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G. Y. Yue

Chinese Academy of Sciences, China

H. L. Zhao

Chinese Academy of Sciences, China

H. Qu

Chinese Academy of Sciences, China

L. Niu

Chinese Academy of Sciences, China

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The 21st International Grassland Congress / 8th International Rangeland Congress took place in Hohhot, China from June 29 through July 5, 2008.

Proceedings edited by Organizing Committee of 2008 IGC/IRC Conference

Published by Guangdong People's Publishing House

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Effects of air velocity on eco-physiological characteristics of some common herb species in Horqin sand land , Inner Mongolia , China

G . Y . Yue , H . J . Zhao , H . Qu , L . Niu

Cold and Arid Regions Environmental and Engineering Research Institute , Chinese Academy of Sciences , 320 Donggang West Road , Lanzhou 730000 , PR China . E-mail : yuegy@lzb.ac.cn (G - Y . Yue)

Key words : sand fixing plants , portable wind tunnel , air velocity , photosynthetic rates (P_n) , water use efficiency (WUE)

Introduction Wind is common in nature and poses impact to the development of plants . Wadsworth (1959) and Kitaya Y (2004) reported that there were optimum air velocities for plant growth at $0.2-0.7 \text{ m s}^{-1}$. However , little is known so far about the effect of single wind factor on plants . Information on these studies is required for a better understanding of the effects of air velocity on eco-physiological characteristics of plant species .

Materials and methods The present research was initiated to study effects of different air velocities (4 and 8 m s^{-1}) and blowing duration (20 to 120 min) on eco-physiological characteristics of some common sand-fixing herb species by using the portable wind tunnel to simulate natural wind . The herbs (*Agripophyllum squarrosum* Moq . , *Corispermum macrocarpum* Bge . , *Digitaria ciliaris* Koeler) in situ were set in a portable wind tunnel ($3.5 \times 0.5 \times 0.5 \text{ m}^3$) under field conditions as shown in Figure 1 , the sample chamber of which was designed as colorless and transparent toughened glass . The net photosynthetic rates (P_n) and transpiration rates (T_s) were determined by using Li-6400 Photosynthesis System .

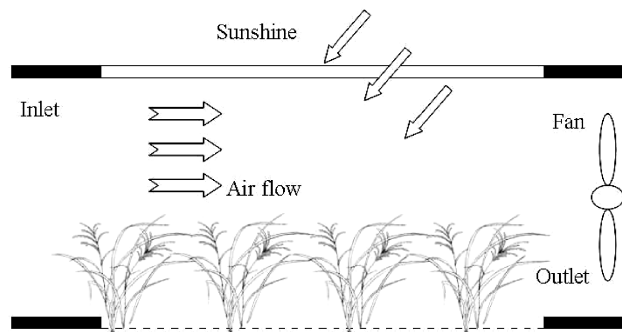


Figure 1 Schematic diagram of wind tunnel simulation experiments .

Results It was found that the P_n and T_s of these three herbs decreased significantly with elevated wind levels and blowing duration . At the air velocity of 4 m s^{-1} , the P_n and T_s of plants inside the wind tunnel were 54.3% - 87.6% and 49.6% - 84% lower than that outside at the end of measuring time , respectively . The most greatly reduced P_n value of $2.1 \mu\text{mol CO}_2 \text{ m}^{-2} \text{ s}^{-1}$ was observed in *C. macrocarpum* as compared to control value of $17 \mu\text{mol CO}_2 \text{ m}^{-2} \text{ s}^{-1}$ outside . In contrast , P_n values of *A. squarrosum* reduced from 18.1 to $6.9 \mu\text{mol CO}_2 \text{ m}^{-2} \text{ s}^{-1}$, while *D. ciliaris* reduced from 15.4 to $8.13 \mu\text{mol CO}_2 \text{ m}^{-2} \text{ s}^{-1}$. Similarly , photosynthesis and evaporative demand remained lower as a result of 8 m s^{-1} air current , e . g . in *C. macrocarpum* , P_n and T_s were taken as $1.58 \mu\text{mol CO}_2 \text{ m}^{-2} \text{ s}^{-1}$ and $1.09 \text{ mmol H}_2\text{O m}^{-2} \text{ s}^{-1}$, respectively . Furthermore , water use efficiency (WUE) presents evident uptrend at the beginning of wind treatment , suggesting that sand-fixing herbs have adaptability to wind current . However , continuous strong wind event more than 60 min would also cause WUE turn to drop .

Conclusions Strong air movement around plants causes considerable effects on plant growth promotion by suppressing the gas and heat exchanges in the leaf boundary layer thereby decreasing photosynthetic and transpiration rates . The inhibitory effect increased with more intensive and longer time wind menace . Considering blown sand is frequent and complex in Horqin Sand Land , the further question arises as to study the effects of wind-sand blow on growth characteristics of some sand-fixing plants .

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