

Public Abstract

First Name:Andrew

Middle Name:David

Last Name:Rackers

Adviser's First Name:Allen

Adviser's Last Name:Thompson

Co-Adviser's First Name:

Co-Adviser's Last Name:

Graduation Term:FS 2011

Department:Civil Engineering

Degree:MS

Title:DEVELOPMENT AND APPLICATION OF VARIABLE RATE IRRIGATION TECHNIQUES ON NON-UNIFORM SOILS USING CENTER-PIVOT IRRIGATION SYSTEMS

Variable rate irrigation was studied for the production of corn and rice on a non-uniform soil texture using a three tower, conventional, center-pivot irrigation system on the East Marsh Pivot (Marsh Pivot) at the University of Missouri Delta Research Center in Portageville, MO. The soil of the Marsh Pivot is of the Hayti-Portageville-Cooter association which have a high variability ranging from poorly drained soils (low sand) to well drained soils (high sand). The use of a variable rate irrigation system allowed for the area under the pivot to be divided into sectors (areas divided at a specified degree from north) or zones (areas divided at a specified degree from north and along the length of the pivot arm). This division enabled the volume of applied water to be varied across the field to reduce water losses due to infiltration. Veris Technologies's<sup>™</sup> Soil Electrical Conductivity (EC) System was used in 2002 to determine the sand content within the soil. The mean sand was calculated from two readings, one shallow and one deep. Only the deep reading was used to calculate the sand content of the soil across the pivot because the EC from the deep reading had the better correlation with the calibration soil samples from the Marsh Pivot.

Six irrigation treatments were used for corn irrigation in 2009 on the east half of the Marsh Pivot in nine sectors. Six irrigation treatments were also studied for corn production on the west half of the Marsh Pivot in six 30o sectors. In 2009, 15 mm was used to produce the maximum yield for corn, but in 2010 46 mm was used to produce the maximum yield for corn on the non-uniform soils. However, for both years 8 mm produced yields equal to or greater than all other irrigation treatments at the 95% confidence interval. From the two years of available data, the best suited irrigation practice for corn production on the non-uniform soils at the Marsh Pivot is to irrigate a depth equal to the evapotranspiration rate of the corn for the given climate, 8 mm-d-1 for sub-humid regions. However, this practice may not be appropriate for all situations and therefore should be used with caution.

Variable rate irrigation was used to irrigate seven repetitions of six irrigation treatments on the east half of the Marsh Pivot to determine if center-pivot irrigation is suitable for cultivating rice while conserving water (compared to conventional flood irrigation) on non-uniform soils. Conventional flood irrigation was not utilized during this study. For comparison purposes, yield values for conventional flood irrigation from Vories et al. (2002) were used to determine if similar or greater yield values could be achieved for center-pivot irrigation in a sub-humid climate. Through this study it was shown that compared to conventional flood irrigation, center-pivot irrigation can produce average yields greater than conventional flood irrigation (8970 kg-ha-1 vs 7040 kg-ha-1, Vories et al., 2002) while using less applied water for an application depth of at least 11 mm, applied every other day (790 mm vs 1200-1600 mm, Jehangir et al., 2004). This comparison does not provide a definitive conclusion for the use of center pivot irrigation over conventional flood irrigation, because study years and location were not the same. However, it does show the use of center-pivot irrigation for rice production is possible and should be further studied.