



University of Kentucky
UKnowledge

International Grassland Congress Proceedings

21st International Grassland Congress / 8th
International Rangeland Congress

Effect of Silicon Application on Water Use Efficiency of Alfalfa Plants

Zhenggang Guo
Lanzhou University, China

Huixia Liu
Lanzhou University, China

Suomin Wang
Lanzhou University, China

Follow this and additional works at: <https://uknowledge.uky.edu/igc>



Part of the [Plant Sciences Commons](#), and the [Soil Science Commons](#)

This document is available at <https://uknowledge.uky.edu/igc/21/2-2/18>

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

This Event is brought to you for free and open access by the Plant and Soil Sciences at UKnowledge. It has been accepted for inclusion in International Grassland Congress Proceedings by an authorized administrator of UKnowledge. For more information, please contact UKnowledge@lsv.uky.edu.

Effect of silicon application on water use efficiency of alfalfa plants

Zheng gang Guo , Huixia Liu , Suomin Wang

College of Pastoral Agriculture Science and Technology , Lanzhou University , Lanzhou City 730020 , P . R . China

Key words : silicon application , water use efficiency , alfalfa , soil moisture

Introduction As one of the most important forage crops , alfalfa production is confined by rising irrigation costs and water demand . One tool to improve sustainability of water use is to increase water use efficiency (WUE) in alfalfa production . Silicon has been found to increase WUE in sunflower by reducing leaf transpiration (Zou et al . 2005) . Silicon also can increase alfalfa shoot and root growth (Guo et al . 2006) . If the WUE of alfalfa could be enhanced by a simple agronomic means such adding silicate to the soil , this measurement could potentially be applied in pasture management .

Materials and methods A pot experiment was conducted in the green house . The equivalent of 23 . 8 kg oven-dried sand soil was put into 48 plastic pots with a plastic film on the bottom to prevent drainage loss of water . Four soil moistures were designed : 80% , 65% , 50% , and 35% of field water capacity (FWC) . At each soil moisture condition , three treatments (4 . 0 g potassium chloride (-Si) , 8 . 0 g Potassium silicate (+Si) , CK) were applied to quantify the effect of silicon application on WUE of alfalfa plants . Alfalfa seedlings were thinned to 10 per pot 10 d after they germinated . During the experiment , sunlight was introduced and soil water was maintained approximately at preset water hold capacity every day by weighing and adding deionized water . Water use efficiency was determined by $WUE = Y/I$. Y is forage biomass and I irrigation water . The transpiration rate was measured under clear and sunny weather using a portable photosynthesis system (LI-6400 , LI-COR Inc . , Lincoln , NE) .

Results WUE of alfalfa plants was different under the different soil moisture conditions . The addition of silicon significantly increase the WUE of alfalfa plant under the 50% and 65% of FWC conditions (Figure 1) . However , under the 80% and 35% of FWC conditions , addition of silicon had no effect on water use efficiency . This study also showed that WUE of alfalfa plants with +Si treatments under the 50% of FWC condition was significantly higher than that under the 65% of FWC condition . Silicon application significantly reduced the transpiration rate of alfalfa leaves across the four soil moisture conditions (Figure 2) . Compared to the transpiration rate of plants with Si treatments , the transpiration rate of control plant was lower under the 35% of FWC conditions and higher under the 80% of FWC conditions , however , no difference under the 50% and 65% of FWC conditions .

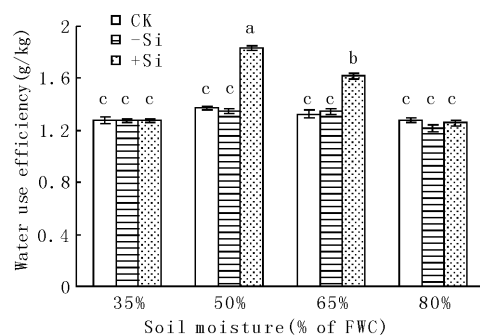


Figure 1 Effect of silicon on WUE under each soil moisture conditions .

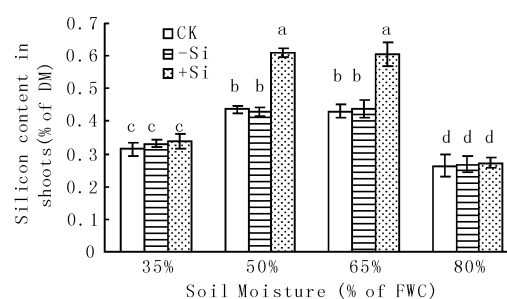


Figure 2 Effect of silicon on transpiration rate under each soil moisture conditions .

Conclusions Silicon application significantly increase the water use efficiency under the lightly and moderately water-stress environments (50% and 65% of FWC) by mainly reducing leaf transpiration rate . Silicon , however , had no effect on WUE of alfalfa under the serious water-stress and wet condition . This observation is not in agreement with the results from *Sorghum bicolor* , in which silicon application had no effect on WUE in both wet and dry conditions (Hattoria et al . , 2005) . These results suggest that the response of water use efficiency of crop plants to silicon application is related to soil moisture condition in which plants grow .

References

- Guo G Z . , Liu H X . , Tian F . P . , Zhang Z . H . , Wang S . M . (2006) . Effect of silicon on the morphology of shoots and roots of alfalfa (*Medicago sativa*) . *Australian Journal of Experimental Agriculture* , 46 , 1161-1166 .
- Zuo C . Q . , Gao P . , Liu Y . J . , Wang L . J . , Zhang F . S . (2005) . Effects of silicon on water use efficiency in sunflower with solution culture . *Plant Nutrition and Fertilizer Science* , (2005) , 11 , 547-550 .
- Hattoria T . , Inanaga S . , Arakib H . , Ana P . , Moritac S . , Luxov M . , Lux A . (2005) . Application of silicon enhanced drought tolerance in *Sorghum bicolor* . *Physiologica Plantarum* , 123 , 459-466 .