Precision Irrigation for Greater Environmental and Economic Sustainability

Mark Reiman
Bayer Crop Science
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Outline

• What is Precision Irrigation?
• How do we get there?
• Starting simple.
• Getting more complex.
• Putting it all together.
What are we worried about?

• Declining water quantity
#ChennaiWaterScarcity Scenes of the dried up Thiruneermalai, Chembarambakkam, Perumbakkam and Korattur lake in Chennai.

All major reservoirs supplying water to Chennai dry up, read: bit.ly/2WLKzwZ
What are we worried about?

• Declining water quantity
• Declining water quality
What are we worried about?
• Declining water quantity
• Declining water quality

2018 Nebraska Groundwater Quality Monitoring Report

Statewide Number & Median of Nitrate Analyses
1974 - 2017

All 129,828 analyses and median nitrate-nitrogen levels for Nebraska, 1974-2017.
(Source: Quality-Assessed Agrichemical Database for Nebraska Groundwater, 2018)
What are we worried about?

• Declining water quantity
• Declining water quality
• Greater pressure on other uses of water
What are we worried about?

• Declining water quantity
• Declining water quality
• Greater pressure on other uses of water
• Legislation forcing adaptation and changing water rights
What are we worried about?

• Declining water quantity
• Declining water quality
• Greater pressure on other uses of water
• Legislation forcing adaptation and changing water rights
• Customer focus on agricultural production and resource use.
What is Precision Irrigation?

• When you hear the term what do you think about first?
What is Precision Irrigation?

• When you hear the term what do you think about first?

  • You probably first think of technology that allows the irrigation system to apply water and crop amendments as it’s need varies across the field.

  • i.e. Variable Rate Irrigation
What is Precision Irrigation?
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What is Precision Irrigation?

• Definition:
  • A system of accurately scheduling and applying irrigation, and amendments to all areas of the field to maximize the desired return to the producer.
  • This is done with the constraints of available resources and equipment.
  • Precision fertigation/chemigation uses the same idea to provide optimum outcomes for the desired factor.
What is Precision Irrigation?

Water Demand

- Crop Type
- Plant Water Use
- Growth Stage
- Crop Type
- Product
- Cover Crop
- Weeds
- Yield Goal
- Weather

Water Use

- Density
- Weather
- Soil Properties
- Topography
- Application Rate

Runoff

- Runoff
- Application Rate
- Residue
- Soil Properties
- Design
- Tillage

Evaporation

- Evaporation
- Residue
- Weather
- Design
- Application Rate

Tillage

- Tillage
- Crop Type
- Plant Water Use
- Growth Stage
- Crop Type
- Product
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- Yield Goal
- Weather

Soil Properties

- Soil Properties
- Topography
- Application Rate
- Precipitation

Application Rate

- Application Rate
- Residue
- Soil Properties
- Design
- Tillage

Growth Stage

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Yield Goal

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Weather

- Weather
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- Yield Goal
So how do we get there?

• Be an **Irrigation Advisor**
  • Farmers really need a partner to help.
  • Take time to listen to what the producer wants and needs to get out of their irrigation environment.
  • Focus on what could be done to help manage the tendency to apply more or less water of fertilizer than necessary.
  • Spend as much time as you can working with fields and using available technology to resolve problems.
So how do we get there?

• Research needs to continue to advance
  • Find and evaluate new tools and ideas
  • Study crop systems to understand all production aspects that impact irrigation demand.
  • Ensure feasibility of the end product.
  • Focus on economic and environmental benefits of precision irrigation systems and communicate it to producers and other stakeholders.
Starting Simple

• Have a well designed system to start with.
• Then you need application hardware that is in good working order.
  • Nozzles: Size, Wear, Functionality
  • Pressure regulators
  • Leaks and other identifiable problems.
Starting Simple

It’s possible to get whole spans with the wrong nozzles.
Starting Simple

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Starting Simple

Pressure Loss

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Span Flow

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Advanced Options

- Drain Sprinkler = Senninger Directional
- Last Sprinkler Coverage = 1.0 ft
- Sprinkler Coverage Length = 338.7 ft
- Use Last Coupler = YES
- Minimum Mainline Pressure = 6.0 PSI

Shipping Options

- Do not ship Hardware
- Do not ship Drain Long Gun
- Do not ship Endgun & Hardware
- Do not ship EndGun Valve / Nozzle Valve Hardware
- Do not ship Boosterpump Hardware
# Starting Simple

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<th>Opl No</th>
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<th>Wear Pad</th>
<th>Drop Length</th>
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Getting more complex

- The next step is accurate irrigation scheduling to match crop needs.
- This is a growing field, but one that has advanced slowly relative to other technologies.
  - It is easier to demonstrate the benefits of other precision technologies.
  - Other technologies require modifying a few machines rather than each field.
  - In general they are well developed and known to make production simpler.
Getting more complex

Adoption of guidance systems (by crop)

Percent of crop planted acres

- Corn
- Cotton
- Peanuts
- Rice
- Soybeans
- Spring wheat

Source: USDA. Economic Research Service estimates using data from the Agricultural Resource Management Survey (ARMS) Phase II.
Getting more complex

U.S. Irrigation: Deciding When to Irrigate

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Getting more complex

Nebraska Irrigation: Deciding When to Irrigate

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<td>Reports on daily crop ET</td>
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<td>When Neighbors Begin to Irrigate</td>
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Getting more complex

- Tools that improve scheduling accuracy for the crop and soil conditions present in the field.
  - Soil moisture monitoring equipment
  - Turgor pressure monitoring
  - Public weather ET information
  - Advanced weather station feedback and ET models
  - Imagery determined field ET
  - Hand feel method
Getting more complex

• To move towards more accurate scheduling we need be able to showcase the benefits.
  • Economic advantages have to be proven.
  • Producers don’t want more log-ins.
  • Environmental gains need to be quantified for support.

• Overall, savings of 2-4 inches of water without negative yield responses are being shown, and there is opportunity for more.
Putting all the pieces together

• Many of the issues lowering sustainability are solved with proper design, maintenance, and scheduling tools.

• To build on the field as a system you can continue to aggregate more information to refine irrigation models.
Putting all the pieces together
Putting all the pieces together

- Another example of aggregate information is better crop response information.
Putting all the pieces together

- Another example of aggregate information is better crop response information.

Corn yield at all irrigation levels both the DroughtGard Hybrids and Aquamax products combined.
Putting all the pieces together

• With these spatial layers you can then start to build out VRI irrigation maps and use equipment capabilities to apply water efficiently.

• The same is true of the crop inputs. With the right information you can basically turn your pivot into a VRI fertilizer applicator.

• With the water savings from improvements and potential Nitrogen savings you are providing the better outcomes you were looking for.
Putting all the pieces together

• VRI is more about better water management and potential gains in over and under watered areas of the field with conventional irrigation.

• Lo et al., 2016 estimated that across Nebraska only 2% of fields would see pumping reductions of 2 inches or more and 13% would see reductions of 1 inch or more.

• Other environmental benefits play a role too. If you are applying the correct amount of irrigation you also leaching less N.
Summary

• Precision irrigation really starts at the simplest level.
• It can continue to be improved for economic and sustainability by aggregating more information.
• Remember there is a solution for the amount of water and crop inputs that maximize your cropping system.
• **Work towards finding it!**
Thank You!