RADIATION USE EFFICIENCY IN COTTON: EFFECT OF ENVIRONMENT AND PLANT GROWTH REGULATORS

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Abstract

Crop growth depends on the amount of intercepted radiation and the time allowed for growth (Sinclair and Muchow, 1999). The effectiveness of a crop to convert intercepted radiation to dry matter is called radiation use efficiency and is defined as the amount of dry matter produced per unit of radiation intercepted ($g \cdot MJ^{-1}$). The correlation of dry matter to intercepted radiation has been described as linear (Monteith, 1977). Both biotic and abiotic stresses such as pest infestation, salinity, water deficit, and increasing vapor pressure deficit have been reported to reduce radiation use efficiency of many crops.

It is logical to assume that radiation use efficiency of cotton differs among geographic locations, as in the contrasting environments of Arkansas and California, due to differences in environmental parameters, i.e. vapor pressure deficit. A two-year study (2006 and 2007) was conducted in Marianna, AR and Fresno, CA to compare the radiation use efficiency of cotton. Radiation use efficiency differed significantly between the two locations in one of the two years of the study and across years, with the Arkansas location having higher values of radiation use efficiency. The California location had higher day temperature, incoming radiation and vapor pressure deficit, while the Arkansas location had higher night temperature and relative humidity. Increasing vapor pressure deficit decreased radiation use efficiency of cotton by a slope of 0.47 $g \cdot MJ^{-1} \cdot kPa^{-1}$.

In addition, as plant growth regulators affect crop growth and canopy dynamics they should also be expected to alter radiation use efficiency of cotton. In 2006 and 2007 the effect of mepiquat chloride on radiation use efficiency of cotton was evaluated in the University of Arkansas Agricultural Research and Extension Center in Fayetteville, AR. The plant growth regulator application significantly increased radiation use efficiency in 2006. In addition, mepiquat chloride application significantly reduced height, leaf area and dry matter weight at the beginning of flowering in 2006 and also altered the dry matter partitioning. Finally, the mepiquat chloride treated plants intercepted significantly lower amount of radiation in 2007 and had a higher value of canopy extinction coefficient.

References

Monteith J.L. 1977. Climate and Efficiency of Crop Production in Britain. Phil. Trans. R. Soc. London, B 281:277-294.

Sinclair T.R. and R.C. Muchow. 1999. Radiation use Efficiency. Adv. Agron. 65:216-265.