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

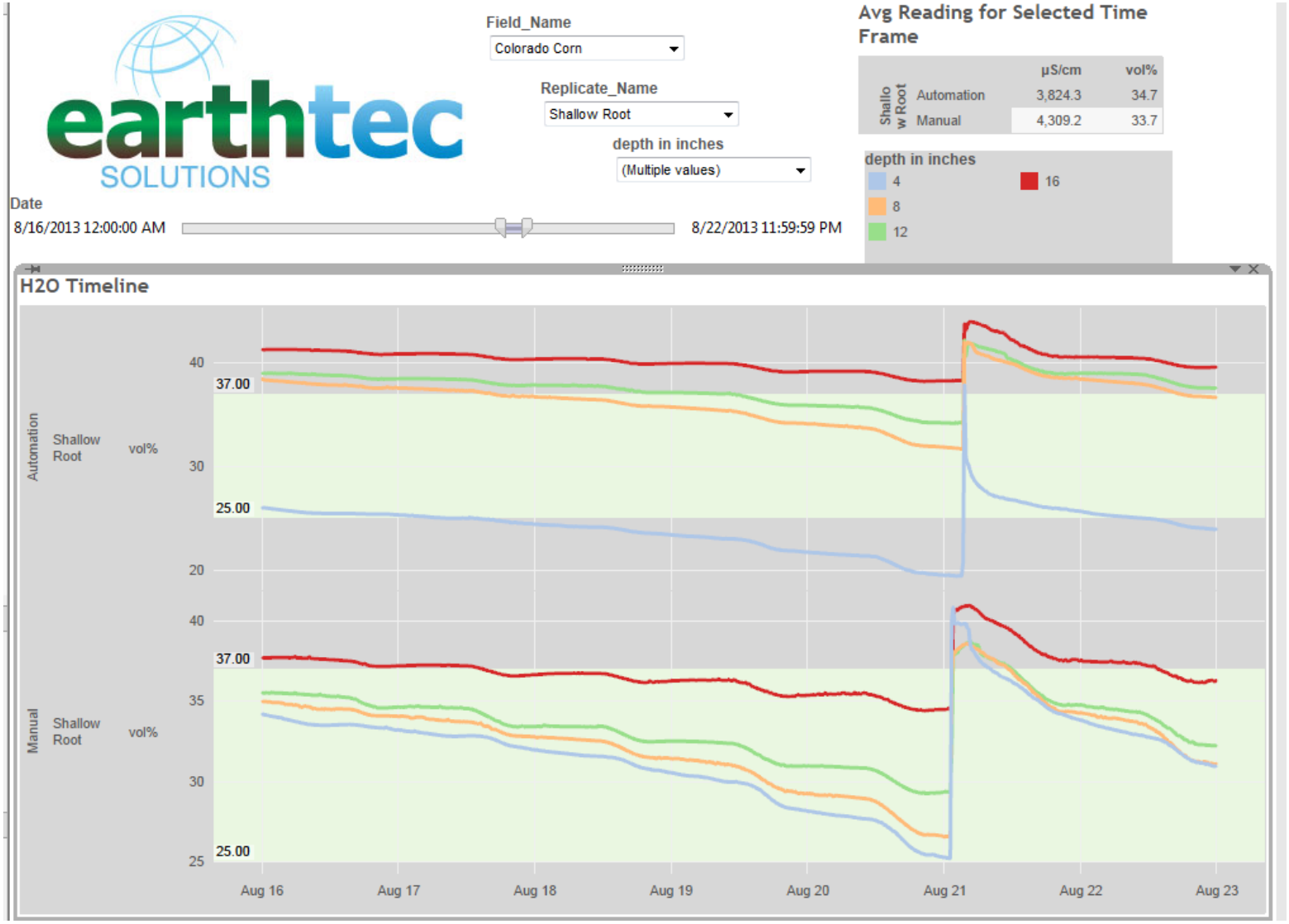
Studying Root using Secondary Evidence

- 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.

The more water the better



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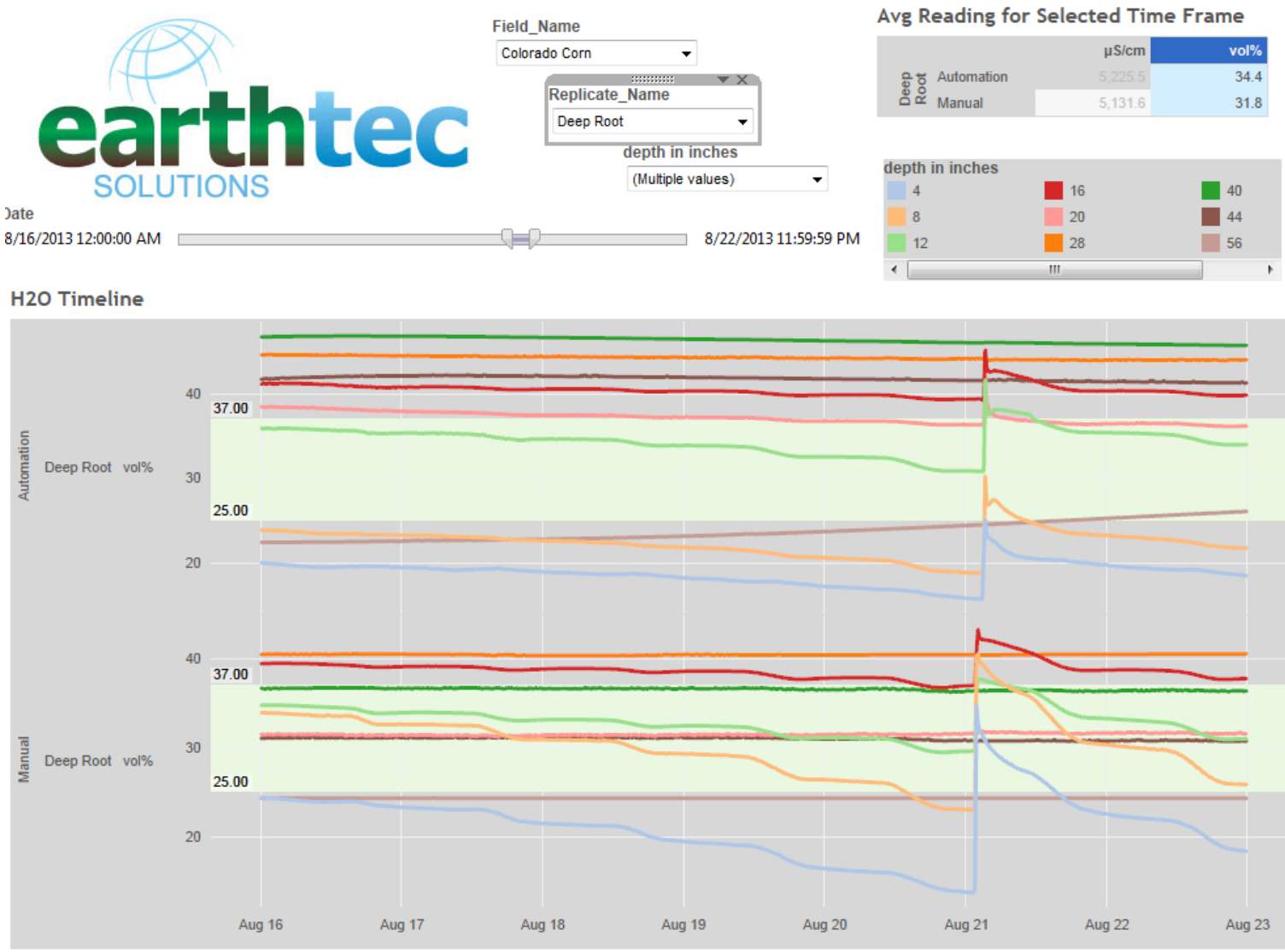

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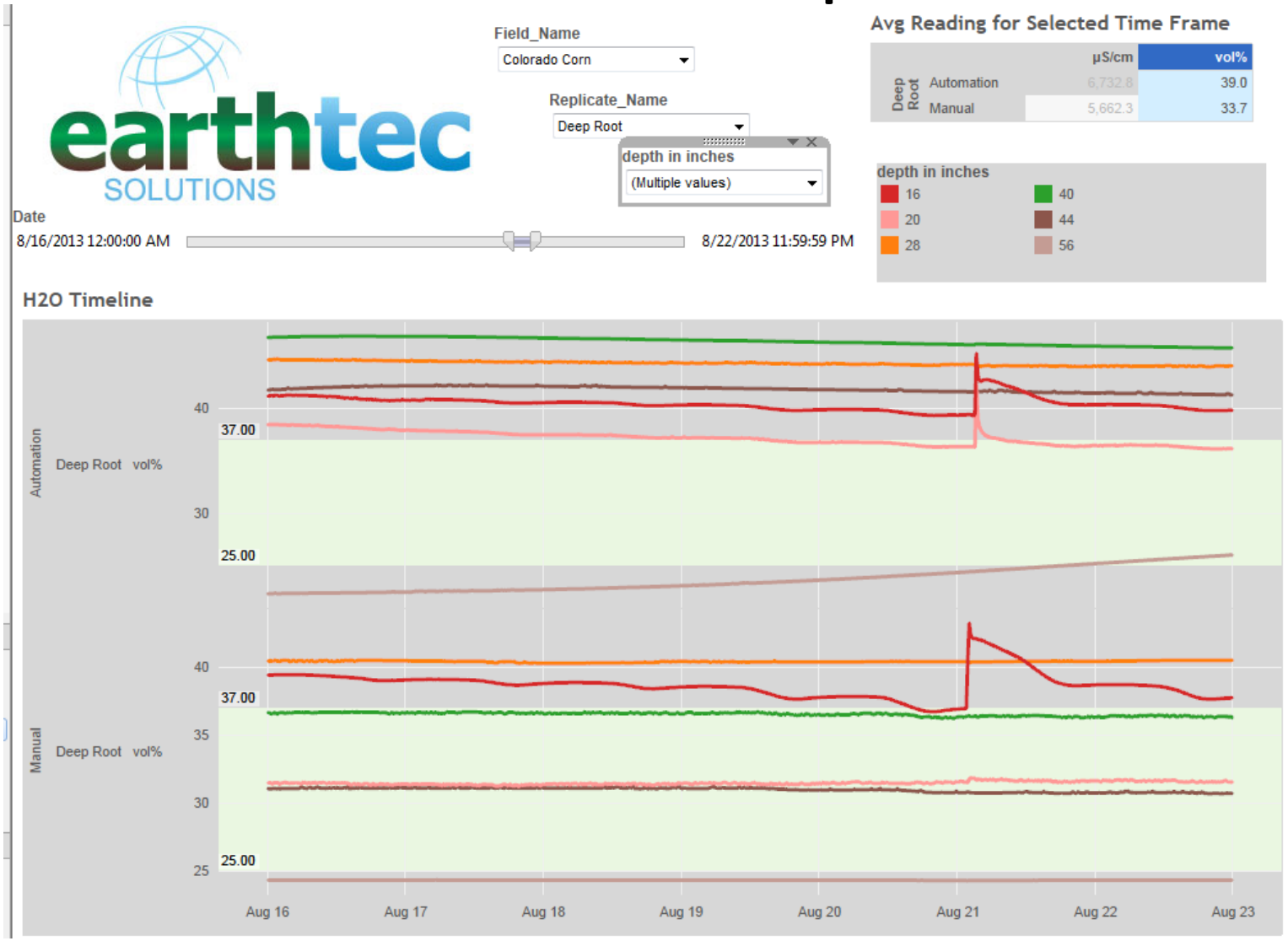
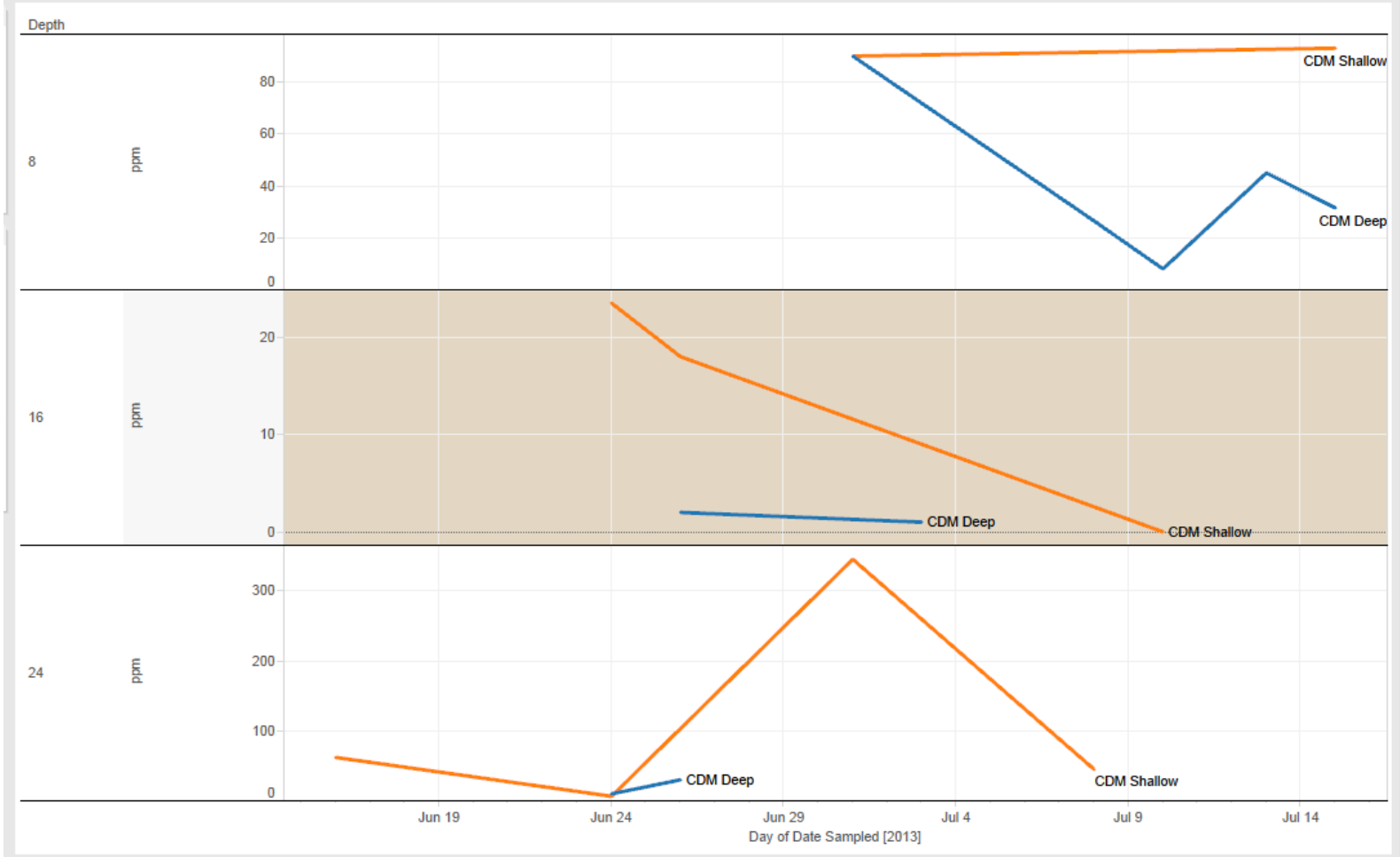


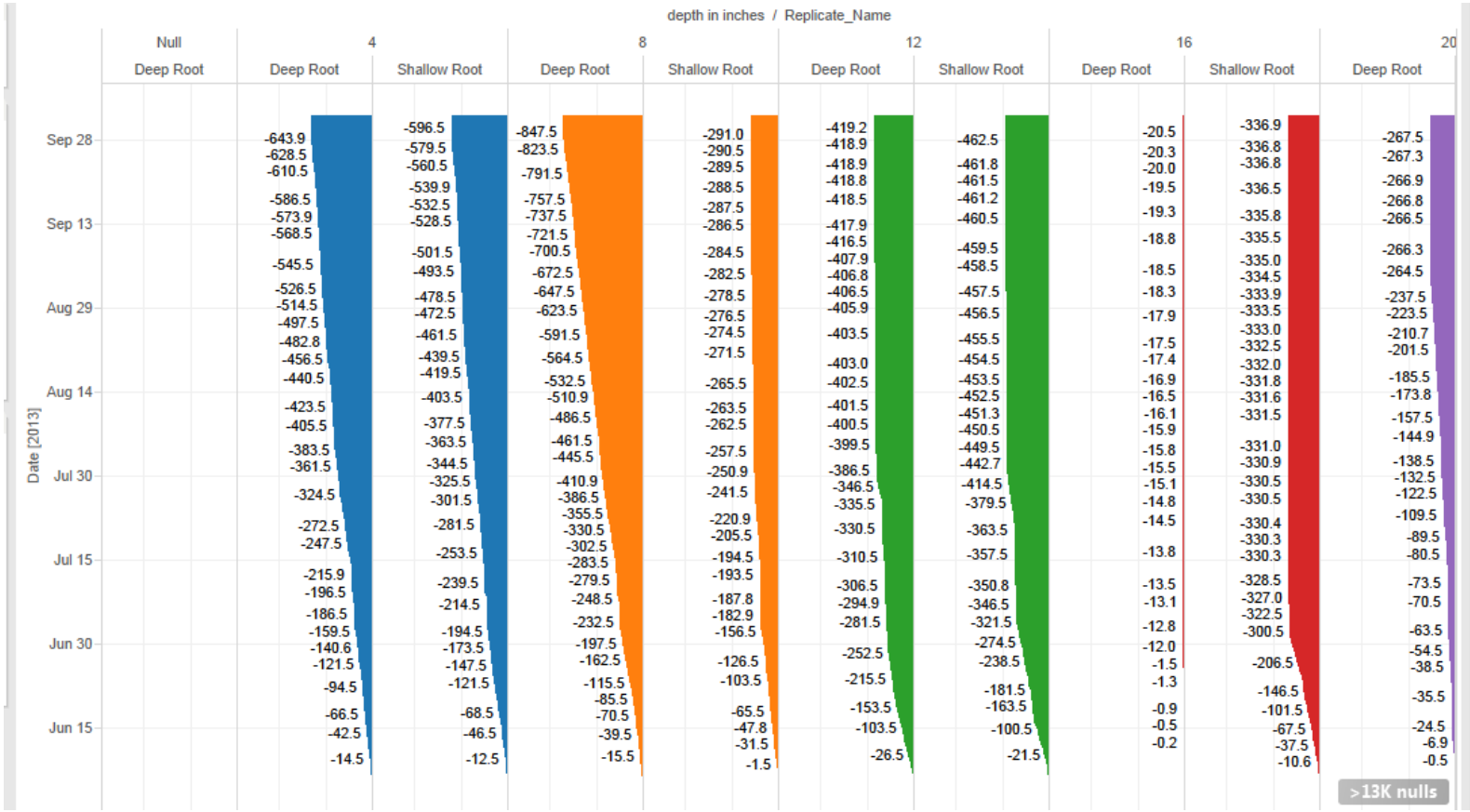
Fertilizer stays where you put it until the plant needs it.



Rain/irrigation causes nitrite to be leached below the root level.

58	Olsen Lab results	Soil Texture	Soil Texture	Soil Texture	Soil Tetxure	6/11/2013	6/11/2013	6/11/2013	7/20/2013	7/20/2013	7/20/2013	9/20/2013	9/20/2013	9/20/2013
59	11-Jun-13	%Sand	%Silt	%Clay	Soil Texture Class	Nitrate-N in Lbs	NH4-N in Lbs	Summary	Nitrate-N	NH4-N	Summary	Nitrate-N	NH4-N	Summary
60	0-12"	31	50	19	Loam	235	18	253.0	51	6.8	57.8	119	17.6	136.6
61	12-24"	21	60	19	Silt Loam	252	22.7	274.7	61	13.0	74.0	81	9.4	90.4
62	24-36"	27	54	19	Silt Loam	131	29.5	160.5	31	12.2	43.2	80	10.1	90.1
63	36-48"	27	54	19	Silt Loam	47	20.5	67.5	17	7.9	24.9	27	10.4	37.4
64	48-60"	29	52	19	Silt Loam	40	9.7	49.7	12	5.8	17.8	21	5.0	26.0
65	60-72"					21	15.1	36.1	10	7.2	17.2	22	1.8	23.8
66	72-84"					23	11.2	34.2	10	4.0	14.0	19	2.9	21.9
67	84-96"					19	7.9	26.9	9	5.4	14.4	17	4.7	21.7
68	96-108"											13	5.0	18.0
69	Totals					768	134.6	902.6	201	62.3	263.3	399	66.9	465.9

Corn roots all work the same.



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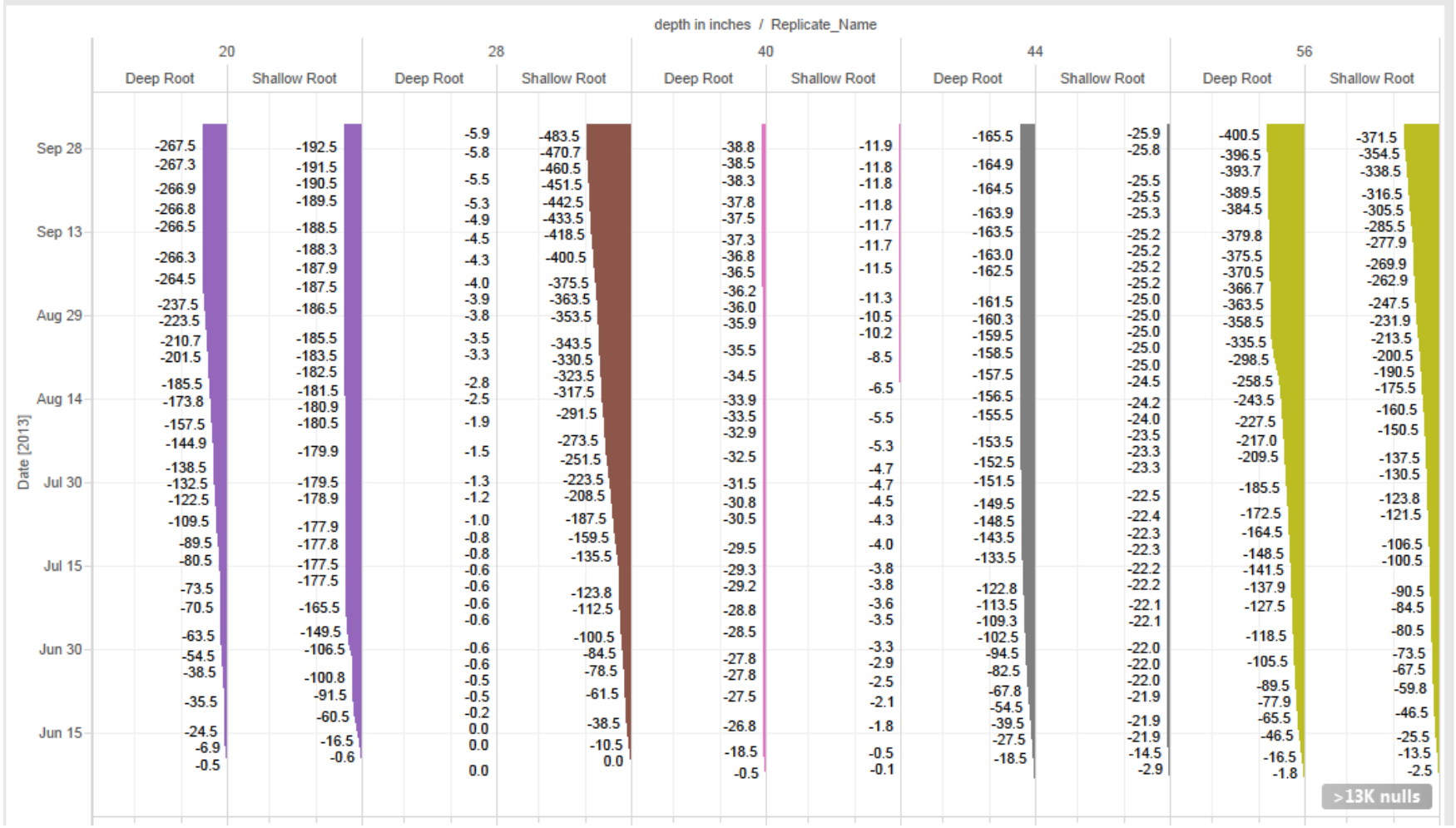

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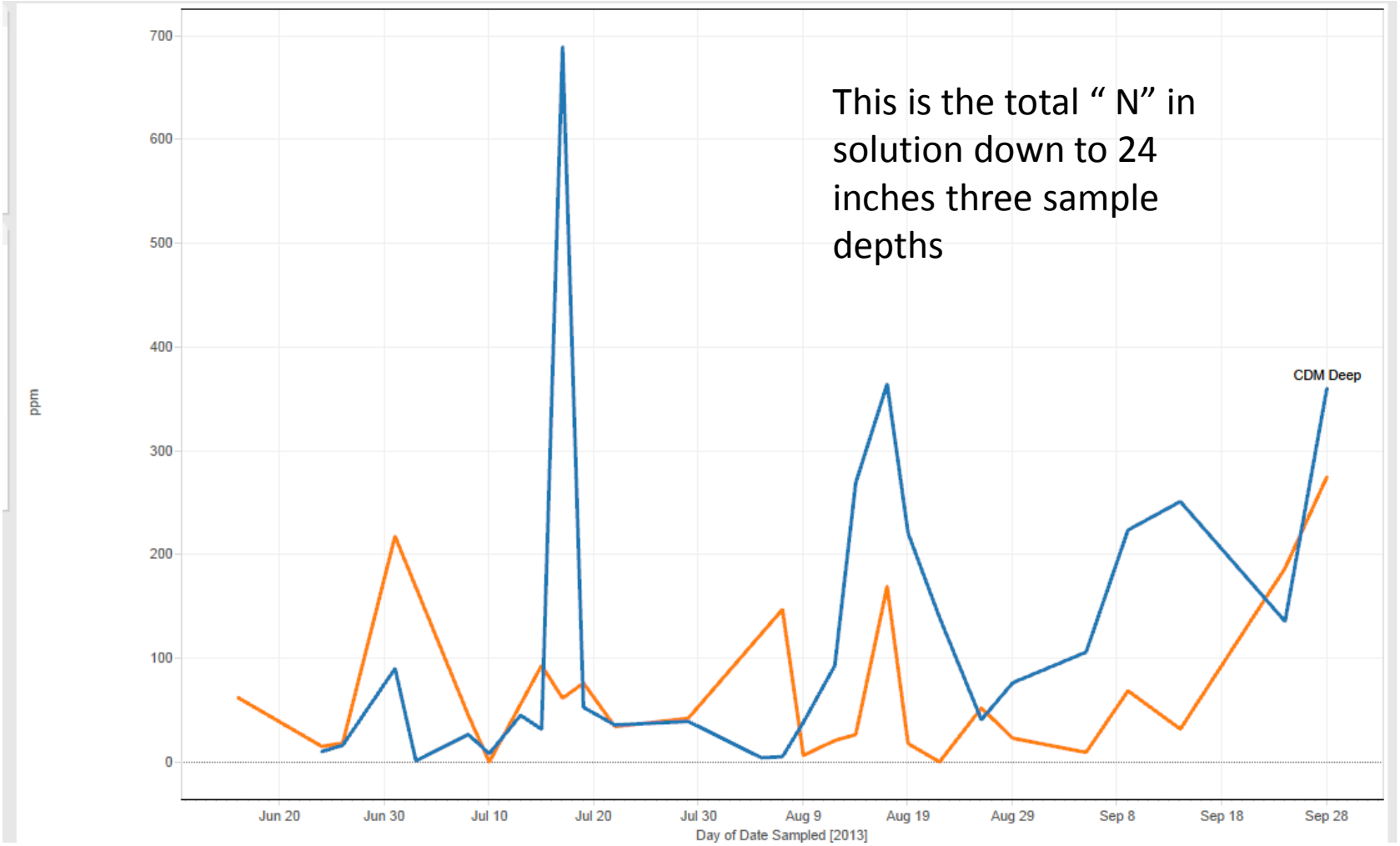

Research on crop triggered irrigation

- 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