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PROVIDING CONFIDENCE IN KNOWING YOUR CROP IS ON TARGET

Common Water Numbers

- 1 Acre Inch = 27,154 gallons
- 1 Acre foot = 325,851 gallons
- 1 Inch irrigation 120 acre pivot = 10 Acre feet total of 3,258,510 Gallons
- 20 inches of irrigation on 120 acres = 65,170,200 gallons of water 200 acre feet
  - ~2468 gallons per bushel of corn on 220 bushel/ac yield

Most permits allow for 2x this amount

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Domestic Water Use

The average household in the Unites States uses an estimated 320 gallons of water per day

- Kit Carson County has a population of 8,195 with 3,500 housing units
- Daily water use estimated at 1,120,000 gallons
- Annual water use estimated at 408,800,000 gallons
  - 1254 acre feet

If we broke that down to irrigation savings it would require

- 15,000 acres saving 1” annual irrigation
- 6,000 acres saving 2.5” annual irrigation
- NASS statistics 71,000-73,000 irrigated corn acres KCC in 2016 & 2017

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Water Management

- Quantity
- Quality

Water Value

Bottled Water from convenience store

- 33.8 oz. for $2.09 = $7.91 per gallon

Bulk RO Water in Burlington

- $0.40 per gallon

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What Is Our Water Worth?

With bottled water cost in mind 1 inch of irrigation on 120 acres is worth $20,593,783.00

Bulk RO water cost that same volume of water is worth $1,303,404.00

- 434,468 bushels of corn @ $3.00 local
- 3620.5 bushel per acre
- 16.45 years at 220 bushel per acre yield average

What is that extra inch to finish the season worth?

What is 2-4” of pre-irrigation worth?

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What Does Irrigation Cost?

How much does it cost to irrigate?

- University of Nebraska study shows $8/acre inch
- Local research $7.50/acre inch electric well power cost
  - Does not account for labor, maintenance, equipment cost, etc.

Have you done the math for your farm?

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Can We Reduce Irrigation Without Losing ~~Yield~~ ? Money

Irrigation & Corn

Corn requires approximately 10” of plant available water to initiate yield

- Stored soil moisture (available) + rainfall + irrigation
- On average from this point forward each inch of ET should produce ~14.9 bushels of grain until we exceed ET
  - ET 70% Transpiration 30% Evaporation on average

True or False: Corn yield is directly correlated to amount of applied irrigation.

- Only when PAW is limiting or we irrigate to ET requirement
- Once total PAW exceeds ET the correlation diverges

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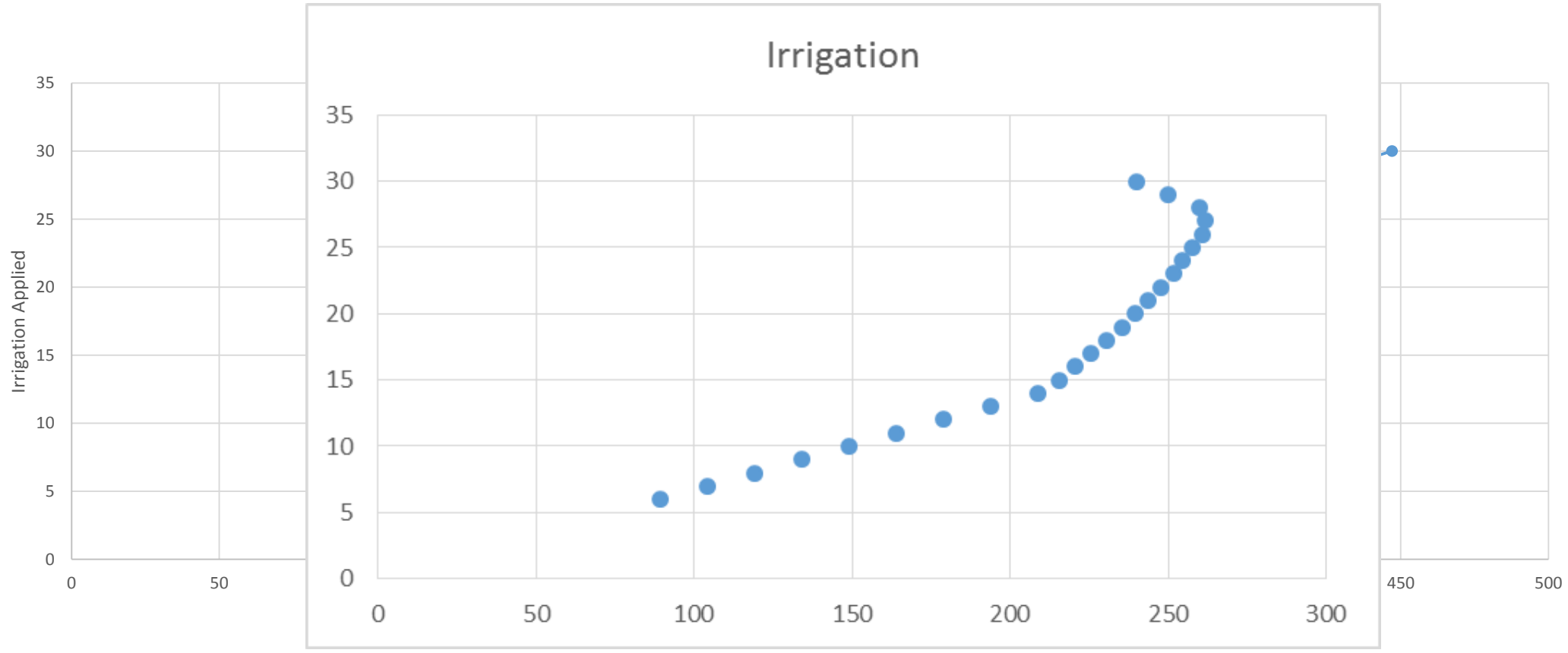
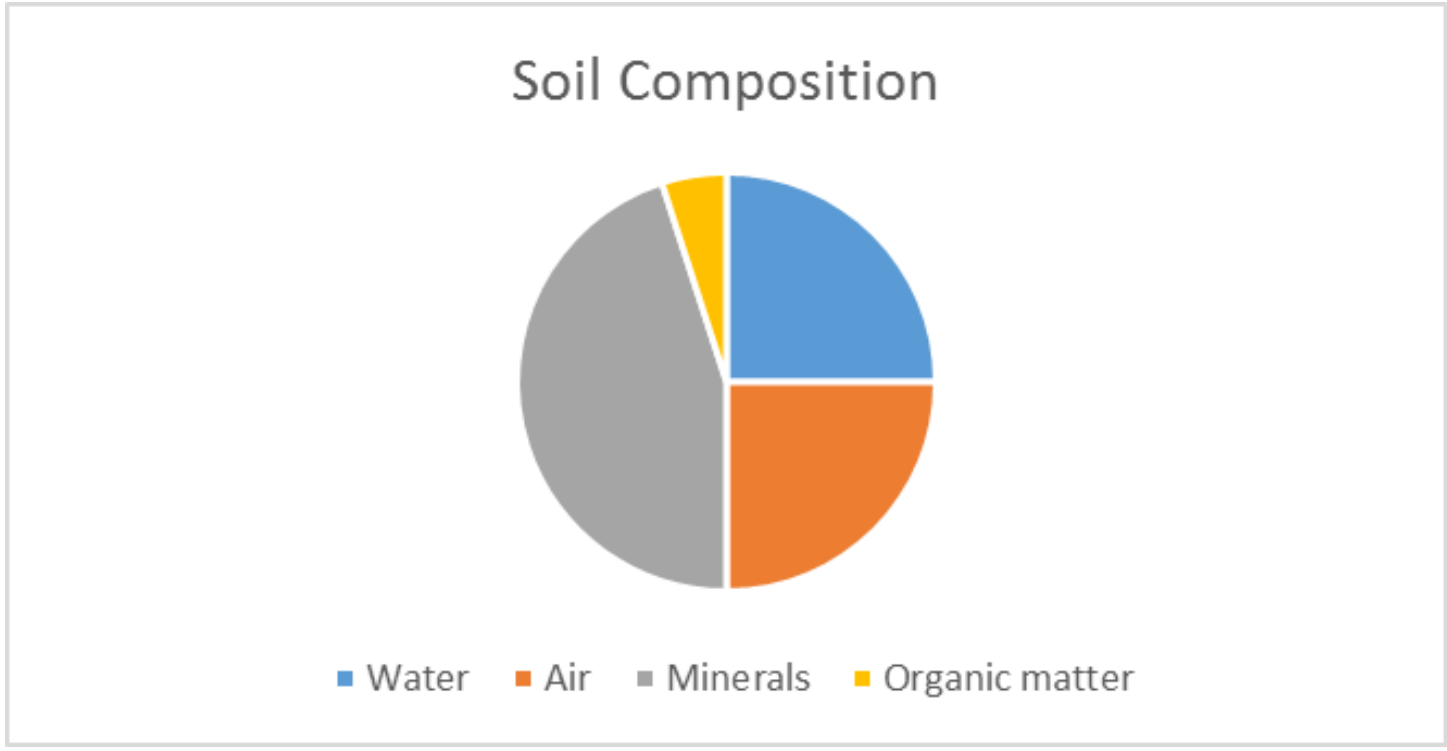
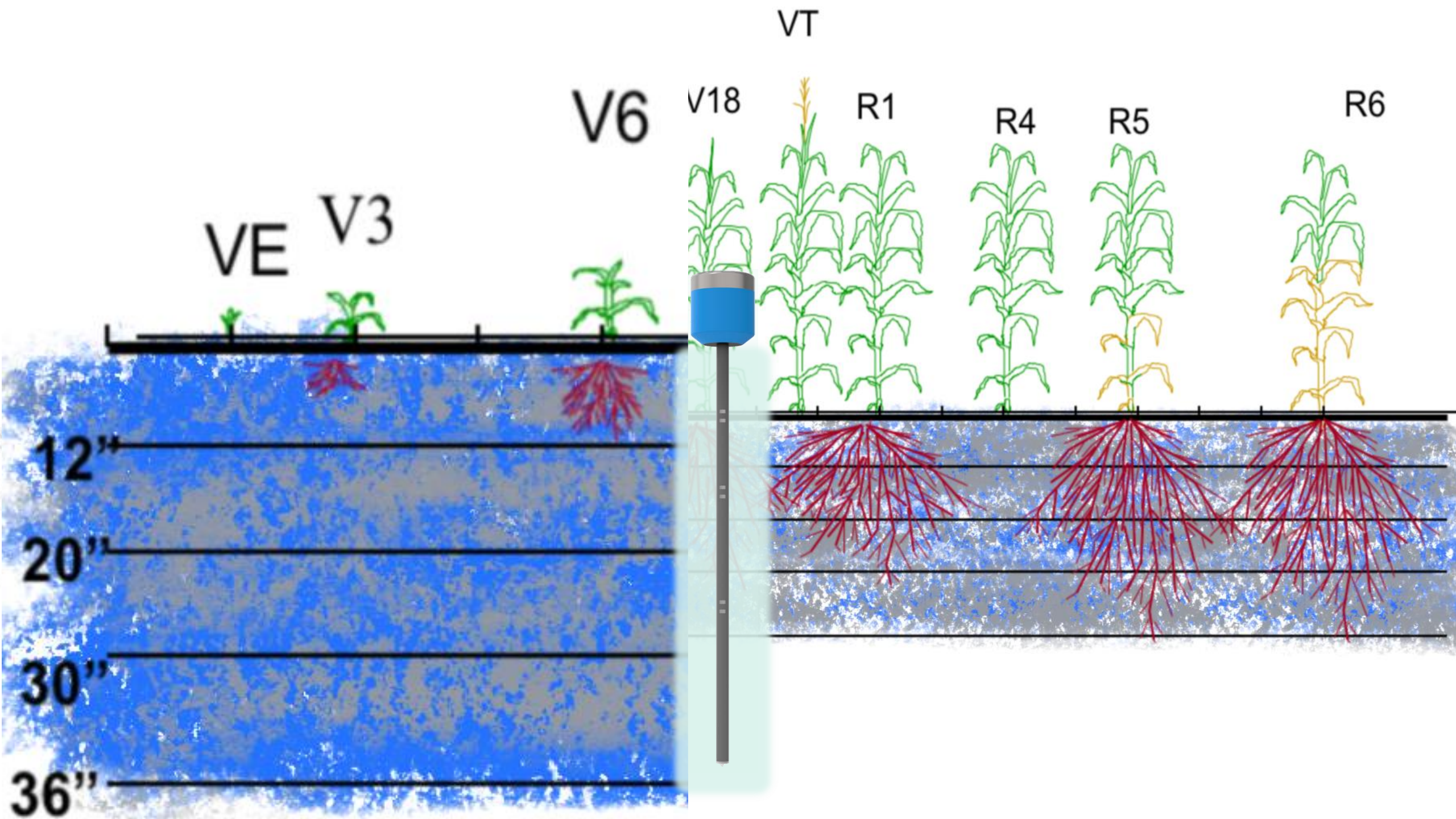
Results If Relationship Were Linear

Scenario assumes 10” rainfall



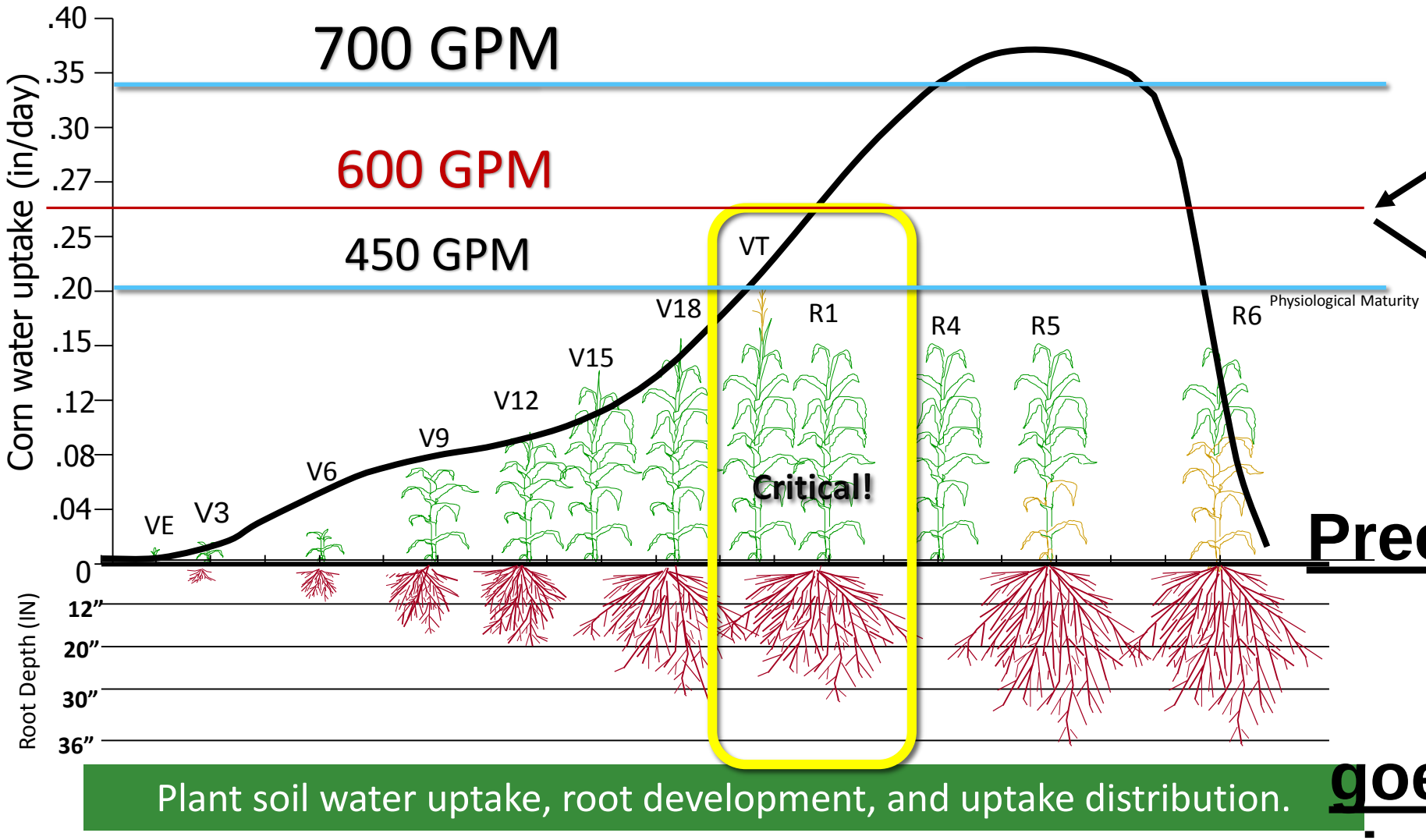
How Can Water Limit Yield?




VE
V3
V6
VT
V18
R1
R4
R5
R6
12”
20”
30”
36”

Well Capacity is Critical

GPM	Hours per acre inch	Hours to apply 1" to 120 Acres	Days to apply 1" to 120 Acres
250	1.810	217.2	9.1
300	1.509	181.0	7.5
350	1.293	155.2	6.5
400	1.131	135.8	5.7
450	1.006	120.7	5.0
500	0.905	108.6	4.5
550	0.823	98.7	4.1
600	0.754	90.5	3.8
650	0.696	83.6	3.5
700	0.647	77.6	3.2
750	0.603	72.4	3.0
800	0.566	67.9	2.8
850	0.532	63.9	2.7
900	0.503	60.3	2.5
950	0.476	57.2	2.4
1000	0.453	54.3	2.3



Plant soil water uptake, root development, and uptake distribution.

Average Pivot Application After Evaporation

Not Accounting for Runoff

Precision Irrigation is Water that goes to and stays in the root-zone

Capacity Matters in Conservation

GPM	Hours per acre inch	Hours to apply 1" to 120 Acres	Days to apply 1" to 120 Acres	Days to 20"	Start Date for 9/15 shutoff
250	1.810	217.2	9.1	181.0	3/17/2017
300	1.509	181.0	7.5	150.9	4/17/2017
350	1.293	155.2	6.5	129.3	5/8/2017
400	1.131	135.8	5.7	113.1	5/24/2017
450	1.006	120.7	5.0	100.6	6/6/2017
500	0.905	108.6	4.5	90.5	6/16/2017
550	0.823	98.7	4.1	82.3	6/24/2017
600	0.754	90.5	3.8	75.4	7/1/2017
650	0.696	83.6	3.5	69.6	7/7/2017
700	0.647	77.6	3.2	64.7	7/12/2017
750	0.603	72.4	3.0	60.3	7/16/2017
800	0.566	67.9	2.8	56.6	7/20/2017
850	0.532	63.9	2.7	53.2	7/23/2017
900	0.503	60.3	2.5	50.3	7/26/2017
950	0.476	57.2	2.4	47.6	7/29/2017
1000	0.453	54.3	2.3	45.3	7/31/2017

Start & End Date

500 GPM Well

- Effect of Starting 7 days earlier than needed and irrigating 5 days longer than needed at end of season (12 total days) leads to 2.66” over irrigation

750 GPM Well

- Same error turns into 4” over irrigation

1000 GPM Well

- 5.32”

In Season Management

Shutting off after rainfall event of 1 inch with .2” ET (5 days worth of water)

- 500 GPM saves 1.11”
- 750 GPM saves 1.66”
- 1000 GPM saves 2.22”

Cumulative Effect

500 GPM Well with correct start & stop date

- 12 days example 2.66”

2 in season rain events with ability to shut off 5 days each

- 2.22”

Total irrigation savings

- 4.88”

Lets Talk Efficiency
Corn Yield vs Irrigation

Corn Yield/Inch of Irrigation							
	Corn Yield						
Irrigation	150	170	190	210	230	250	270
8	18.8	21.3	23.8	26.3	28.8	31.3	33.8
10	15.0	17.0	19.0	21.0	23.0	25.0	27.0
12	12.5	14.2	15.8	17.5	19.2	20.8	22.5
14	10.7	12.1	13.6	15.0	16.4	17.9	19.3
16	9.4	10.6	11.9	13.1	14.4	15.6	16.9
18	8.3	9.4	10.6	11.7	12.8	13.9	15.0
20	7.5	8.5	9.5	10.5	11.5	12.5	13.5
22	6.8	7.7	8.6	9.5	10.5	11.4	12.3
24	6.3	7.1	7.9	8.8	9.6	10.4	11.3

Cost/Bushel for Irrigation

Cost per bushel pumping costs							
	Corn Yield						
Irrigation	150	170	190	210	230	250	270
8	$ 0.427	$ 0.376	$ 0.337	$ 0.305	$ 0.278	$ 0.256	$ 0.237
10	$ 0.533	$ 0.471	$ 0.421	$ 0.381	$ 0.348	$ 0.320	$ 0.296
12	$ 0.640	$ 0.565	$ 0.505	$ 0.457	$ 0.417	$ 0.384	$ 0.356
14	$ 0.747	$ 0.659	$ 0.589	$ 0.533	$ 0.487	$ 0.448	$ 0.415
16	$ 0.853	$ 0.753	$ 0.674	$ 0.610	$ 0.557	$ 0.512	$ 0.474
18	$ 0.960	$ 0.847	$ 0.758	$ 0.686	$ 0.626	$ 0.576	$ 0.533
20	$ 1.067	$ 0.941	$ 0.842	$ 0.762	$ 0.696	$ 0.640	$ 0.593
22	$ 1.173	$ 1.035	$ 0.926	$ 0.838	$ 0.765	$ 0.704	$ 0.652
24	$ 1.280	$ 1.129	$ 1.011	$ 0.914	$ 0.835	$ 0.768	$ 0.711

Confidence is Critical

We must have the confidence to make the right decision!

Technology development in soil moisture sensors makes it possible to confidently make the determination of when to turn on, and more importantly when to shut off.

Good data and the knowledge to interpret the information into a useable recommendation is key

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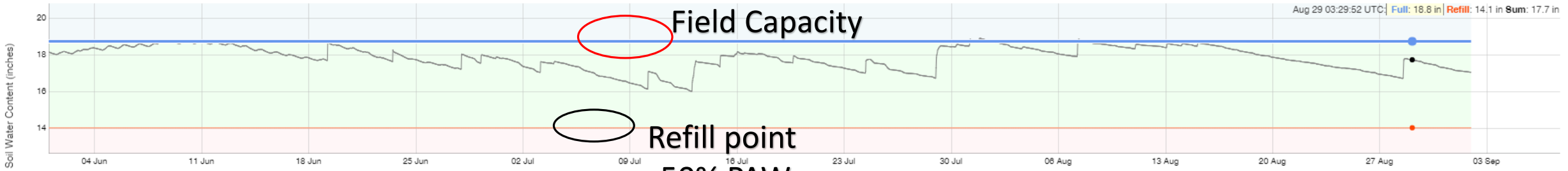
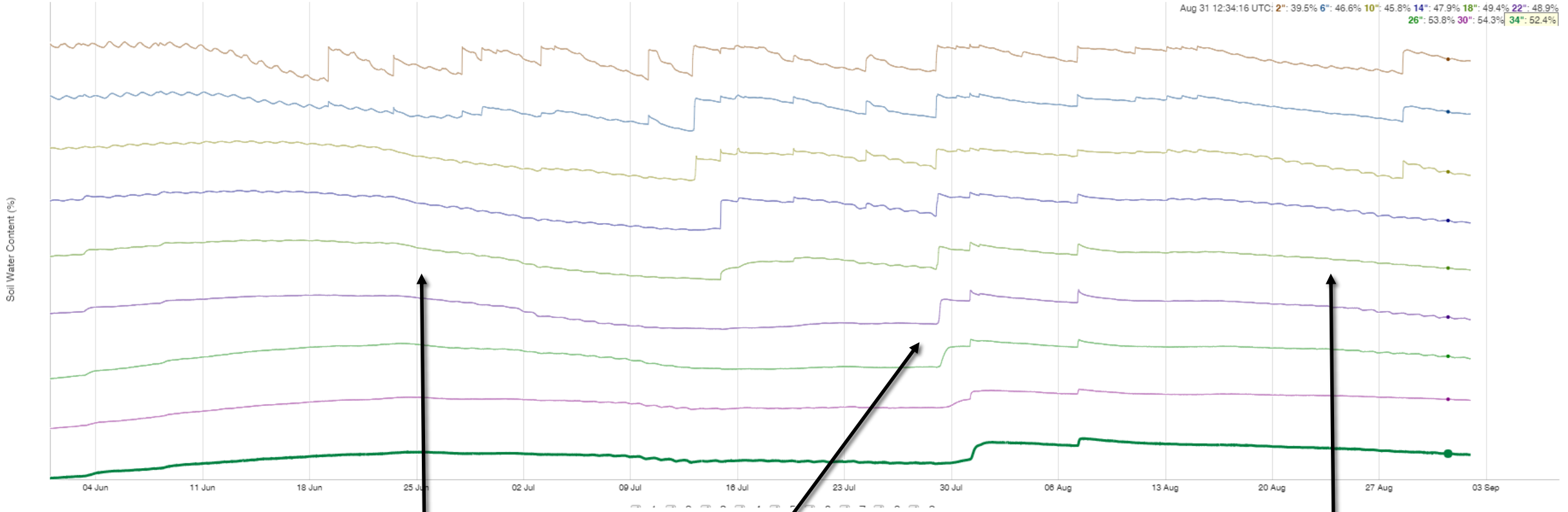
Sum



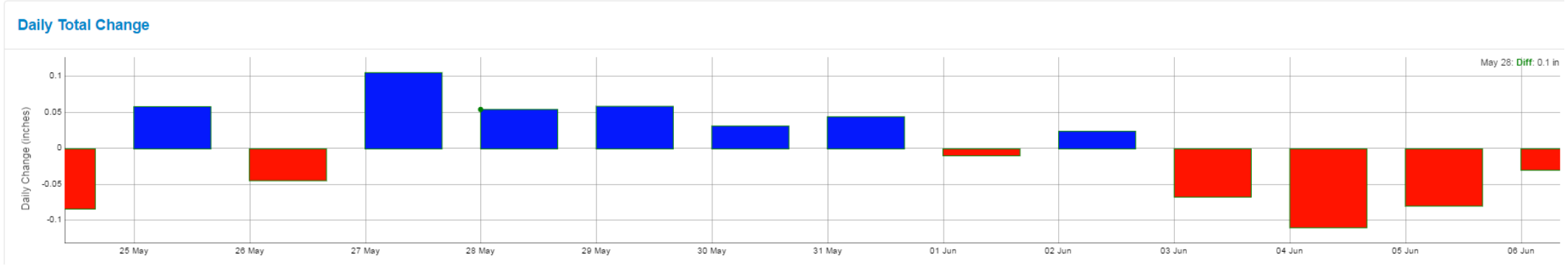
Field Capacity

Refill point
50% PAW

Sensor



Daily Change vs. ET



Data Into Action

8-2: After the two rain events and irrigation this past week there has been a complete refill of the profile with the latest event pushing moisture down to and most likely past 34" sensor which is further than we have active roots. Seeing this along with current forecast there is easily room for 5-7 days off on this circle without any additional moisture. I would look at it early to mid next week if it needs restarted or not.

350 GPM Well on 8/2 during pollination and early kernel development we had the confidence to recommend shutting off for 5-7 days.

More small rain events allowed the water to stay off until 8/22 with irrigation registering on probe 8/28

Example Field Results

Active Roots = Higher yields

- 350 GPM Well
- 9.0 Inches Irrigation
- 14.4 Inches rain planting through maturity
- 0.6” Soil moisture
- 189.85 Total Nitrogen (soil removal + applied)
- 264.4 Bushel per acre
  - .71 pounds nitrogen per bushel
  - 27.83 bushels per inch of irrigation

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Example Field Results Cont.

Active Roots = Higher yields

- 800 GPM Well
- 9.0 Inches Irrigation
- 17.7 Inches rain planting through maturity
  - 2 rainfall events over 2.5”
- 1.1” Soil moisture
- 186 Total Nitrogen (soil removal + applied)
- 244 Bushel per acre
  - .76 pounds nitrogen per bushel
  - 27.11 bushels per inch of irrigation

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How Can Managing Irrigation Increase Nutrient Efficiency

- 1 inch of irrigation pushed through the profile leaches an estimated 8 pounds of nitrogen as it moves through deeper into the profile
  - Nitrogen & Sulfur macro-nutrients mobile in soil
- 1 inch of irrigation estimated $8 per acre pumping costs based on KSU & UNL research
  - This means an un-needed irrigation of 1 inch can cost estimated $10.40 per acre based on current nitrogen price
    - 8 pounds * $0.30 per pound = $2.40

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Closing Thoughts

1. Consider doing the math for what your cost per acre inch is
2. Keep track and calculate your bushels per inch of irrigation
3. Consider technology to better manage your water

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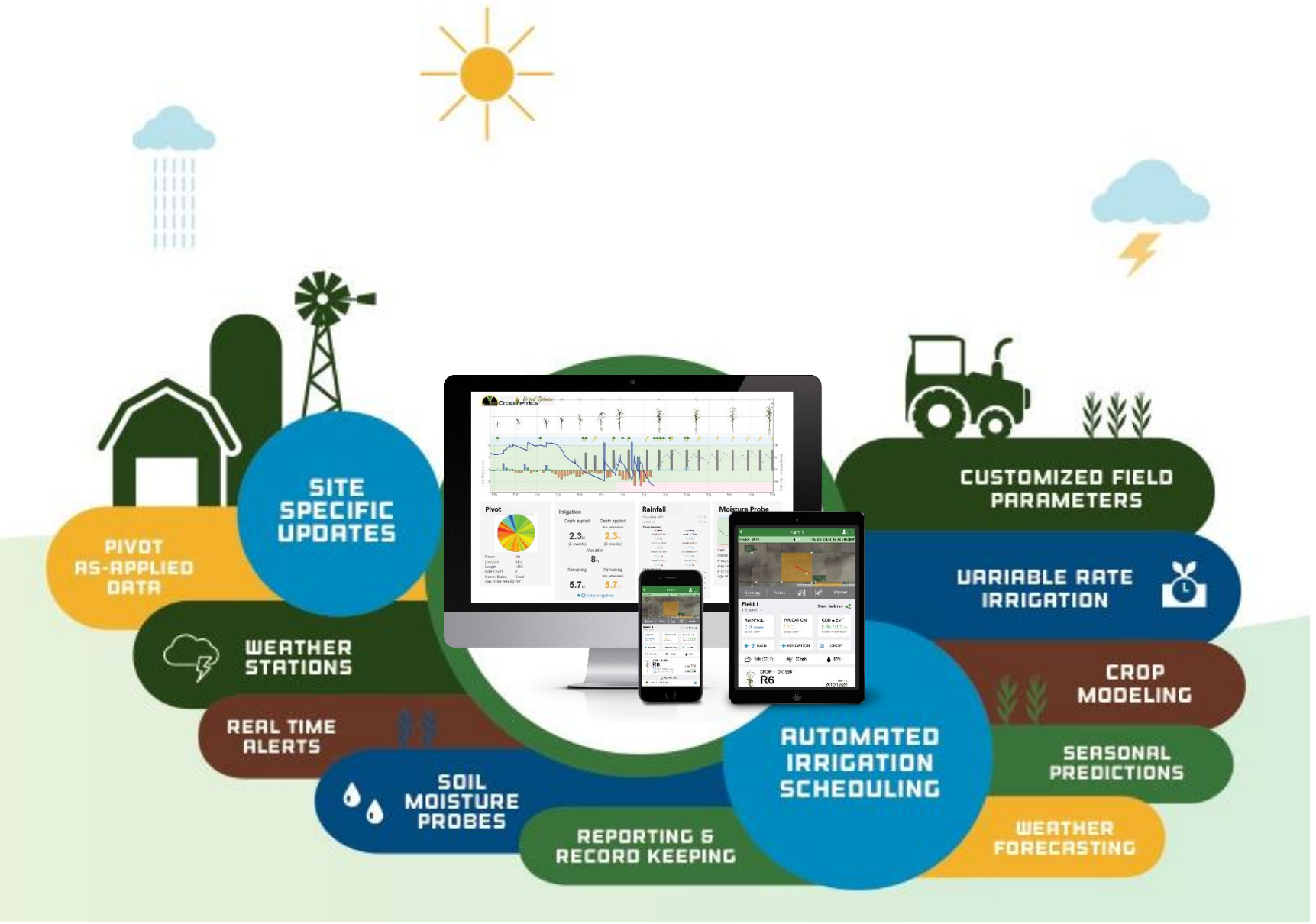

Technology is <u>NOT</u> the Solution

The <u>ADOPTION</u> of Technology is the Solution