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Effect of silicon application on water use efficiency of alfalfa plants

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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 .

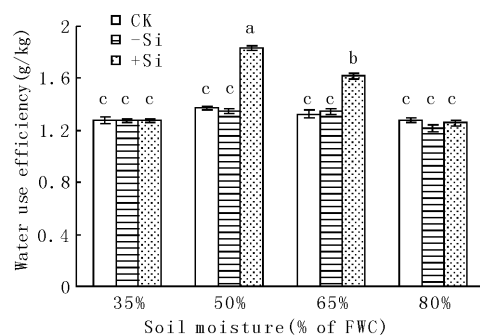


Figure 1 Effect of silicon on WUE under each soil moisture conditions .

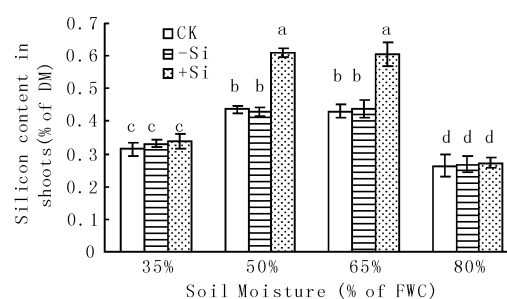


Figure 2 Effect of silicon on transpiration rate under each soil moisture conditions .

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 .