Introduction

Variable Rate Irrigation (VRI) allows for site specific watering depths that provide the potential to optimize water use. There are numerous factors that impact effectiveness of irrigation, including soil properties, topography, runoff, run-on, tillage practices, crop condition, and previous weather events. Topographic wetness index utilizes elevation data to estimate locations that have potential to be wetter than other regions based solely upon terrain. Wetness index was analyzed using GIS to investigate any existing relationships with recorded soil moisture values. The objective of this study was to analyze wetness index values with watermark data and compare consistencies between the two.

Materials and Methods

- Watermark sensors (Fig 1.) were installed into an irrigated cornfield in Hamilton county at six different locations.
- Depths of 0.5, 1.5, 2.5, 3.5, and 4.5 ft were installed and connected to a data logger which took readings every 10 minutes.
- Watermark sensors are an accurate and affordable way to monitor soil moisture status at multiple locations combined with wireless transmitters which are relatively low maintenance.
- Soil samples were also collected and tested results used to convert watermark data to volumetric water content.
- ArcGIS was used to calculate wetness index values.
- RTK GPS data were used to create a digital elevation map (DEM) by interpolation (Fig 2).
- TauDEM (Terrain Analysis Using Digital Elevation Models) was used to analyze the elevation data to determine the specific catchment and slope of each cell.
- Cell sizes of 3 m² and 10 m² were used.

Wetness Index Results

- ArcGIS was used to calculate WI throughout the field based upon RTK GPS data which was interpolated and transferred to a surface. For sensors A through F (with the exception of C), the index values of the 3 m² cell and 10 m² cell were used as the WI for that sensor location. Location C fell close to a boundary which resulted in a significant difference between adjacent cells so this was taken into consideration.
- The range of WI values of the study field was 3.2 to 24 with most locations having a value of greater than 9; results are in table 1.

<table>
<thead>
<tr>
<th>Sensor</th>
<th>Location</th>
<th>Resolution</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>10 m</td>
<td>3 m</td>
<td>13</td>
</tr>
<tr>
<td>B</td>
<td>6.22</td>
<td>9.15</td>
<td>17</td>
</tr>
<tr>
<td>C</td>
<td>9.5</td>
<td>8.3</td>
<td>6.9</td>
</tr>
<tr>
<td>E</td>
<td>9.6</td>
<td>9.8</td>
<td>7.4</td>
</tr>
<tr>
<td>F</td>
<td>7.4</td>
<td>7.5</td>
<td>9.8</td>
</tr>
</tbody>
</table>

*Location C includes additional adjacent cell value

Conclusions

For the study field, higher WI values did not result in a wetter profile over an extended period. When observing rain events it was concluded that the 1’ AW indicated greater variability in AW when compared to 2’ AW. The 1’ AW estimates showed the greatest correlation with WI. These results suggest that precipitation exceeded infiltration rates which resulted in runoff. As a result, locations with higher WI may have received run-on which caused higher AW values at 1’ depths. Less correlation between WI and AW at 2’ depths may have resulted from different subsoils or other underlying factors.

Acknowledgements

- Alan Boldt, Tyler Smith & Julia Alves with the University of Nebraska Department of Biological Systems Engineering
- Our Cooperating Producers
- UNL Agricultural Research Division