Crop Yield Effects of Controlled Drainage, Soil Drainage Class, and Elevation
Amanda Locker1, Jane Frankenberg1, Laura Bowling2, Eileen Kladivko2
1Agricultural and Biological Engineering, 2 Agronomy, Purdue University

Introduction
Controlled drainage has the potential to increase crop yields by raising the outlet elevation during the growing season. However, published yield effects have been mixed.

<table>
<thead>
<tr>
<th>Location</th>
<th>Crop</th>
<th>Yield Impact</th>
<th>Reference</th>
</tr>
</thead>
<tbody>
<tr>
<td>Iowa</td>
<td>corn &amp; soybean</td>
<td>no effect</td>
<td>Schroep et al. 2017</td>
</tr>
<tr>
<td>Illinois</td>
<td>corn &amp; soybean</td>
<td>no effect</td>
<td>Cooke &amp; Verma 2012</td>
</tr>
<tr>
<td>Ohio</td>
<td>corn &amp; soybean</td>
<td>no effect</td>
<td>Fayou 2005</td>
</tr>
<tr>
<td>Canada</td>
<td>corn &amp; soybean</td>
<td>no effect</td>
<td>Drury et al. 2006</td>
</tr>
<tr>
<td>North Carolina</td>
<td>corn &amp; soybean</td>
<td>increase</td>
<td>Poole et al. 2013</td>
</tr>
<tr>
<td>Sweden</td>
<td>cereals</td>
<td>increase</td>
<td>Winterstrom &amp; Messing 2007</td>
</tr>
</tbody>
</table>

The objective of this study is to evaluate how soil type or elevation may drive the impact of controlled drainage on crop yields over a multi-year period.

Site Description and Data
The field was located at the Davis Purdue Agricultural Center in eastern Indiana. NW, 3.5 ha NE, 3.6 ha SW, 3.5 ha SE, 3.7 ha

The field had two controlled (NW,SE) and two free (SW,NE) draining quadrants.

Methods
Monthly precipitation data for May-August from the on-site weather station was compared to the 30-year average (1981-2010) for the on-farm NOAA weather station to determine a wet, dry, or normal year by ±100 millimeters.

<table>
<thead>
<tr>
<th>Yearly Wetness Classification</th>
<th>Wet</th>
<th>Normal</th>
<th>Dry</th>
</tr>
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<tbody>
<tr>
<td>Precipitation (mm)</td>
<td>350</td>
<td>250-350</td>
<td>150</td>
</tr>
</tbody>
</table>

2010 Yield (MT ha⁻¹)

- **Controlled**: 15.9
- **Free**: 12

Crop Yield by Treatment

- **Controlled drainage**: significantly increased corn yield in 7 out of 9 years.
- **Free drainage**: increased soybean yield in 3 out of 4 years.

Crop Yield by Soil Type

- **Dry**: means within wetness classification with a different letter are significantly different p-value is 0.05

Crop Yield by Elevation & Wetness Classification

- **Elevations (<30 cm, 30-60 cm, >60 cm)**

Statistical Analysis
- The yield response equation to be estimated was
  \( y_{ijt} = \beta_0 + \beta_1 x_{ijt} + \beta_2 + \epsilon_{ijt} \)
- \( r_{ij} \) account for temporal effect over the years, known as spatial symmetry
- The spatial correlation was contained in \( \epsilon_{ijt} \) by assuming the following spatial covariance structure \( \sigma^2 \exp(-d_{ij}/\theta) \)
- A t-test was used to analyze crop yield and treatment by year.

Results

- **Controlled drainage**: significantly increased corn yield in the very poorly and very poorly drained soils during dry years, and the somewhat poorly and very poorly drained soils during wet years.

Conclusion

- Controlled drainage has the potential to increase crop yields by raising the outlet elevation during the growing season. However, published yield effects have been mixed.
- The objective of this study is to evaluate how soil type or elevation may drive the impact of controlled drainage on crop yields over a multi-year period.

References: