SUITABILITY OF CROP CANOPY SENSORS FOR DETERMINING IRRIGATION DIFFERENCES IN MAIZE

T.M. Shaver, S. van Donk, and G.R. Kruger

Department of Agronomy and Horticulture
University of Nebraska-Lincoln, WCREC
North Platte, Nebraska

SUMMARY

Water is the most limiting factor for agricultural production in the semiarid Great Plains of the United States. Dry climate conditions combined with a large availability of ground water has led to crop production systems that are highly dependent on irrigation for maximum and stable yields (Opie, 2000). Increasing the efficiency of irrigation water used for crop production is important in semiarid environments (Howell, 2001). Crop canopy sensors may have the potential to determine the water status of crops. If this potential can be realized, an effective, non-invasive way to determine the water requirement of crops could be developed that may lead to decreased applications of water for crop growth. A study was initiated to evaluate the potential of a crop canopy sensor to differentiate between irrigation levels at two corn (Zea *mays*) growth stages (R3 and R5). The sensor was placed in three orientations to evaluate which best determined corn irrigation across two sensor calculated indices while avoiding taking measurements involving the corn tassel. These orientations were 1) nadir, between corn rows (above canopy), 2) 45° off nadir within the corn canopy (below corn tassel), and 3) 90° off nadir within the corn canopy.

Results show that the sensor could differentiate between irrigation levels at the R3 and R5 corn growth stages. At the R3 corn growth stage crop canopy calculated red-edge normalized difference vegetation index (ReNDVI) differentiated high and low irrigation treatments across all treatments tested (Fig. 1).

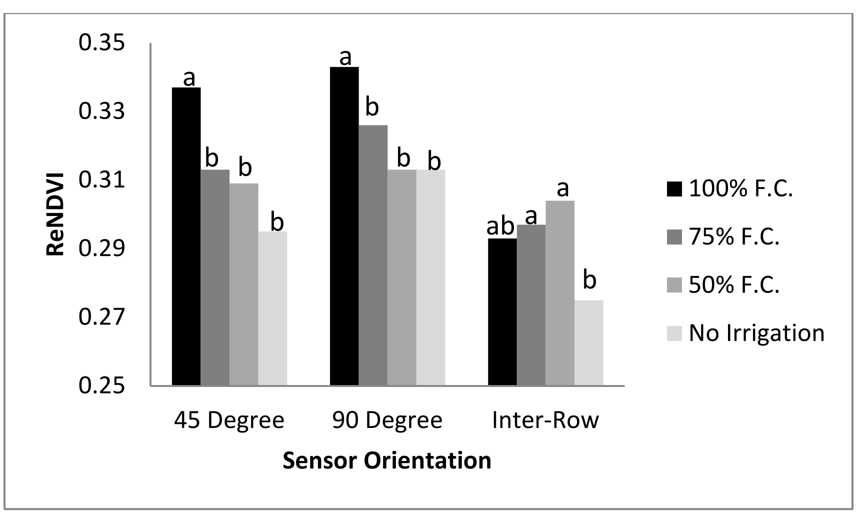

Figure 1. Corn red-edge normalized difference vegetation index (ReNDVI) as affected by sensor orientation and irrigation at the R3 growth stage.

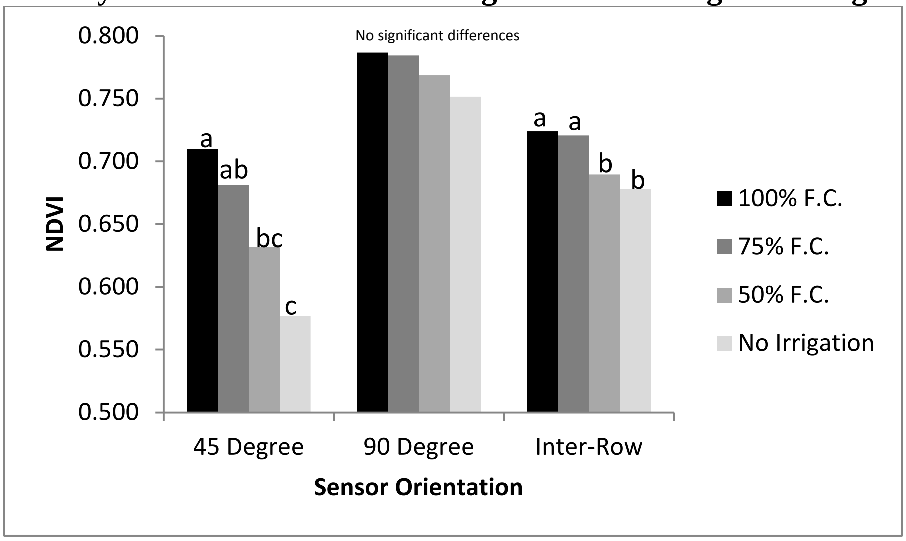

Figure 2. Corn normalized difference vegetation index (NDVI) as affected by sensor orientation and irrigation at the R5 growth stage.

At the R5 corn growth stage normalized difference vegetation index (NDVI) differentiated high and low irrigation treatments at the 45 degree and inter-row orientations (Fig. 2).

There was no clear benefit to sensor readings by changing sensor orientation to within the canopy. Each sensor orientation was tested in eight ways; two growth stages (R3 and R5) and two indices (ReNDVI and NDVI) across two sites. The 45° within canopy orientation yielded significant trends in three out of eight measurements. The 90° within canopy orientation yielded significant trends in five out of eight measurements. The inter-row orientation also yielded significant trends in five out of eight measurements. This suggests that the 90° and inter-row orientations worked equally well for the determination of irrigation effects on corn growth. This could be of great benefit for practical application purposes. If the sensor can be used above the canopy inter-row, this is beneficial from a mounting standpoint. Placing the sensor within the canopy (as with the other two sensor orientations tested) could be quite challenging if readings are taken in manners other than by hand.

The results of this study suggest that a Crop Circle 430 (Holland Scientific, 2010) crop canopy sensor can distinguish among different irrigation rates in corn at later growth stages (R3 and R5) when irrigation is usually critical in the semiarid Great Plains. While more study is needed, this suggests that crop canopy sensors may be a valuable tool not only in increasing water use efficiency as well.

REFERENCES

Holland Scientific. 2010. Crop Circle ACS-430 User's Guide. Holland Scientific, Inc. 6001
South 58th Street, STE D, Lincoln, NE. 68516.

Howell, T.A. 2001. Enhancing Water Use Efficiency in Irrigated Agriculture. Agron. J. 93: 281-
289.

Opie, J. OGALLALA: Water for a Dry Land. 2000. University of Nebraska Press.