Mobile Drip Irrigation & Variable Rate Irrigation: A review of Existing Research

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What is MDI?

Spray heads (MESA) **Drip Lines, MDI**

MDI Design & Installation Costs

- **Applications:** Center pivot and Linear
- **Companies producers:** Netafim, Dragon Lines
- **Designing**: Based on soil type and crop
- **Space between driplines:**

  Soil type & crop need (between 20 to 40 inches)

- **Emitters:** 1 or 2 gal/hr
- **Costs:**
  - $150-$200 /acre (Yost et al., 2019)
  - $250-$280 /acre, converting LESA to MDI (O'Shaughnessy, 2017)

MDI Mounting Methods

Based on Crop types (crop height) & Row orientation

Tall crops:

Manifold attached to the truss rods or driplines attached directly to the pivot using rigid or flexible drops (Netafim)

Short crops: manifold 3-4 ft from the ground

Water Savings with MDI??

- MDI saves water compared to MESA and LESA
- Surface evaporation from MDI is 35% less than LESA
- 30.6% water savings by MDI (Jones in 2015)
- Improved yields when water is limiting

Average Application Efficiency (E_a)

MESA = 80% LESA = 97% E_a of MDI > LESA

Spearmint, Toppenish, 2017 to 2019

Energy Savings with MDI??

- More water reaches the soil surface per gallon pumped
- Pumps and pivot can be shut off more often
- MDI does not need the same pressures as sprinklers

  Lower pressure & less run time sig. power savings
- A few research studies reported energy savings:
  - 20-70% (Lamede et al., 2017)
  - 40-50% (Derbala, 2003)
  - 70% (Hezarjaribi, 2008)

Other Benefits of MDI

- Significant (!) wheel track reduction
- Better infiltration compared to LEPA/LESA
  - Less runoff
  - Can handle tighter soils and steeper slopes
- Canopy stays dry. Reduces disease pressure and salt contamination when irrigating with high salt irrigation water
- MDI is ideally adapted to forages and small grains

Barriers for MDI

- Cost!
  - Lots of drip tubing, fittings, and hose
  - Very tight filtration requirements
- Drags on ground damages the hoses (less robust than sprinklers that don't touch the ground/crop)
- Damage due to animals
- Tangling and Reversing
- Limited ability to chemigate crop foliage
- Tall crops (corn) can be difficult
- Planting in circles is better

Summary of MDI

- MDI can save *at least* 20% of water compared to MESA
- Electric power savings depends on the particular pump, and water source, operating condition before converting
- Because of higher cost, growers will only be motivated to convert if :
  - Water is limiting
  - Growing higher value crops
  - They have runoff issues

Variable Rate Irrigation

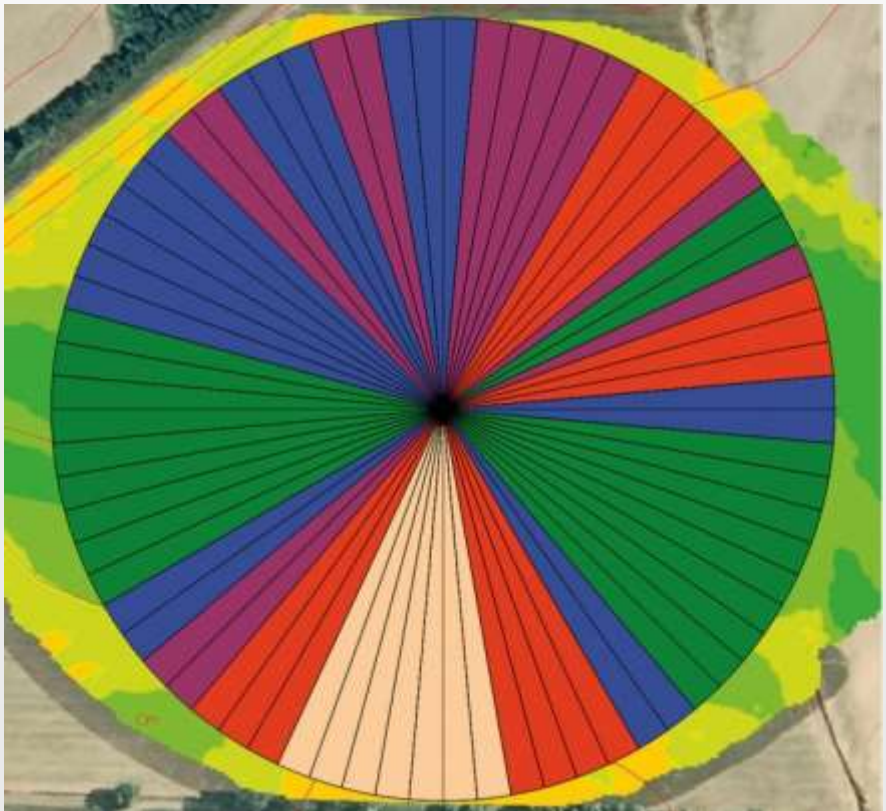
Applying different amounts of water to different areas of the field

Variable Speed Irrigation

- Uses a sophisticated control panel: slow down or speed up the pivot to apply more or less water in different areas of the field
- Many newer pivot control panels have speed control ability

Costs: $2,000 - $4,000

Colors indicate areas with different amounts of water applied



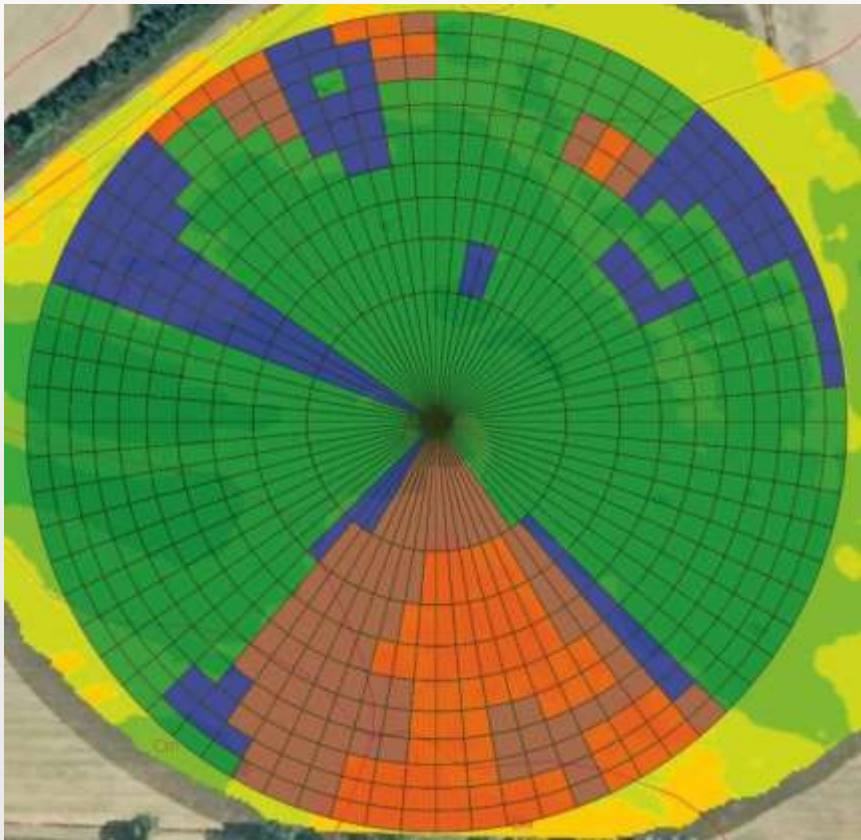
Variable Zone Irrigation

Wide variety of irrigation depths to different areas

- ❑ Variations in application rate along the pivot lateral
- ❑ Variation the speed of pivot as it moves in a circle

Costs: $15,000 - $25,000

Different application rate along lateral is due to pulsing sprinklers on/off for various amounts of time



Water Savings with VRI???

- Does not always conserve water
- Ambiguous water saving, or yield improvement

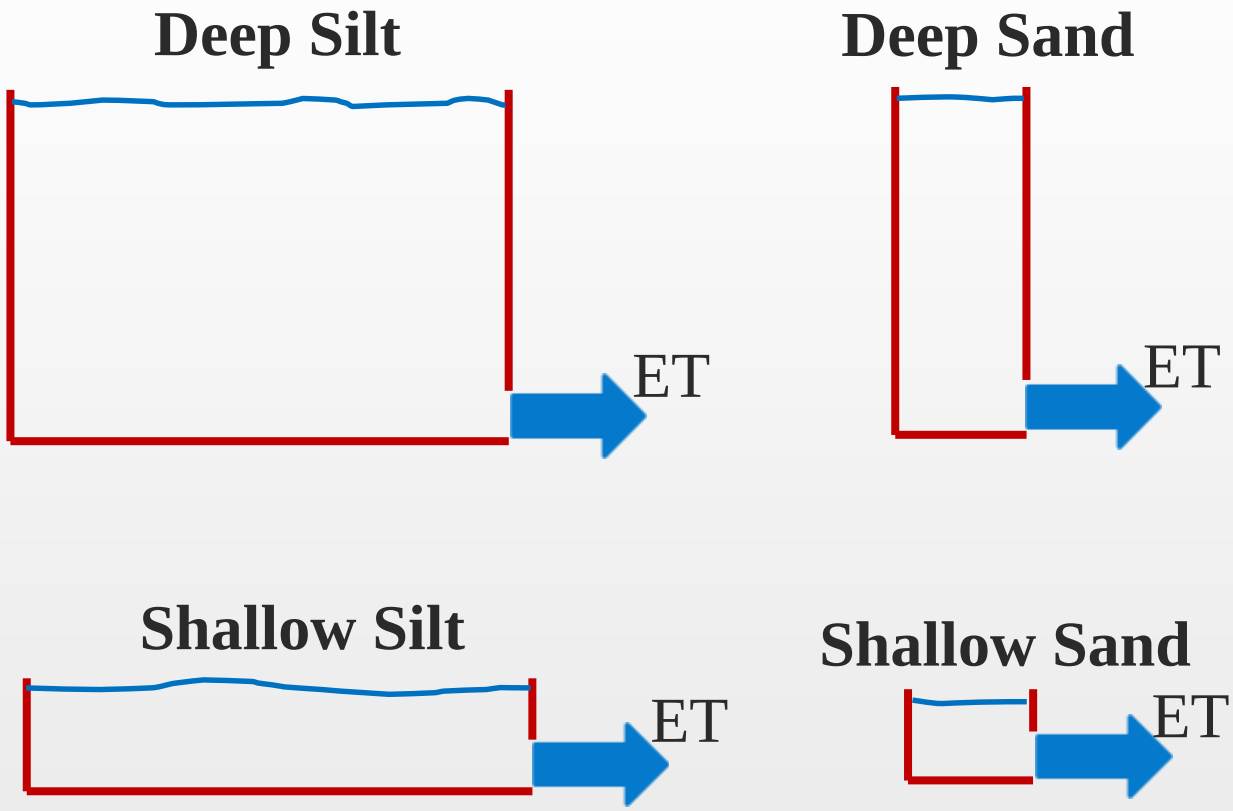
Studies in New Zealand, Missouri and Mississippi

- Large in-season rainfall & large differences in WHC allow
  - To "mine" the soil water
  - Reduce deep percolation
- Saved 4-7%, 9-19%, and 22-26% in different studies
- Reduction in drainage losses of 45%
- 25% less water with VRI (Sui and Haijun, 2017)

Thinking about VRI

Variable Rate Irrigation?

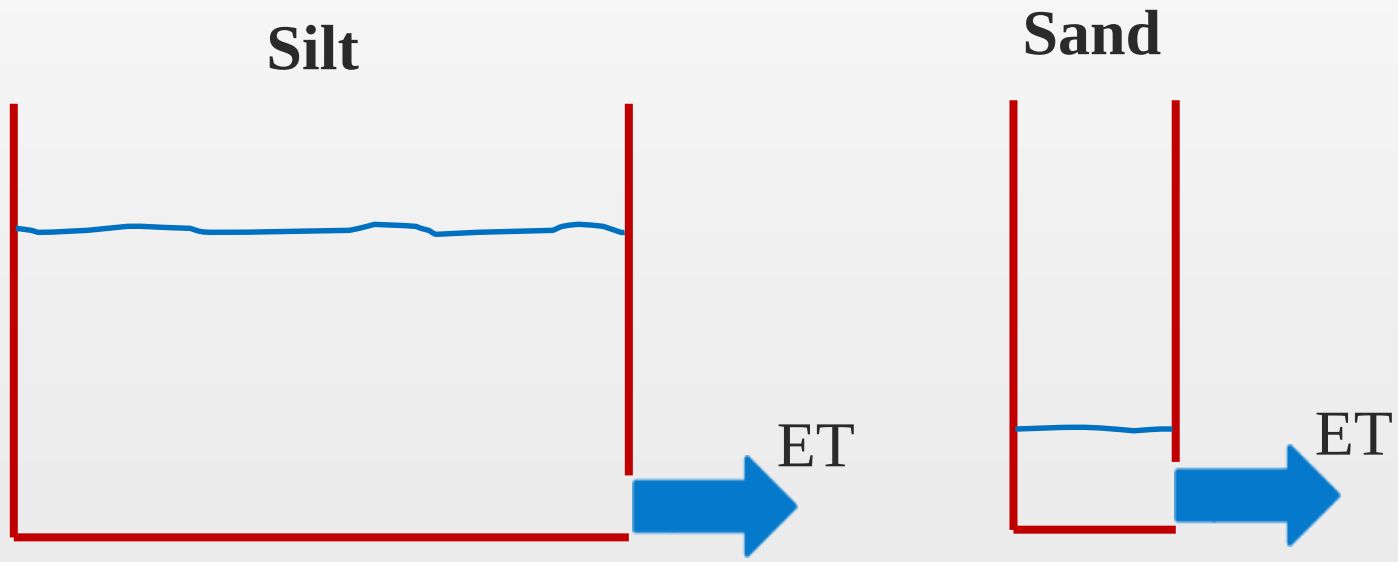
Different Amounts of Water to Different Areas



Most problems can be mostly solved through "precision" *uniform* irrigation management

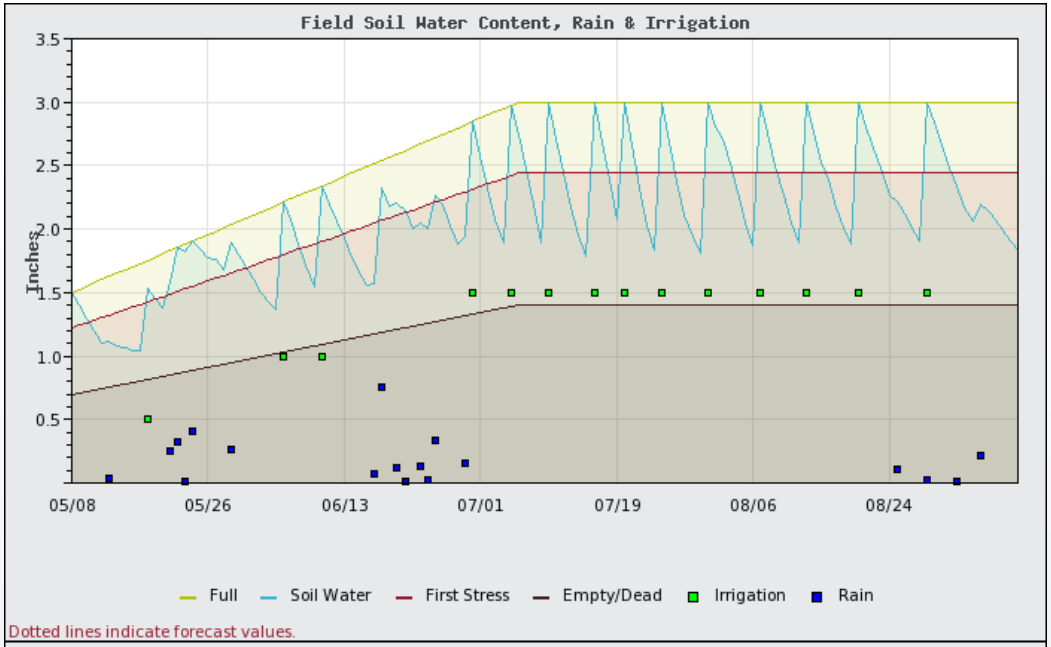
Thinking about VRI

Starting from full, after a few days of water use

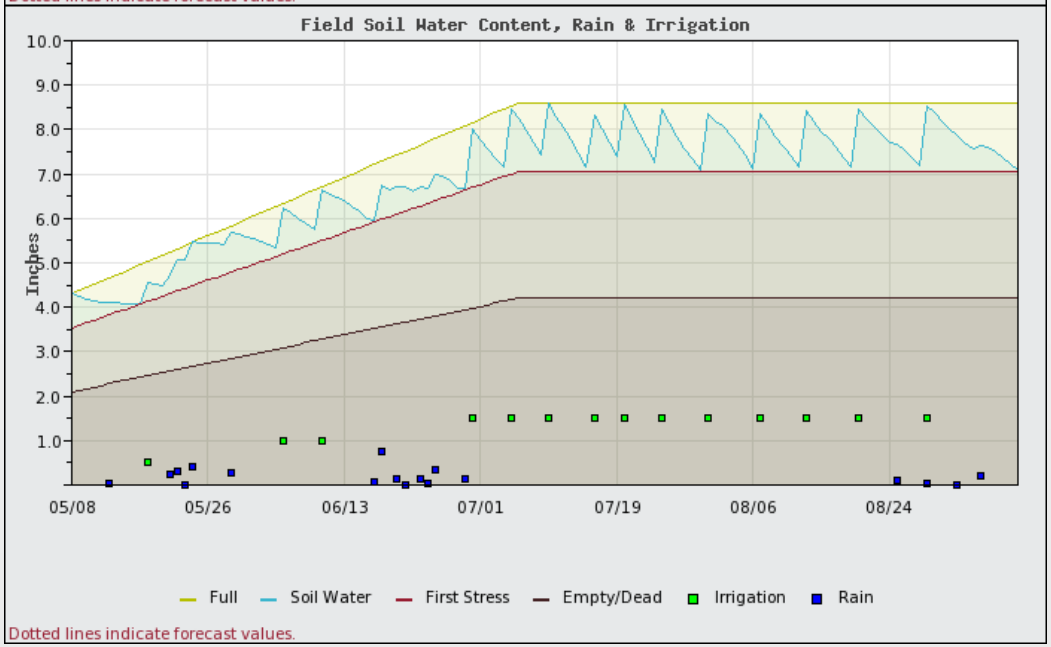


Managed Irrigation Based On the Silt Soils

Shallow Sandy/Rocky Soils

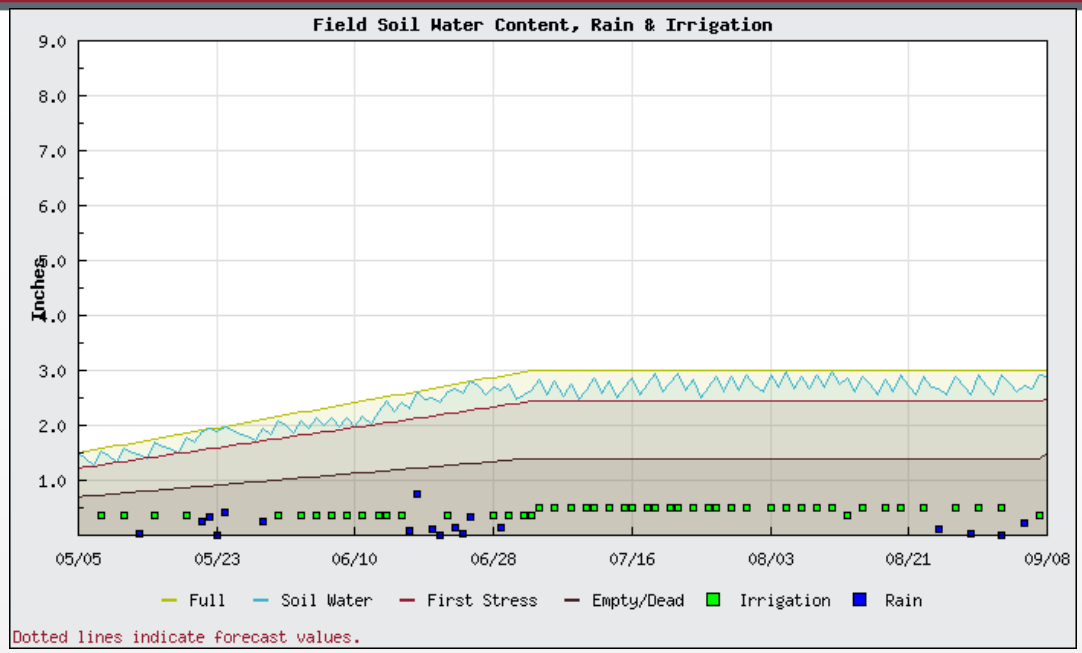


Deep Silt Soils

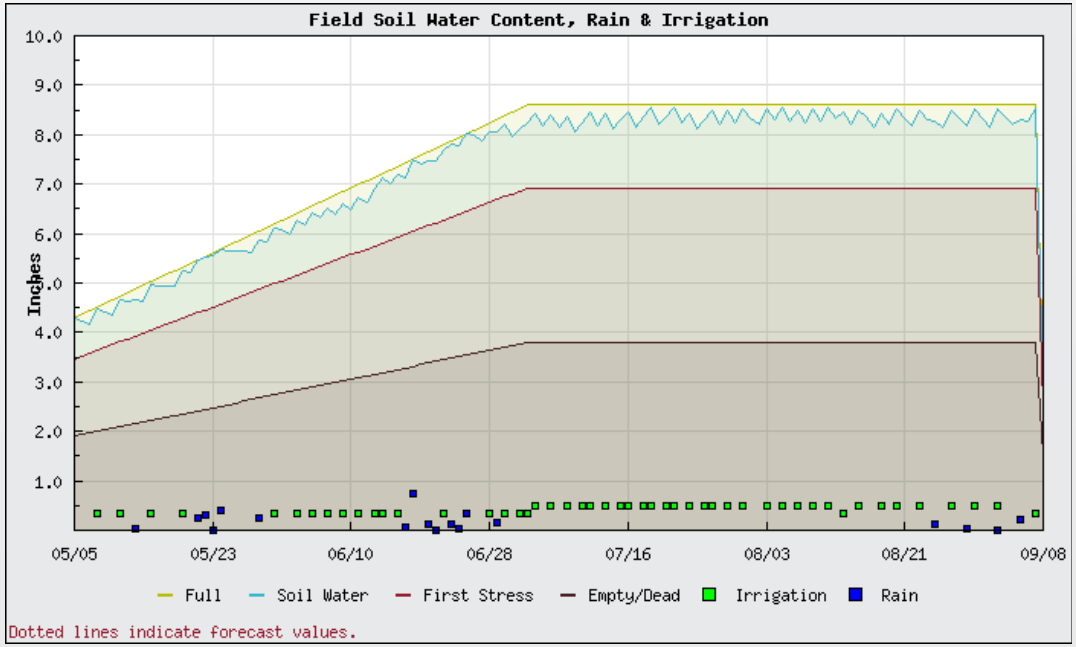


Managed for Sandy/Rocky Soils

Shallow Sandy/Rocky Soils

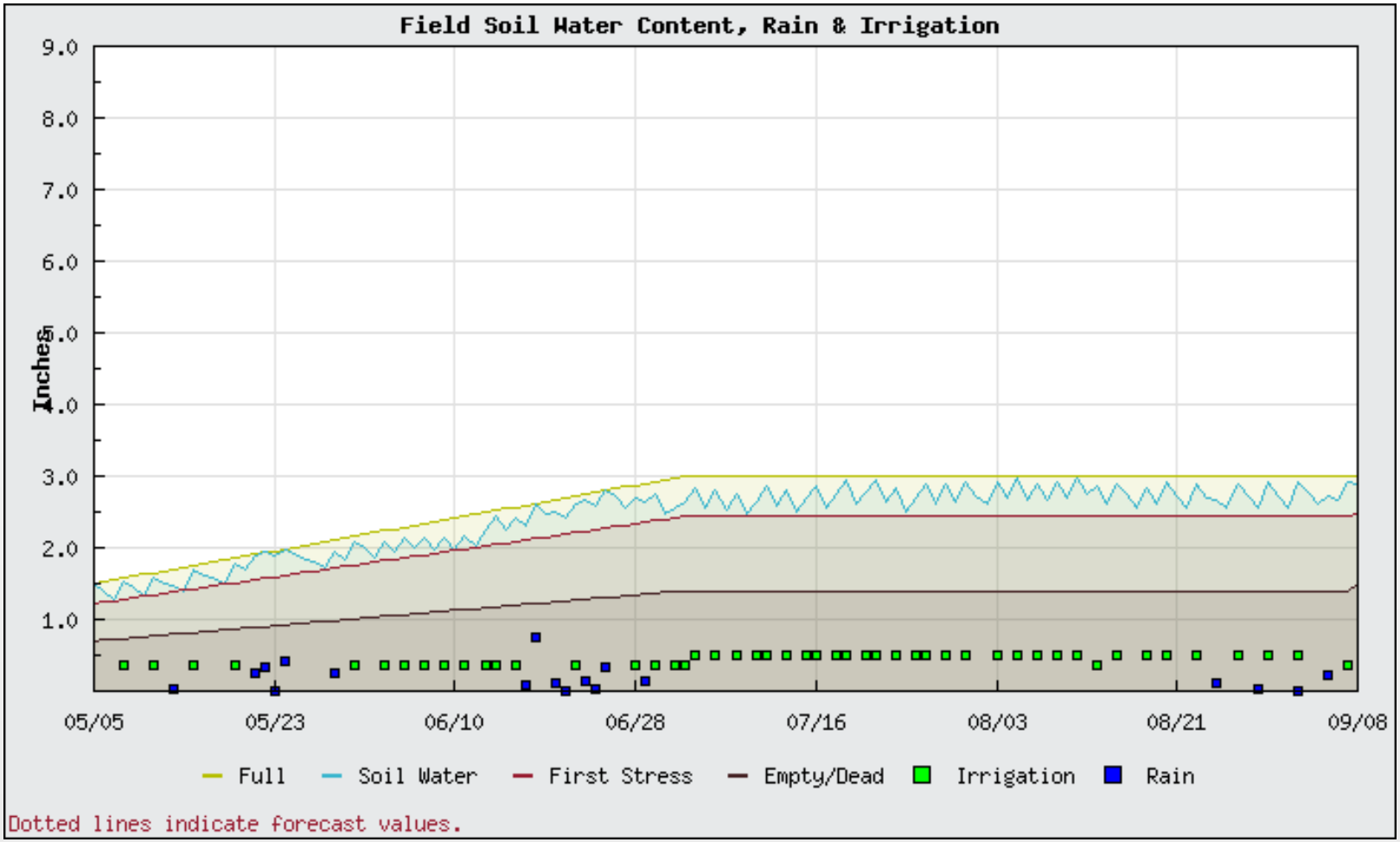


Deep Silt Soils



Thinking about VRI

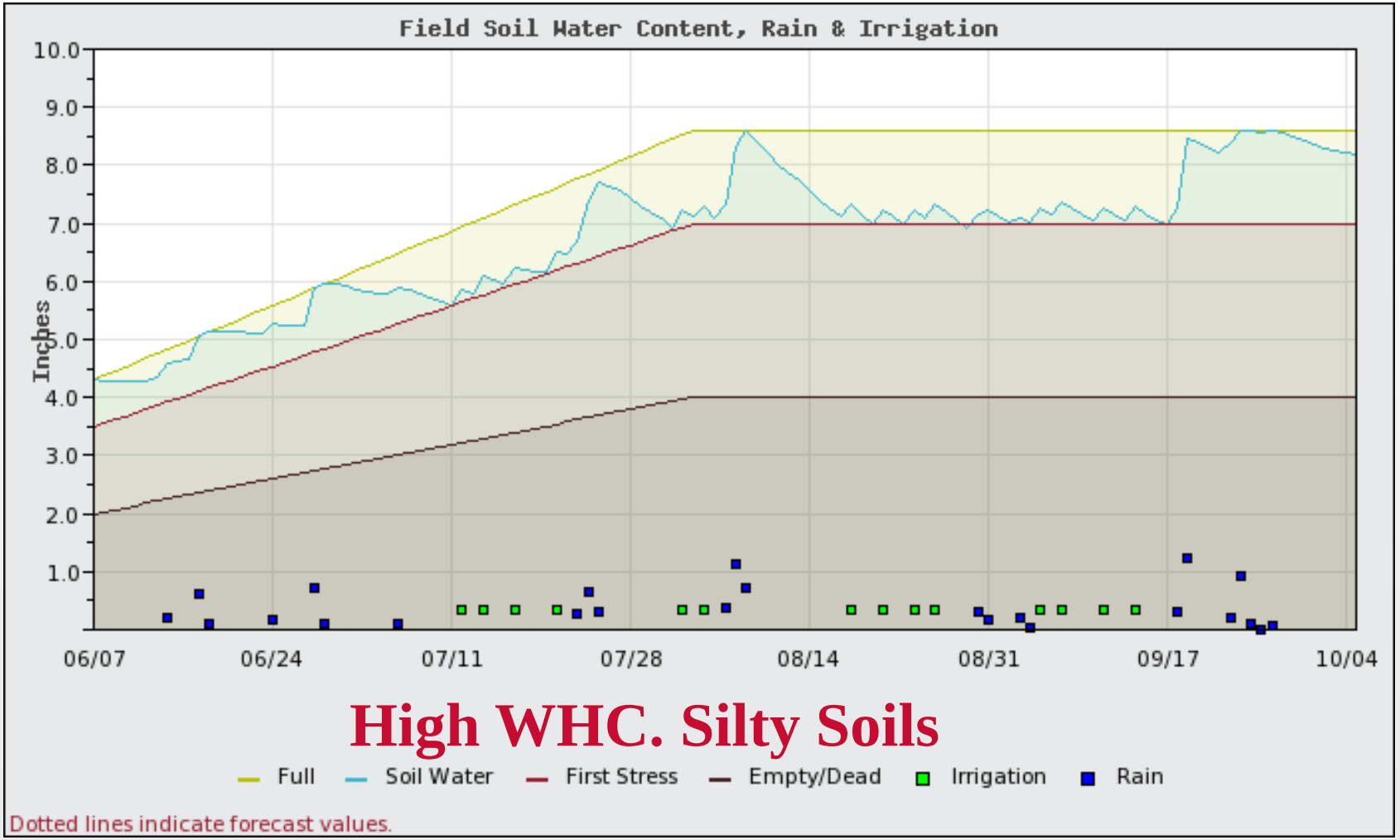
Managing to Maintain Space for Significant in-season rainfall



Low WHC. Shallow Sandy/Rocky Soils

Thinking about VRI

Managing to Maintain Space for Significant in-season rainfall



Requires very close water management in time *and* space

Greatest Profit Potential for VRI

- Consistent prescription maps
  - No irrigation to non-cropped surfaces
  - Crops getting consistent amounts of water from alternative sources

- May be necessary if injecting chemicals that can't legally be applied to non-cropped areas

Benefits of VRI

- Potential to save water and energy is certain situations!
- Simple water and energy conservation opportunities when using VRI to avoid irrigating non-cropped areas of the field
  - % savings = % of field that is non-cropped
- Can save water when crops are getting water from other sources



Fields with non-cropped surfaces

Summary about VRI

- VRI can save water and energy to avoid irrigating non-cropped surfaces
- VRI can save water in other instances, but currently it is so complicated to manage so the savings cannot be relied upon
- Growers may choose to use VRI to increase yields in high-value crops and to alleviate water-logging that can theoretically be avoided using “precision uniform irrigation”
- Large variations in WHC in the field = > Savings water
- Climates with significant in-season rainfall helps = > greater water savings

Thanks for your attention