiration rates is

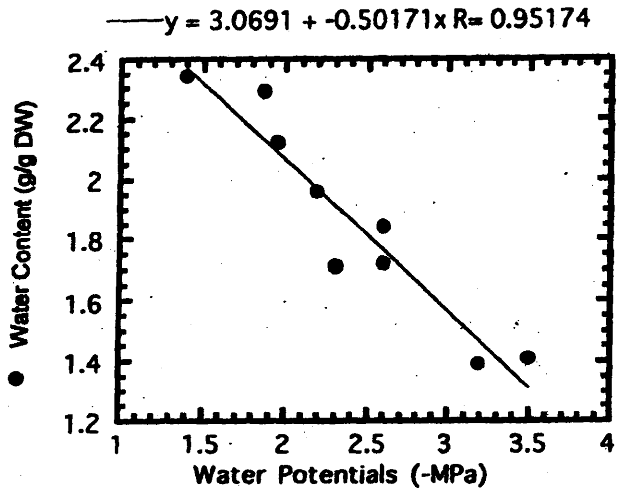

Fig. 2　The relations between water potential and water content of leaves of *A. mongolicus*

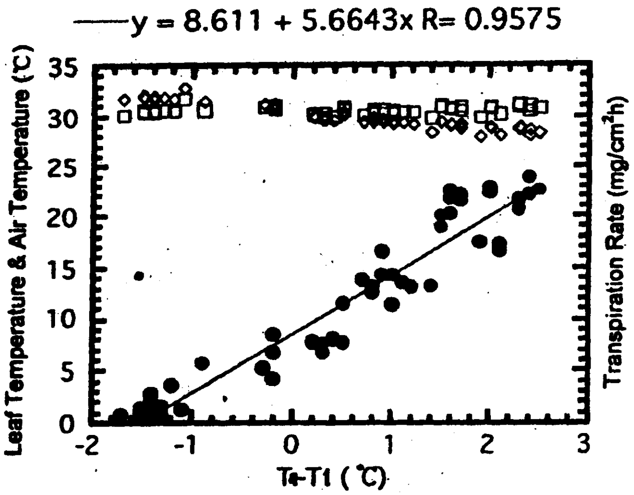

Fig. 3　The transpiration rates under different leaves temperature and air temperature.

• transpiration rate (mg/cm^{2}h), ◇leaves temperature, □air temperature.

about 6～7 mg/cm^{2}h responding similar leaf temperature and air temperature. This is because of the difference of (Ta — Tl) that respond the energy balance of leaves. When the leaf is under water stress, the leaf can not supply enough water for transpiration that can cool leaf temperature.

Discussion

There is no research report on the relation between water potential and transpiration rates of leaves of *A. mongolicus*, this is because the *A. mongolicus* only distribute in small area. The transpiration rates distributed in dispersal under different water potentials in our experimental results. The main reason was individual difference of plant samples. But the changing tendency of transpiration rates with water potentials was clear in Fig. 1 that shows the transpiration rates reduced with the reduction of water potentials. Paul J. (1983) showed the changes between leaf water potential and transpiration of corn and soybean. The special change characteristics of transpiration with water potential of *A. mongolicus* is slowly decreasing transpiration by the reduction of leaf water potential. Liu Jia—qiong (1982) showed that *A. mongolicus* had a very strong water—holding power and thick cuticle of leaf, that also showed the reason of slow decreasing transpiration rate with the reduction of leaf water potential.

The relations between leaf water potential and leaf water content is very complex. But in our results, there was a good linear relations between leaf water potential and leaf water content.

The relations between leaf temperature and transpiration responded a energy balance of leaf in certain air temperature and radiation intensity. When the air temperature and radiation intensity is stable, the leaf temperature will change with the leaf water status. The leaf temperature is lower than air temperature under good water condition with high transpiration rate. Under water stress, the leaf temperature is higher than air temperature with a lower transpiration rate. When the leaf temperature is near air temperature, the absorption of energy of leaf mainly was used for leaf transpiration. In our experiments, the transpiration rate was 6～7mg/cm^2h with the PAR 400$\mu Em^{-2}s^{-1}$and the air temperature from 29.2℃ to 31.8℃. If the radiation intensity and air temperature is changed, the transpiration rate will be changed with similar leaf temperature and air temperature.

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