Irrigation and Fertilization Efficiency

David Lankford
Define Efficiency

- Max Production
  - Corn Plants are more efficient at 300 bushel than 200 bushels per acre (factory approach)

- Economic
  - What is the percent return of input cost (cost analysis or cost per unit produced)

- Unit Comparison
  - Bushels per pound of “N” applied (conversion efficiency)

- Reduction of inputs maintaining or improving production
  - Field mapping with variable rate irrigation and fertilizer (Precision Ag, or waste management)
Why Not all of the Above?

• Increase production
• Reduce waste
• Improve conversion
• Improve profit per acre
Think of a Plant as a Chemical Factory

• Sunlight is the energy source
  – Heat drives speed (DGD)
  – Photosynthesis converts inputs

• Water, nutrients and air main input chemicals
  – Roots are the main vehicle for the supply of inputs
  – This is the first “just in time supply system”

• Output is food or fiber
  – Measureable output
What parts of the factory can we NOT manage?

- Heat of the chemical process (Sunlight)
- Excess water or lack air (Rain)
- Reduction of ideal inputting conditions (Eto)
- Damage to factory (Hail or other destructive weather events)
What parts of the factory can we manage?

- Competition for water and nutrient from other factories (herbicide)
- Sabotage of the factory (insecticide)
- Access to nutrients (fertilizer)
- Drought (irrigation)
- Improve Factory conversions (Ph adjustment, amend shortages, etc.)
Challenge

• We have spend years looking at the plant and making adjustments based on yield and looks.
• This method has created the greatest production agriculture system in the world.
• Less is known about the input side of the plant; the roots.
• To achieve better efficiency; just the right amount of inputs, with just in time delivery, to the most active roots is needed to achieve max efficiency.
Facts about Roots

• Designed for two main functions:
  – Anchor the plant to an input source
  – Extract needed inputs for the plant (factory)

• Roots can not import nutrients without water and air
  – Water and nutrients enter through different parts of the root system
  – There are different ways the plants imports nutrients depending on element and conditions
Studying Root using Secondary Evidence

• Monitoring soil in 4 inch slices
• Velocity calculations
• Ion concentration
• Alignment
What does data research show about some common beliefs?

1. The more water the better.
2. The deeper the corn roots the more water it takes up under irrigation.
3. Fertilizer stays where you put it until the plant needs it.
4. Rain/irrigation causes nitrite to be leached below the root level.
5. Corn roots all work the same.
6. Fertilizing corn with one side dress works well.
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The deeper the roots the more water it takes up
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Fertilizing corn with one side dress works well.

This is the total “N” in solution down to 24 inches three sample depths.
Research on crop triggered irrigation

• Clemson Watermelons.
  – 3 water treatments
  – Drip irrigation

• SC peach production.
  – Irrigate by ponds
  – Have to move pumps
  – Long soak periods with micro irrigation

• NJ blueberry.
  – Plant triggered irrigation using inline emmiters

• Corn at IRF center pivot
  – Limited water- 18 inches
Questions