Estimating Stomatal Conductance with Computer Modeling

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To understand how various plants handle drought, we need to measure the rate at which water moves from the roots, through the plant, and back into the atmosphere.

During transpiration, water vapor is released from the plant through tiny pores on the underside of the plant leaf called stomata. The carbon dioxide required for photosynthesis also enters the plant through these openings. Therefore, a reliable computer model of stomatal conductance is useful in analyses involving both photosynthesis and transpiration. This information is also useful in ecosystem simulation.

Several stomatal conductance models have been developed, but one described by Gao et al. (2002) seems to be the simplest because it only requires soil water potential, relative vapor pressure deficit and photosynthetically active radiation values. Jinzhi Wang, a Visiting Scholar from the Chinese Academy of Science, tested this model on plants in a native mixed-grass prairie at the CGREC.

Wang used a LI-6400 Portable Photosynthesis System to measure the photosynthetic rate and stomatal conductance of seven dominant plant species in both moderately and heavily grazed pastures under natural rainfall conditions, as well as under rain-out shelters that simulate drought. These species were: smooth brome, Kentucky bluegrass, green needlegrass, western snowberry (buckbrush), rigid goldenrod, white sage and Flodman’s thistle. Weekly measurements of photosynthetically active radiation, relative humidity, soil moisture, and air temperature and pressure also were made.

The predicted values of stomatal conductance fit the measured ones quite well for green needlegrass, Kentucky bluegrass and buckbrush. However, predicted values were not close to the measured values for the other species. Further data analysis, along with more field data to be collected next year, will be used to better calibrate the model for use in the mixed-grass prairie.

For more information, visit the CGREC Web site at www.ag.ndsu.edu/streeter.