Comparing Weekly Irrigation to Rain Sensor Performance

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Rain Sensors in Texas

- Also referred to as Rain Shutoff Devices
- 2009 State of Texas started requiring rain or moisture shutoff devices on all new automatically controlled irrigation systems
  - Majority of irrigation professionals use rain shutoff devices
- Many irrigation professionals (and homeowners) do not really understand how a rain sensor works
  - Many Question their use in irrigation scheduling
Questions about Rain Sensors

* How do Rain Sensors Operate?
  * How long will they prevent operation of the controller?
* How does Rain Sensor Performance effect weekly irrigation scheduling?
  * Should irrigation professionals create irrigation schedules that assume (average) rainfall?
Rain Sensor Study
Rain Sensors

* Hunter
  * Mini-Click
  * RFC*
  * RainClick
* Orbit 57069N
* Weathermatic 420GLS
* Toro TRS
* Rainbird
  * RSD-BEX
  * WR2-RFC*
Study Period

- Sensors installed October 2018
- Datalogger recorded timestamp when sensor triggered and “resumed irrigation”
- Sensors installed for minimum threshold, (1/8”)
- To Date (9/30/19)
  - 43 Rain Sensor Triggering Events
  - Total Rainfall: 47.79 inches
Analysis Breakdown

* What effects Sensors “off-time”??
  * Total Rainfall
  * Rainfall Period
    * Time from first rain to last rain recorded
  * Total Rain Time
    * Data logged hours that had rainfall (Actual Rain Time)
  * Rainfall Intensity
    * Average Total Rainfall / Total Rain Time
Average Off Time

Rainfall Period, Hours

Sensor Activated Time, hours

$R^2 = 0.6828$
Average Off Time

- **Graph Description**: The graph shows the relationship between hours of rainfall greater than 0.10" and sensor activation time in hours. Each data point represents a unique observation.

- **Axes**:
  - Y-axis: Sensor Activation Time, hours
  - X-axis: Hours of Rainfall > 0.10"

- **R² Value**: The coefficient of determination, denoted as $R^2$, is 0.4644, indicating the proportion of the variance in the dependent variable that is predictable from the independent variable.
Average Off Time

Sensor Activated Time, hours vs. Actual Rainfall Hours

R² = 0.7352
Average Off Time Summary

* On Average, “Actual Rainfall Time” had the strongest correlation to sensor triggered period
  * $R^2 = 0.7352$

* On Average, Total Rainfall had the weakest correlation to sensor triggered period
  * $R^2 = 0.3853$
Freezing Effects

- Multiple Devices included Freeze Sensing
- Freeze Period: 11/12/19 - 3/6/19
Freeze Range
November-February (Freeze)

![Graph showing the relationship between rainfall and trigger time, with an R² value of 0.5242.](image-url)
October & March-August 2019 (No Freeze)

R² = 0.6434
When comparing the freezing to the non-freezing season, the rainfall time still showed the stronger correlation to off time, compared to total rainfall.

<table>
<thead>
<tr>
<th></th>
<th>Freeze</th>
<th>No Freeze</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total Rainfall, Inches</td>
<td>0.52</td>
<td>0.19</td>
</tr>
<tr>
<td>Rainfall Hours</td>
<td>0.82</td>
<td>0.64</td>
</tr>
</tbody>
</table>

Normally would expect irrigation to be turned off during the freezing season...
Weekly irrigation needs were calculated for a neighborhood in College Station, Texas

- March – August, 2019
- 26 Weeks

Calculations showed that no irrigation was needed for at least 10 weeks due to rainfall

- Greater than 0.96” of rain per week

The average sensor performance was compared to the irrigation schedules of 8 random irrigation systems in a single neighborhood

- Focus on the 10 Rainfall Weeks
College Station Watering Needs

Irrigation, Inches

Rainfall, Inches

0 0.1 0.2 0.3 0.4 0.5 0.6 0.7


Irrigation Rainfall

Legend
8 Residential Sites in 1 Neighborhood were selected

Controller Settings were documented for:
  * Start Time – All sites had only 1 start time
  * Runtime
  * Watering Days

<table>
<thead>
<tr>
<th>Site #</th>
<th>Start Time</th>
<th>Sunday</th>
<th>Monday</th>
<th>Tuesday</th>
<th>Wednesday</th>
<th>Thursday</th>
<th>Friday</th>
<th>Saturday</th>
</tr>
</thead>
<tbody>
<tr>
<td>31</td>
<td>5:00 AM</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>34</td>
<td>6:00 AM</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>37</td>
<td>5:30 AM</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>38</td>
<td>4:00 AM</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>39</td>
<td>5:00 AM</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>40</td>
<td>3:00 AM</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>41</td>
<td>6:30 AM</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>42</td>
<td>5:00 AM</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
### Comparing Sensor Operation to Rain Events and Daily Irrigations

**Ave Sensor Performance - Irrigate That Day?**

<table>
<thead>
<tr>
<th>Rain Week</th>
<th>Total Rain</th>
<th>Monday</th>
<th>Tuesday</th>
<th>Wednesday</th>
<th>Thursday</th>
<th>Friday</th>
<th>Saturday</th>
<th>Sunday</th>
<th>(Monday)</th>
</tr>
</thead>
<tbody>
<tr>
<td>11-Mar</td>
<td>0.96</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td><strong>No</strong></td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td>1-Apr</td>
<td>1.53</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td><strong>Yes</strong></td>
<td><strong>No</strong></td>
<td>Yes</td>
</tr>
<tr>
<td>15-Apr</td>
<td>1.61</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td><strong>No</strong></td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td>22-Apr</td>
<td>2.3</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td><strong>No</strong></td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td>29-Apr</td>
<td>4.42</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td><strong>No</strong></td>
<td><strong>No</strong></td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td>6-May</td>
<td>2.26</td>
<td>Yes</td>
<td><strong>Yes</strong></td>
<td><strong>No</strong></td>
<td><strong>No</strong></td>
<td>Yes</td>
<td><strong>Yes</strong></td>
<td><strong>No</strong></td>
<td>Yes</td>
</tr>
<tr>
<td>27-May</td>
<td>1.19</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td><strong>Yes</strong></td>
<td><strong>No</strong></td>
<td>Yes</td>
</tr>
<tr>
<td>3-Jun</td>
<td>2.01</td>
<td>Yes</td>
<td><strong>Yes</strong></td>
<td><strong>No</strong></td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td>10-Jun</td>
<td>1.3</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td><strong>No</strong></td>
</tr>
<tr>
<td>24-Jun</td>
<td>1.03</td>
<td><strong>No</strong></td>
<td><strong>No</strong></td>
<td>Yes</td>
<td><strong>No</strong></td>
<td><strong>No</strong></td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
</tr>
</tbody>
</table>

**Rain Day**
### Site Irrigations based on Average Sensor Performance

<table>
<thead>
<tr>
<th>Site</th>
<th>Total Irrigations</th>
<th>Prevented Irrigations</th>
<th>% Prevented</th>
<th>% Allowed</th>
</tr>
</thead>
<tbody>
<tr>
<td>31</td>
<td>30</td>
<td>5</td>
<td>16.7%</td>
<td>83.3%</td>
</tr>
<tr>
<td>34</td>
<td>30</td>
<td>10</td>
<td>33.3%</td>
<td>66.7%</td>
</tr>
<tr>
<td>37</td>
<td>30</td>
<td>3</td>
<td>10.0%</td>
<td>90.0%</td>
</tr>
<tr>
<td>38</td>
<td>20</td>
<td>9</td>
<td>45.0%</td>
<td>55.0%</td>
</tr>
<tr>
<td>39</td>
<td>30</td>
<td>10</td>
<td>33.3%</td>
<td>66.7%</td>
</tr>
<tr>
<td>40</td>
<td>10</td>
<td>2</td>
<td>20.0%</td>
<td>80.0%</td>
</tr>
<tr>
<td>41</td>
<td>20</td>
<td>7</td>
<td>35.0%</td>
<td>65.0%</td>
</tr>
<tr>
<td>42</td>
<td>30</td>
<td>7</td>
<td>23.3%</td>
<td>76.7%</td>
</tr>
</tbody>
</table>

**Average**: 27.1% 72.9%

*10 Week Period*
Summary

- The amount of rain has little effect on duration a rain sensor is active
- Analysis suggest irrigation professionals (and homeowners) should anticipate the effects of rainfall when programming controllers
  - Maximize the use of controllers with programmable sensor delay
- There is a need for better rain sensor technology that not only detects rain but also takes credit for rain

Controller Rain Gage-Sensors that have been discontinued by Manufacturers
Contact Information

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