Effect of Controlled Drainage and Subirrigation on Corn Evapotranspiration

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Abstract

The effect of controlled drainage and subirrigation (CDS) on crop evapotranspiration (ETc) was assessed by measuring the energy flux components with an eddy covariance system over six years for corn (4 yrs.), soybean (1 yr) and sugarbeets (1 yr). The results illustrated that CDS treatment had significant effect (P<0.05) on ETc during the high crop water demand period. The CDS treatment increased the soil water content and resulted in a better yield. Utilizing CDS practice provided better distribution of moisture in times without sufficient rain events.

Materials and Methods

The study site (44 ha) is located in Clay County, MN (Fig. 1). The data were collected during the growing season (May-October). The site is a poorly drained silty clay loam soil (30 to 38% of clay) and nearly flat with shallow water table. Pairs of soil moisture sensors and pressure transducers were used to monitor soil moisture, and water table fluctuation above and between tile drainage locations (Fig. 2).

Eddy covariance system was used to measure energy flux components with 10 Hz frequency and stored data as an average of 30-minute value to calculate the ETc.

Results

CDS had significant impact on the overall water balance. CDS treatments increased ETc and reduced the soil deficit during the critical stage of growing period (Fig 3), and prevent crop from yield reduction (Tan et al, 2012). Keeping the water in the field as a result of control drainage reduced drainage outflow especially for wet years in which crops utilized from available moisture during the critical stages of water requirement.

Conclusion

High-quality measurements of ETc using eddy covariance were obtained for six years. The comparison of years with the same crop showed that despite the weather condition, controlled drainage and subirrigation (CDS) can increase the ETc and crop yield. Due to non-uniform distribution of rainfall among the growing season, controlled drainage provide an ability of using soil storage capacity and keeping soil moisture for a longer time. Using one time subirrigation during critical stage of growing season can satisfy crop water requirement, increase crop transpiration to the highest level and can prevent crop from yield reduction.

Acknowledgments

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References


Contact Info

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Table 1. Summary of measured and calculated data

<table>
<thead>
<tr>
<th>Year</th>
<th>Crop</th>
<th>Rainfall (mm)</th>
<th>Sub-irrigation dates</th>
<th>Sub-irrigation (in)</th>
<th>Seasonal Avg. ETc (mm/day)</th>
<th>Seasonal Avg. ETc (mm/day)</th>
<th>Yield (kg/ha)</th>
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<tbody>
<tr>
<td>2012</td>
<td>Corn</td>
<td>167</td>
<td>0.31</td>
<td>4.7</td>
<td>2.8</td>
<td>7.783</td>
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<td>2013</td>
<td>Corn</td>
<td>594</td>
<td>03 Aug.</td>
<td>0.16</td>
<td>3.8</td>
<td>2.6</td>
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<td>2014</td>
<td>Soybean</td>
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<td>29 Jul. to 01 Aug.</td>
<td>1.79</td>
<td>4.1</td>
<td>3.1</td>
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<tr>
<td>2015</td>
<td>Sugarbeets</td>
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<td>-</td>
<td>4.2</td>
<td>3.8</td>
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<td>2016</td>
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<td>2 &amp; 6 Sep.</td>
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