Irrigation System Evaluation & Basic Irrigation Scheduling Tools

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http://msue.anr.msu.edu/resources/irrigation
https://engineering.purdue.edu/ABE/Engagement/Irrigation
Have you seen yield map patterns that match the irrigation system configuration?
Irrigation System Uniformity

An 1” application should be 1” everywhere in the irrigated field

• 10% or less deviation from the average is ideal
• Over applied area will likely be over applied each application
• Under applied areas will likely be under applied each application

A 30% deviation on a field in an 8” irrigation application year will have areas receiving as little as 5.6” and as great as 10.4”

Repair all visible system leaks and problems first.
Low Uniformity
  = Under Application in areas
  = Reduced Yields
  = Reduced Income

Even with adequate scheduling a 30% deviation in application uniformity can result in a 40% yield reduction in low application areas of the field.

\[
30\% \times 40\% = 12\%, \quad 150 \text{ acres} \times 200 \text{ bu.} = 30,000 \quad 12\% \times 30,000 \quad 3,600 \text{ bu.} \times 3.5/\text{bu.} = 12,600
\]
Water savings

= Energy Savings

= Reduced Expenses

= Increase Profitability

A 30% deviation on a field in an 8” irrigation application year will have areas receiving as little as 5.6” and as great as 10.4”

• To over apply by 30% to make up for lack of uniformity will take an additional 2.4” of water.

• With average energy cost nearing $3.00/acre.

• A typical 140 acre irrigated field with a 30% deviation will cost over $1000/ year more than uniform system to irrigate.
Make sure the system is within it’s design.

• Has the system changed in length or coverage area?
• Is the water supply flow and pressure what was designed for?
• Sprinkler height?
• End drive changes?
• Tire changes?
Irrigation System Uniformity
Irrigation System Uniformity

Basic system evaluation

Collect enough uniform container to place every 10 feet the length of the system or across the application pattern.

Spread the container every ten feet from the center point to the outside edge of the application area.

Run the system at standard setting over the container.

Measure and record the water volume caught by each container.

Note sample point varying greater than 50% of the average.
Evaluating Irrigation System Uniformity

Pivot Extensions (cornering arm or Z-arm)

- Some center pivot irrigation systems are designed to expand the wetted area to allow coverage of corner or odd-shaped fields, often referred to as cornering arms or Z-arm.
- These systems require two separate evaluations if the extension accounts for 30 percent or more of the irrigated portion of the field.

- One evaluation will evaluate the system while extended, and a second when the arm is not deployed.
Sprinkler overlap with end gun

http://web1.msue.msu.edu/stjoseph/anr/anr.htm
Irrigation System Uniformity

• Most systems are designed to have 90% or better uniformity.

• Changes in **volume** and **pressure** from design parameters will cause reduction in uniformity.

• Some sprinklers can perform well over a large change in pressure over others.

• Multiple overlaps tend to reduce potential problems.
Water supply over or under design

supply over design yield tail up, supply under design yield tail down

Example of Water supply under volume for sprinkler design
Measure flow at desired pressure and match to sprinkler package

Poor performance:

Ask dealer to measure flow at peak water use season and compare to design parameters.
Over and under application issue affect the majority of the application area.
# Center Pivot Percent Timer, Water Applied Estimator Chart

**MSU Extension, St. Joseph County**  
**V 1.0**  
7/24/2007

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<th>Water Applied</th>
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Improving Traveler Uniformity

- Check traveler uniformity by placing catch cans every 10’ across the width of the coverage pattern.
- Traveler lane spacing should be adjusted to create an even application between lanes.
- Spacing will be narrower further from pump or additional pressure will need to be provided.
Improving traveler uniformity

• Measure traveler forward speed at the beginning, middle, and end of the run.

• Traveler forward travel speed may be reduced as more hose is being pulled in the second half of the run.

• Adjust speed accordingly.
Greatest improvement needed

Pivots

• End gun stop adjustment
• Water supply over or under design
• End gun orifice, too little or too much
• Wrong sprinkler or tip
• Leaks, plugs and no turn sprinklers

Trickle/Drip

• Follow a good design
• Line length matched to design
• Supply pressure issues at manifold

Big Gun Travelers

• Traveler lane gap spacing
• Water supply over or under design (pressure at gun)
• Gun orifice, tip wrong
• Wind differences
Most system apply within 85% of the expected application.
Leaching

Full water holding line

Allowable depletion line (40% of available water)

Allowable depletion line (60% of available water)
Average water use for CORN in inches/day - adapted from "Irrigation Scheduling Checkbook Method," Jerry Wright, University of Minnesota, 2002

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</tbody>
</table>

Corn growth stages

- 3 leaf
- 8 leaf
- 1st tassel
- Silk
- Blister kernel
- Early dent
- Dent

Crop Stage | Kc | Rooting Depth | % Growing Season |
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<thead>
<tr>
<th></th>
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<tbody>
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<tr>
<td>Begin Dent</td>
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<tr>
<td>Full Dent</td>
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<tr>
<td>Full Maturity</td>
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</table>

Corn Growth Stages

- 2 leaf (V2): Two collars visible.
- 4 leaf (V4): Four collars visible.
- 6 leaf (V6): Growing point above ground, tassel forms.*
- 8 leaf (V8): Ear formation begins.
- Silking (R1): Silks are visible outside husk.
- Dough (R4): Endosperm milk turns thick and pasty.

* Paint/Mark V6 leaf to make counting easier!

It is the policy of Purdue University Cooperative Extension Service that all persons
Watermark Soil Moisture, 2014 Soybean, Constantine MI

Irrigation Threshold

- 1Foot
- 2Foot
- 3Foot

[Graph showing soil moisture levels over time with irrigation threshold]
Cost Share Opportunities

• Natural Resources Conservation Service (NRCS)
  – Administers USDA Farm Bill Programs
  – Every County is covered by a local NRCS office

• Environmental Quality Incentives Program (EQIP)
  – Covers Entire State of Michigan
  – Cutoff Deadline: March 17th

• Regional Conservation Partnership Program (RCPP)
  – Covers St. Joseph River Watershed (MI & IN)
  – Cutoff Deadline: March 17th (MI)
Program Eligibility

• Land Eligibility
  – Written Control of Land
  – Owned, Leased, other
  – Land under contract must have been irrigated at least 2 out of the last 5 years.

• Individual or Entity Eligibility
  – Farm Service Agency (FSA) records
  – Individual or Business Entity
  – Signatory Authority
Irrigation Conservation Practices

• **Irrigation System – Sprinkler (442)**
  • *Physical system*

• **Irrigation System – Micro (441)**
  – Drip Irrigation outside or in SHT

• **Irrigation Water Management (449)**
  • *Management of system (any type)*
Irrigation System – Sprinkler (442)

Replace sprinkler packages and install pressure regulators on existing Center Pivot irrigation system or existing Linear-Move irrigation system.

Contract Unit = linear feet of lateral pipe (pipe where nozzles are attached)
Irrigation System – Sprinkler (442)

Scenario 1

Coefficient of Uniformity (CU) for retrofitted system must be greater than or equal to 85%.

– Only eligible for existing Center Pivot or existing Linear-Move system with CU less than 85% OR nozzles that are at least 8 years old. (Existing CU documented by in-field system evaluation.)

– Flow measurement with flow meter required for retrofit design.

– Post-retrofit CU ≥ 85% documented by in-field system evaluation, Center Pivot Evaluation and Design (CPED), or manufacturer computer model.

– Only eligible with Irrigation Water Management (contract or conservation plan).
Irrigation System – Sprinkler (442)

- Other scenarios for systems meeting uniformity standard.

- **Scenario 2**
  - VRI System Retrofit
    - Used to address resource concerns related to varying field conditions. Ex: Different Soil Types, Slope, Crops etc.

- **Scenario 3**
  - Fertigation Retrofit
    - Used to address excess nutrients in surface or groundwater
Irrigation Water Management (449)

Payment Rate determined by level of management and size of field. Above or below 30 acre field size. An Irrigation Water Management Plan will be developed.

Can be used with any type of irrigation system.

- **Basic** - Checkbook Method Irrigation Scheduling
  - Record rainfall, irrigation amounts, and soil moisture
- **Intermediate**
  - Basic + using a computer irrigation scheduler
- **Advanced**
  - Computer Scheduler with automatic sensors etc.