CENTER FOR AGRICULTURAL PROFITABILITY

Institute of Agriculture and Natural Resources

With the public launching next month. For more information see farm.unl.edu/cap

Back to basics, control costs and maximize profits

June 10, 2021

By: Matt Stockton, Chuck Burr, Julie Peterson, and Sarah Sivits

University of Nebraska Lincoln

Topics and Panelist

Marginal Decision Analysis - Matt Stockton (Ag Economist)
Water & Fertilizer – Chuck Bur (Agronomy Educator)
Corn and Soybean Diseases – Sarah Sivits (Plant Pathologist Educator)
Corn and Soybean Insects – Julie Peterson (Entomologist)

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Marginal Analysis - Matt Stockton

- Relationship between inputs and cost
- Several types of economic decisions, high frequency, infinite choices (production function choices, e.g. irrigation, fertilization, etc.), and single choices (binary choices, apply herbicide, fungicide etc.)
- High frequency choices result in an accumulated value, it isn't always easy to have that accumulation equal the optimal choice. does the total added units cover their costs in revenue generated.
  - Water, Fertilizer
- Binary decisions are based on individual value of the one-time outcome
  - single application costs

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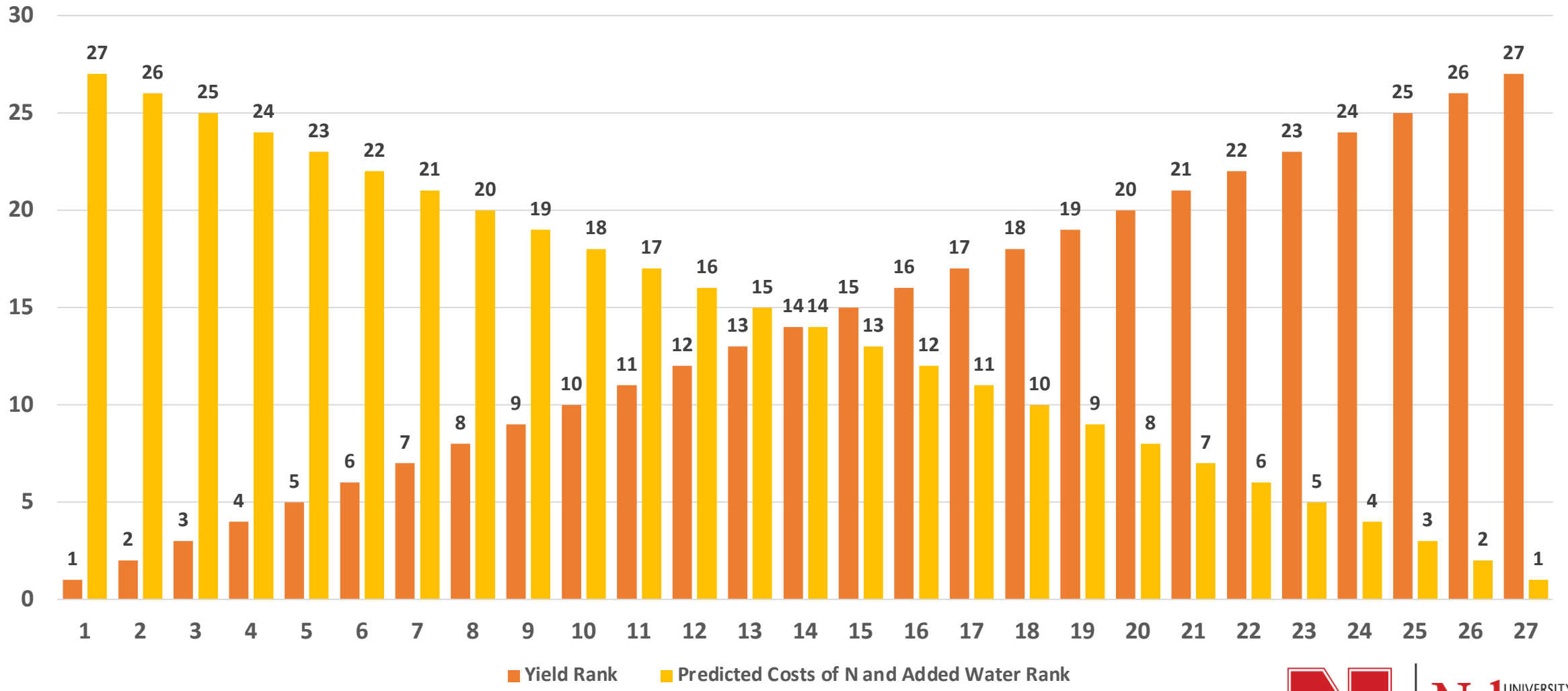
How should cost relate to productivity? Or Should they?

- Relationship between inputs and cost
- Seems basic, and simple, “Right”
- I expected cost and productivity to be linked. Where added cost would result in added productivity.

Predicted Relationship of N and Water Costs Rank to Yield Rank



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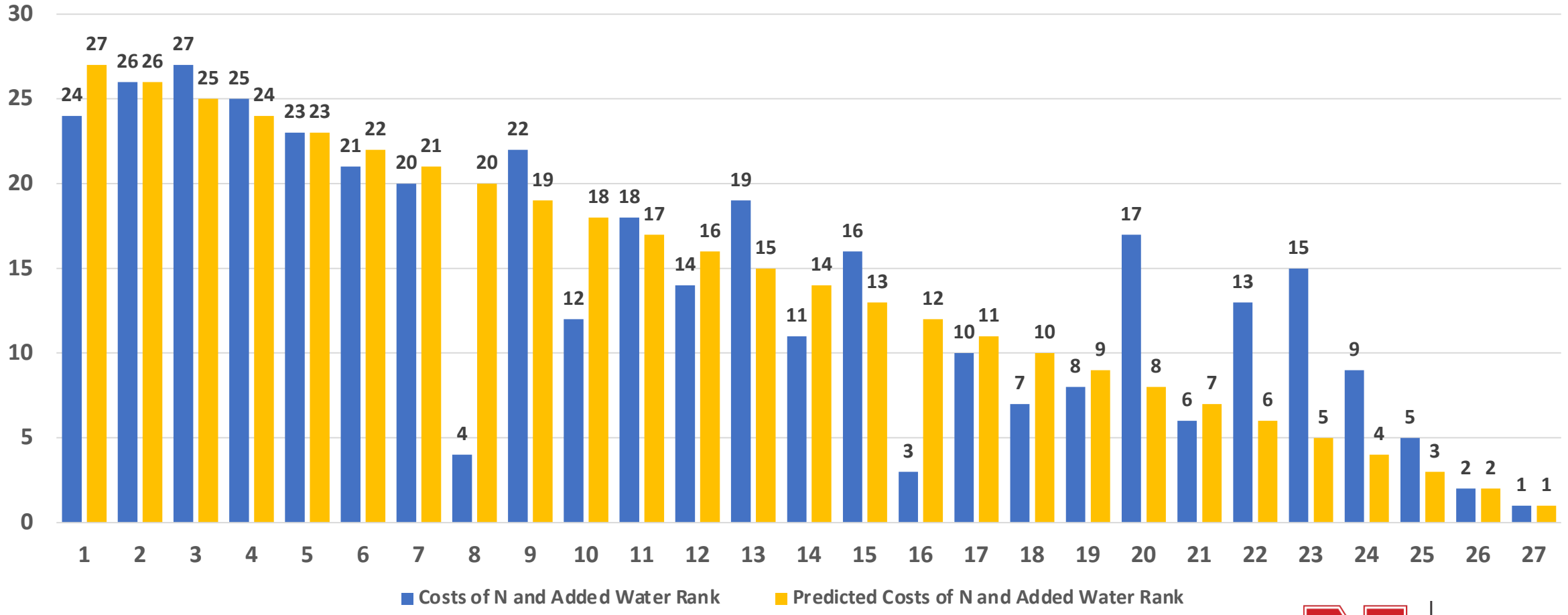
However, this is what I found.

- While generally there is a tendency for cost and productivity to be inversely related, that was not true for the TAPS contests.
- SO what's happening why are they different.
- The list is long and beyond our Seems basic, and simple, "Right"
- I expected cost and productivity to be linked. Where added cost would result in added productivity.

Actual N and Added Water Costs Rank Compared to the Predicted Ranks for the 27 TAPS Contest Farms



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The decisions made during the season are one of the keys to success.

- Better decisions, result in better outcomes

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2nd Point are you optimizing biological or economic outcomes

- Several types of economic decisions, high frequency, infinite choices (production function choices, e.g. irrigation, fertilization, etc.), and single choices (binary choices, apply herbicide, fungicide etc.)
- High frequency choices result in an accumulated value, it isn't always easy to have that accumulation equal the optimal choice. Criteria, does the total added units cover their costs in revenue generated. (Water, Fertilizer)
- Binary decisions are based on individual value of the one-time outcome, Fungicide treatment

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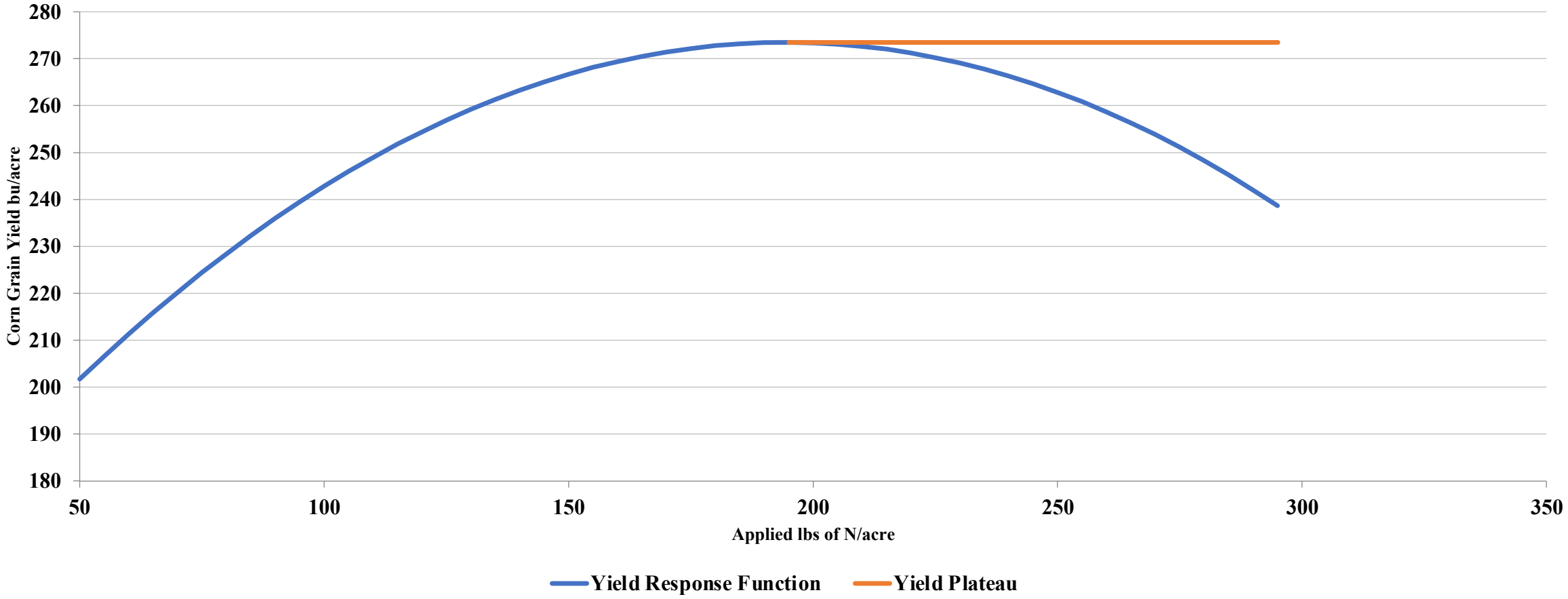
Approximation of 2018 TAPS sprinkler corn yield response to varying levels of N (continuous possible choices)



Biological or Economic outcomes

- 197 pounds of N/Acre (biological Optimum)

$3.50 corn price

- Economic Optimum 180 lbs N/Acre @ $3.50 Bu, $0.40/lb N
  - $6.80/Acre increase cost for the 17 lbs of N
  - Increase in Yield of about .96 bu/acre, value of $3.37/Acre
  - Net Loss of $3.43/acre

$5.00 corn price

- Economic Optimum 185 lbs N/Acre @ $5.00 Bu, $0.40/lb N
  - $4.80/Acre increase cost for the 12 lbs of N
  - Increase in Yield of about .48 bu/acre, value of $2.37/Acre
  - Net Loss of $2.37/acre

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In season Irrigation and Fertilization Decisions – Chuck Burr

In season disease control and monitoring decisions – Irrigation Cost Decisions

Chuck Burr
Extension Educator - Water and Integrated Cropping Systems
Lincoln County, North Platte

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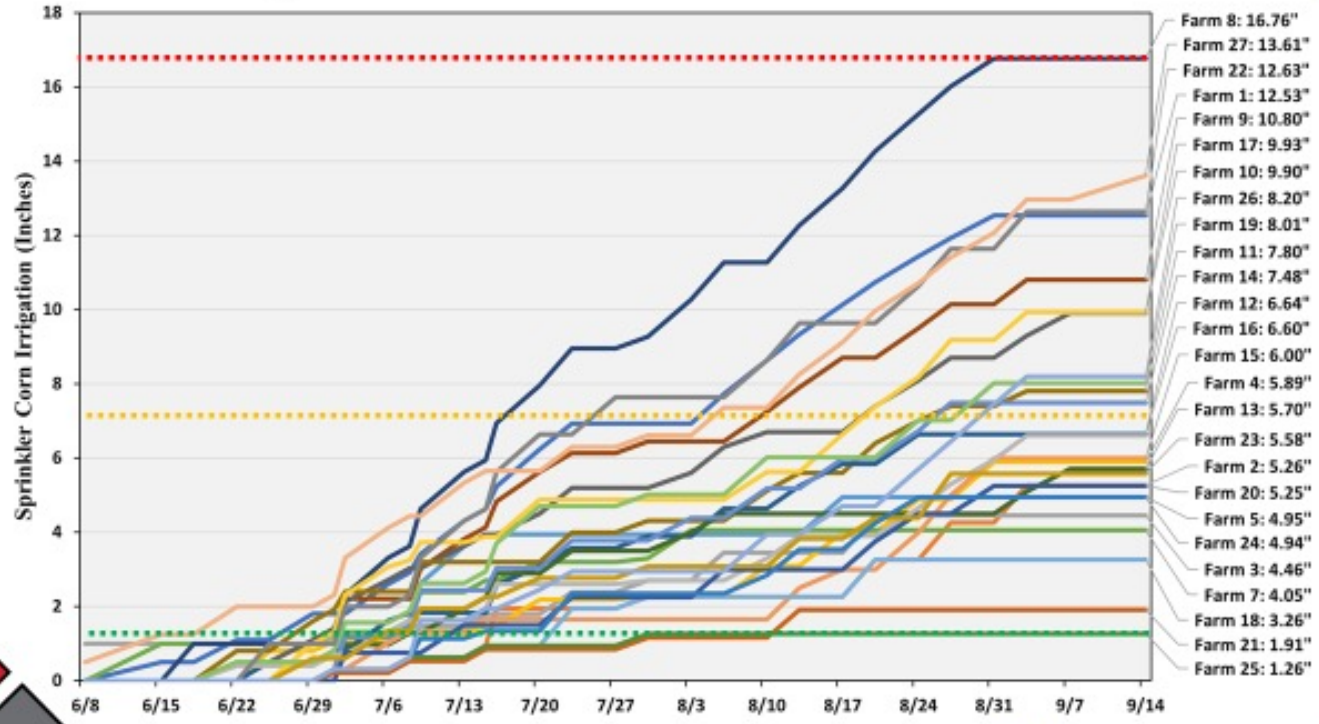
Irrigation Cost

Sprinkler Corn: Irrigation



UNL TAPS
TESTING AG PERFORMANCE SOLUTIONS

Glance:

- Min: 1.26"
- Avg: 7.29"
- Max: 16.76"

USDA United States Department of Agriculture
Natural Resources Conservation Service

Nebraska CornBoard

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Census of Ag Irrigation Survey 2013		
	# Farms	Percent
Nebraska	15,747	
Any Method	15,747	100
Condition of crop	13,491	86
Feel of Soil	6,957	44
Soil Sensing	3,599	23
Plant Sensing	45	0
Schedule Service	2,549	16
ET	3,792	24
Water Delivery	1,449	9
Personal Calendar	1,496	10
Computer Simulation	113	1
Neighbors	619	4

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Soil Moisture Monitoring

- Simple, lower cost sensors
- Higher cost, real time data
  - Sentek
  - CropX
  - AquaSpy
  - Trellis
  - Phytec

Use a Soil Probe in other parts of the field !!!!!

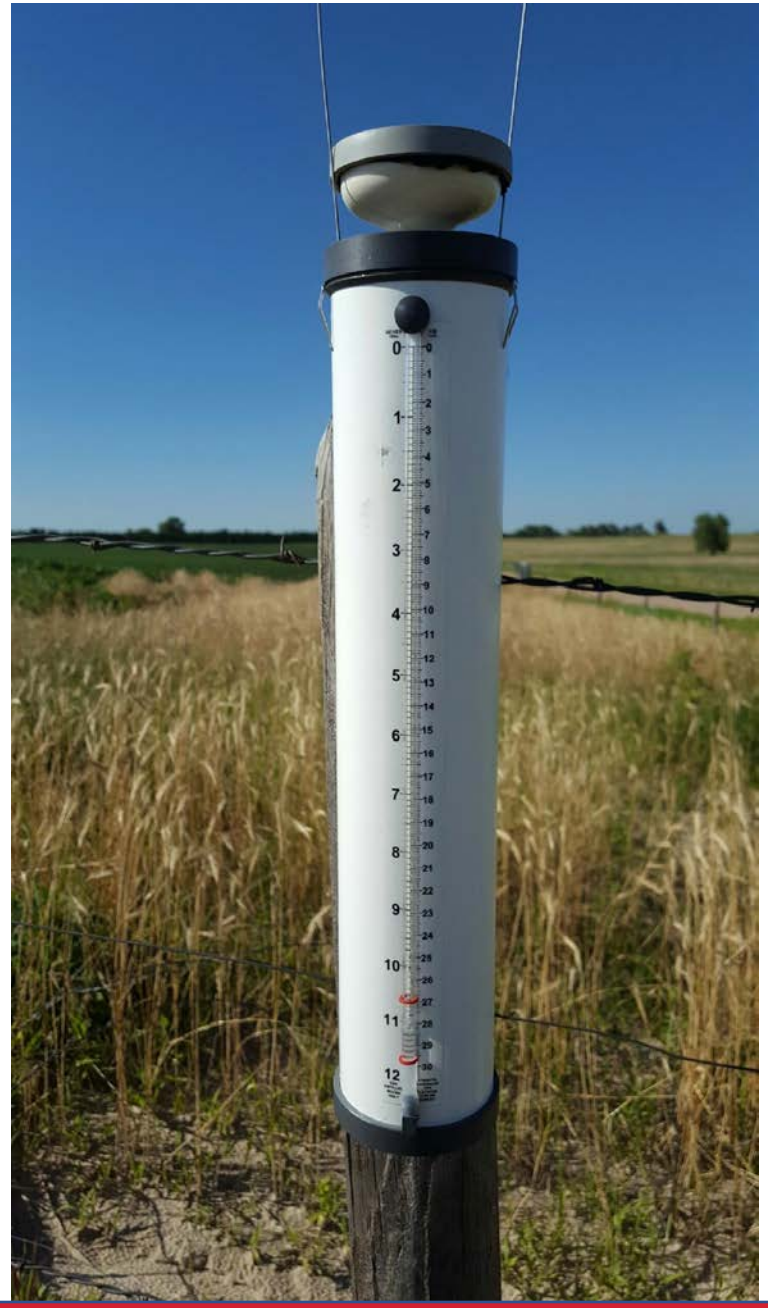
Crop Water Use Data

- NAWMN - https://water.unl.edu/category/nawmn
- ET Gauge
- NebGuide – G1994. Evapotranspiration Basics and Estimating Actual Crop Evapotranspiration from Reference Evapotranspiration and Crop-Specific Coefficients

- Local Weather Station

Crop Water Use Data

Growth Stage	K_c
2 leaves	0.10
4 leaves	0.18
6 leaves	0.35
8 leaves	0.51
10 leaves	0.69
12 leaves	0.88
14 leaves	1.01
16 leaves	1.10
Silking	1.10
Blister	1.10
Dough	1.10
Beginning Dent	1.10
Full Dent	0.98
Black layer	0.60
Full maturity	0.10



Weather Station

https://cropwatch.unl.edu/gdd-etdata

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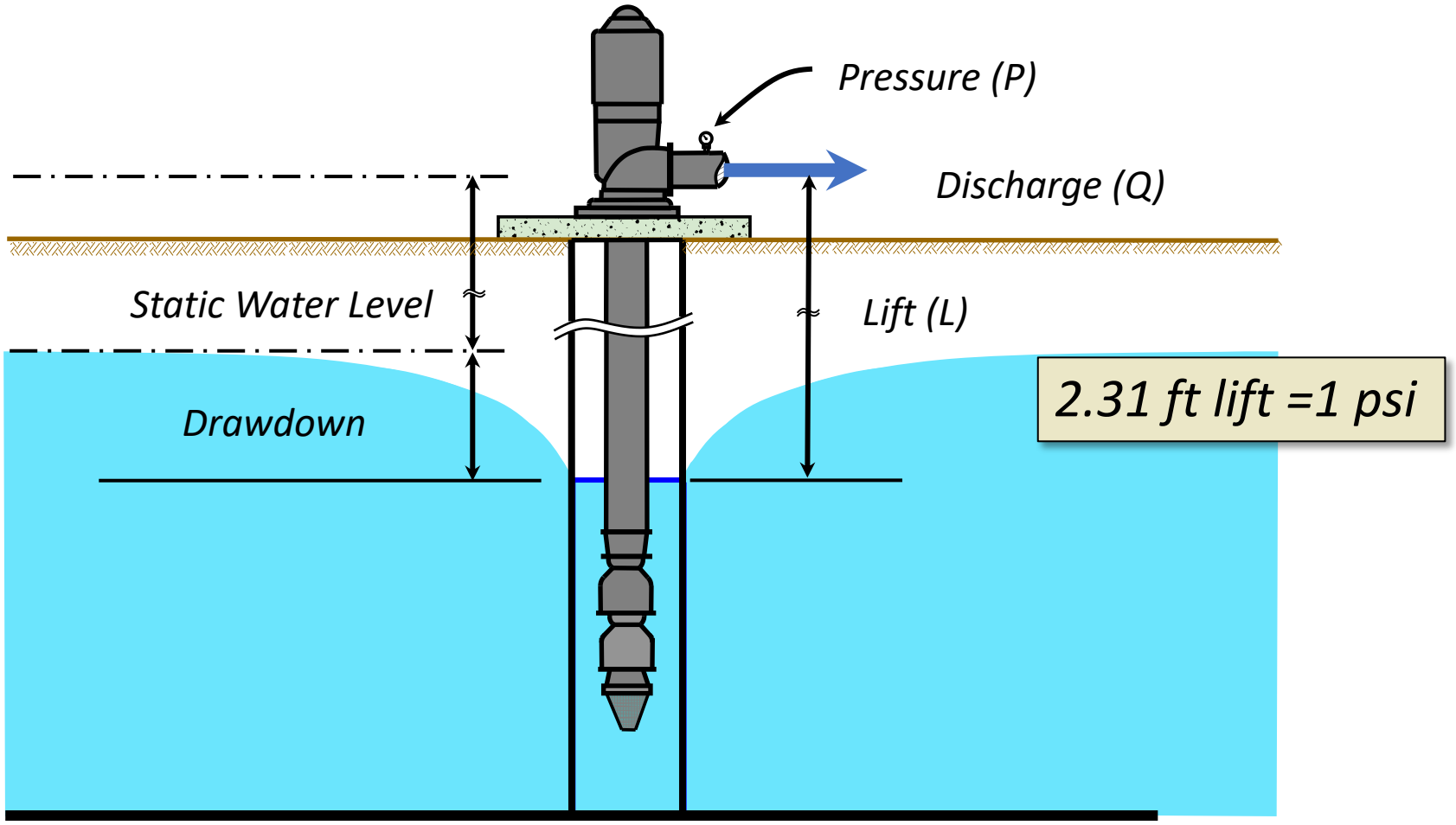
Cost to Pump Inch of Water - How much energy is being used to lift and pressurize water?



Cost to Pump Inch of Water

- Tri-Fold Brochure - COMPUTING THE COST OF PUMPING IRRIGATION WATER

Table 2. Gallons of diesel fuel required to pump an acre-inch at a pumping plant performance rating of 100% (values for the example are included in the highlighted columns and rows).

Lift feet	Pressure at Pump, psi								
	0	10	20	30	40	50	60	70	80
0	0.00	0.21	0.42	0.63	0.84	1.05	1.26	1.47	1.69
25	0.23	0.44	0.65	0.86	1.07	1.28	1.49	1.70	1.91
50	0.46	0.67	0.88	1.09	1.30	1.51	1.72	1.93	2.14
75	0.68	0.89	1.11	1.32	1.53	1.74	1.95	2.16	2.37
100	0.91	1.12	1.33	1.54	1.75	1.97	2.18	2.39	2.60
125	1.14	1.35	1.56	1.77	1.98	2.19	2.40	2.61	2.83
150	1.37	1.58	1.79	2.00	2.21	2.42	2.63	2.84	3.05
175	1.60	1.81	2.02	2.23	2.44	2.65	2.86	3.07	3.28
200	1.82	2.03	2.25	2.46	2.67	2.88	3.09	3.30	3.51
225	2.05	2.26	2.47	2.68	2.89	3.11	3.32	3.53	3.74
250	2.28	2.49	2.70	2.91	3.12	3.33	3.54	3.75	3.97
275	2.51	2.72	2.93	3.14	3.35	3.56	3.77	3.98	4.19
300	2.74	2.95	3.16	3.37	3.58	3.79	4.00	4.21	4.42
325	2.96	3.17	3.39	3.60	3.81	4.02	4.23	4.44	4.65
350	3.19	3.40	3.61	3.82	4.03	4.25	4.46	4.67	4.88
375	3.42	3.63	3.84	4.05	4.26	4.47	4.68	4.89	5.11
400	3.65	3.86	4.07	4.28	4.49	4.70	4.91	5.12	5.33

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Cost to Pump Inch of Water

- Tri-Fold Brochure - COMPUTING THE COST OF PUMPING IRRIGATION WATER

Table 3. Conversions for other energy sources:

Energy Source	Fuel/Energy Unit	Source Multiplier
Electricity	kilowatt-hours	14.12
Propane	gallons	1.814
Gasoline	gallons	1.443
Natural Gas	1000 cubic feet	2.026

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Cost to Pump Inch of Water

- Excel based Spreadsheet

PUMPING COST CALCULATOR

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Performance Rating of Pump is Known

2. Select the mode of operation:

1. Select the type of energy used for pumping:

Diesel

3. Enter the field information:

Input Parameters:	Value	Units
Size of Irrigated Field	130	acres
Depth of Water Applied	1	inches
Pumpage Rate	900	gallons per minute
Pumping Lift	150	feet
Pump Pressure	40	psi
Performance Rating of Pumping Plant	80	%
Energy Cost	4.00	$ / gallon

4. Results:

Volume of Water Applied	130	acre-inches
Time of Operation	65	hours
Energy Use Rate	5.50	gallons / hour
Energy Used at 100% Performance Rating	287	gallons
Amount of Energy Used	359	gallons
Cost per Unit of Water Pumped	**11.05**	$ / acre-inch
Cost for Period at Current Performance Rating	**1,437**	$ / period
Cost for Period at 100% Performance Rating	1,150	$ / period
Potential Savings During the Period	287	$ / period

ENERGY SOURCE COMPARISON

Enter Costs for Alternate Energy Sources

Electric $/kilowatt hour	Gasoline $/gallon	Natural Gas $/1000 cubic ft	Propane $/gallon
0.07	4.00	8.25	2.50

Pumping Cost, $/acre-inch

2.73	15.95	4.62	12.94

Note: Other factors should be considered before changing energy sources, see Estimated Irrigation Costs, 2001. Nebraska Cooperative Extension CC 371 for more information:
http://agecon.unl.edu/prices/Estimated Irrigation Costs 2001.pdf

UNL-TAPS Efficiency Data

- Farm 26 Most Efficient Award – 226.6 bu/ac - 140 lb. N & 8.2 in/ac
  - Agronomic Efficiency – 0.85bu/lb. N
  - IWUE – 14.5 bu/in

- Farm 7 – Least Efficient – 155 bu/ac – 200 lb. N & 4.0 in/ac
  - Agronomic Efficiency – 0.25 bu/lb. N
  - IWUE – 11.7

- Make use of other inputs such as fertilizer

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UNL-TAPS Efficiency Data

- Farm 1 Highest Yield – 294.9 bu/ac, 220 lb. N & 12.5 in/ac
- Farm 26 Most Efficient Award – 226.6 bu/ac - 140 lb. N & 8.2 in/ac
- Maximum efficiency does not mean most profitable/productive

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Irrigation Cost

- Contact:

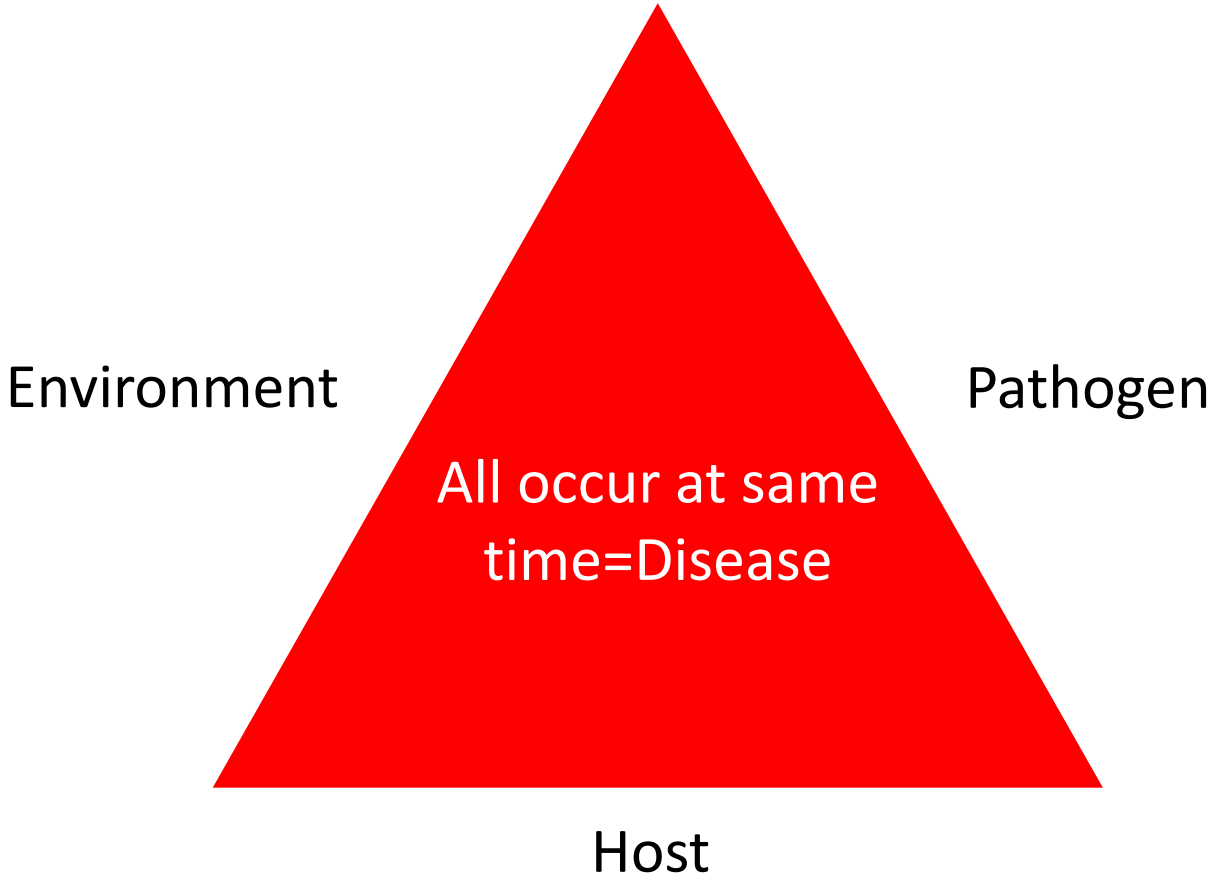
- Chuck Burr
- chuck.burr@unl.edu

In-Season Crop Disease Management Decisions

Sarah Sivits
Cropping Systems, Extension Educator
ssivits2@unl.edu

University of Nebraska Lincoln

Understanding Disease Development



- Focus on the basics:
  - Disease triangle
  - Field history
  - Environmental conditions

Economic Thresholds

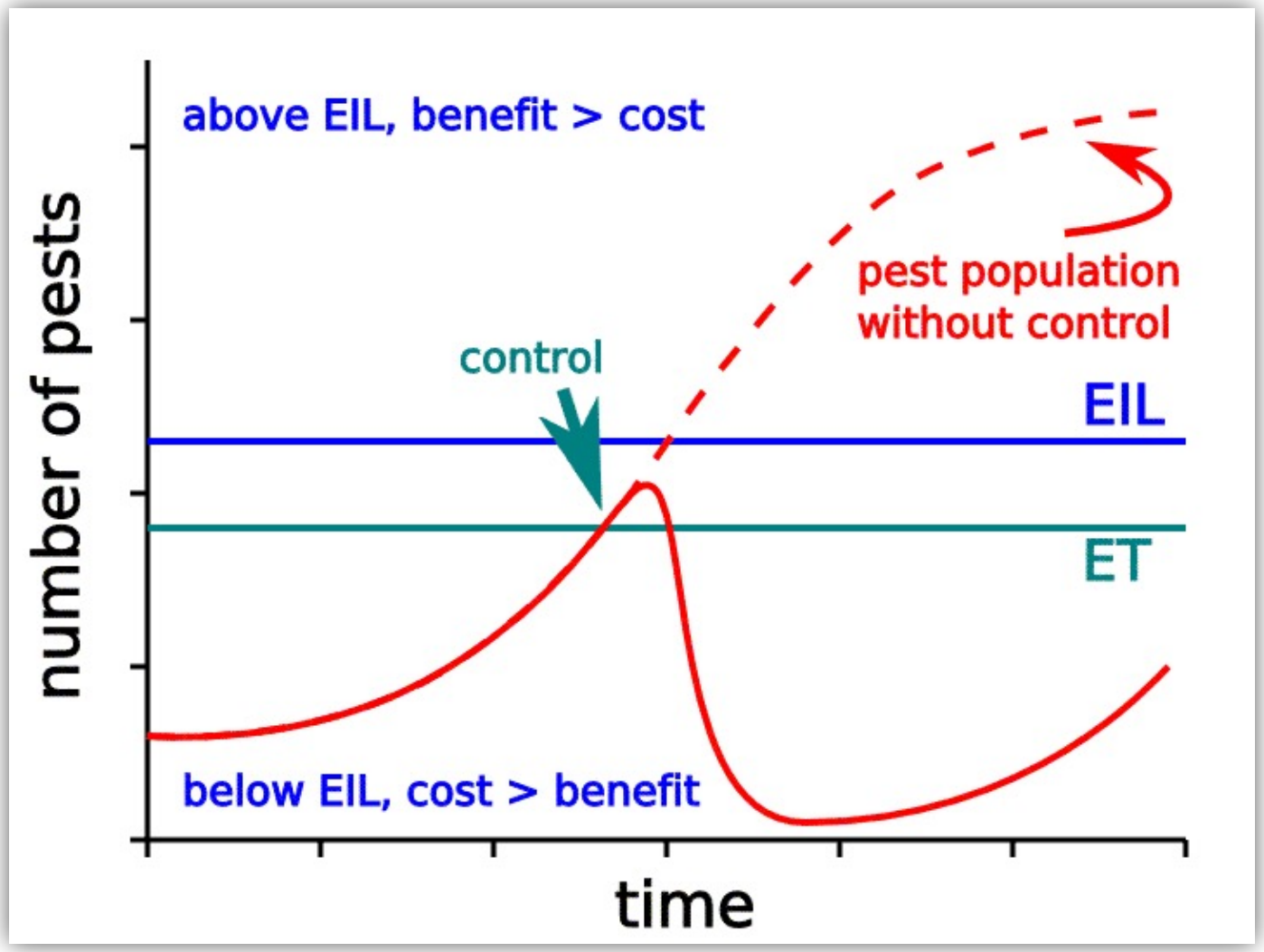


Figure credit: Ed Zaborski, University of Illinois.

- Considerations:
  - Time of year
  - Crop value
  - Field history
  - Treatment cost
  - Resistance issues
  - Farmer preference
  - Environmental conditions

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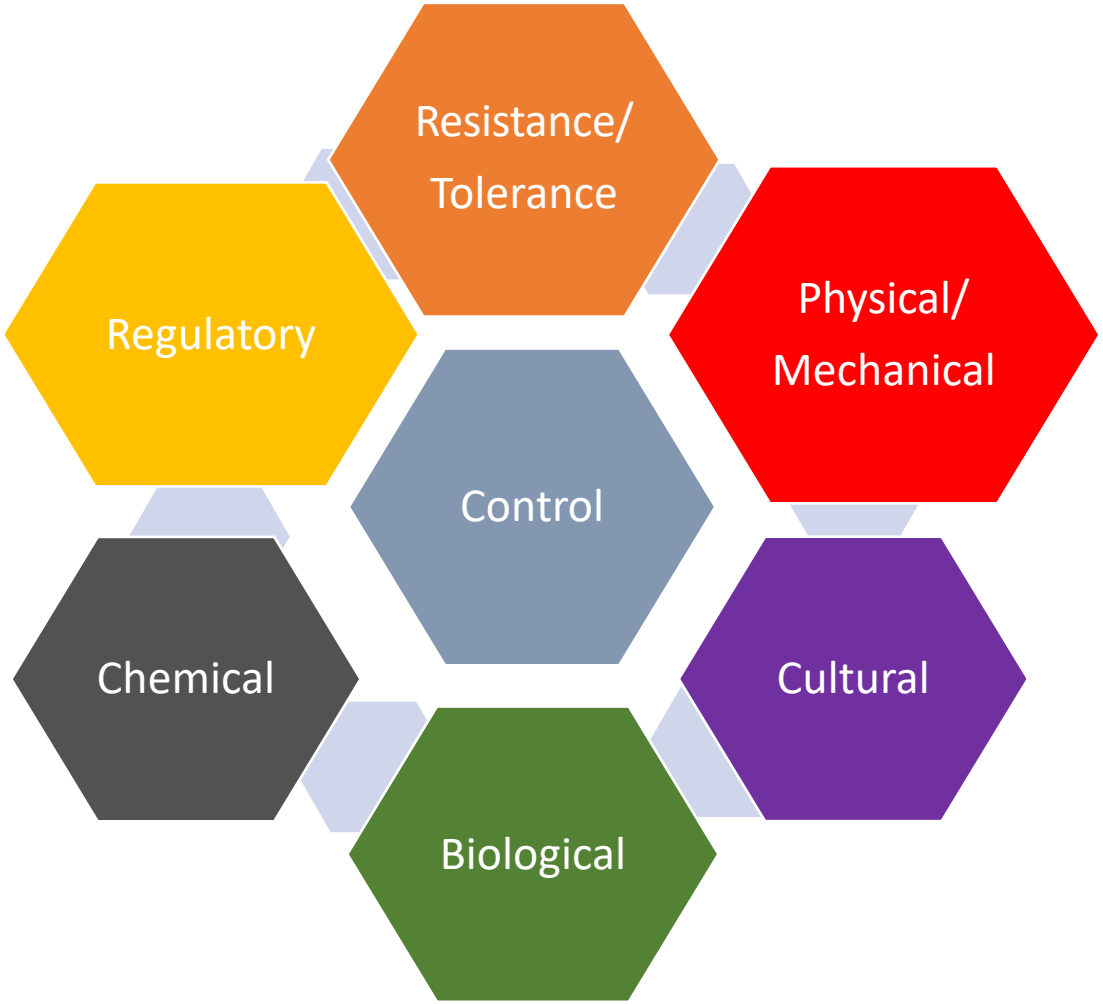
Integrated Pest Management (IPM) Strategies

1. Identify pest
2. Evaluate pest damage
3. Determine need for controls
4. Consider multiple control options
5. Select best combination of control options
6. Monitor your selection



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Chemicals-Fungicides

- Best time to apply?
  - Economic thresholds
  - Pest/environmental conditions
- Who makes the application?
  - Co-op vs Custom Applicator vs You
    - Costs vs Time
- Best products to use?
  - Effective vs Affordable
    - Generic vs Brand Name
- Factors that increase diseases:
  1) Hybrid/variety susceptibility
  2) Previous crop rotations
  3) Weather patterns (wet/cool vs dry/hot)
  4) Field history
  5) Time of year

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Chemicals-Fungicides

- Proper identification is key
  - Fungicides will not manage bacterial diseases
- Application timing is critical
  - Soybeans→R3—R5 growth stages*
  - Corn→VT—R3 growth stages*
    - *Timing depends on the pathogen
- Consider disease pressure
  - No consistent yield increases with low disease pressure
- Fungicides after hail/wind events?
  - Typically not necessary
    1) Wounding for bacterial diseases
    2) Fungal diseases don't need wounding
    3) Might only be effective at R2— blister stage (helps with standability)

https://cropwatch.unl.edu/fungicide-use-corn-after-hail-or-wind-damage

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Corn Examples

- **Southern Rust** (*Puccinia polysora*)
  - Optimal temperature ~80°F
  - Orange/tan pustules
  - Predominantly on upper leaf surface
  - Aggressive pathogen, reproducing quickly in susceptible hybrids and with favorable weather
- Management:
  - Fungicides necessary if it develops early during grain fill with favorable (warm/wet) forecast

- **Common Rust** (*Puccinia sorghi*)
  - Common disease
  - Early season moisture
  - Optimal temp 70's°F
  - Brick red/brown pustules
  - Sporulates on both leaf surfaces
- Management:
  - Usually unnecessary
  - Fungicides effective (crop value)
  - Natural resistance in most hybrids

Southern Rust (above)
Common Rust (below)

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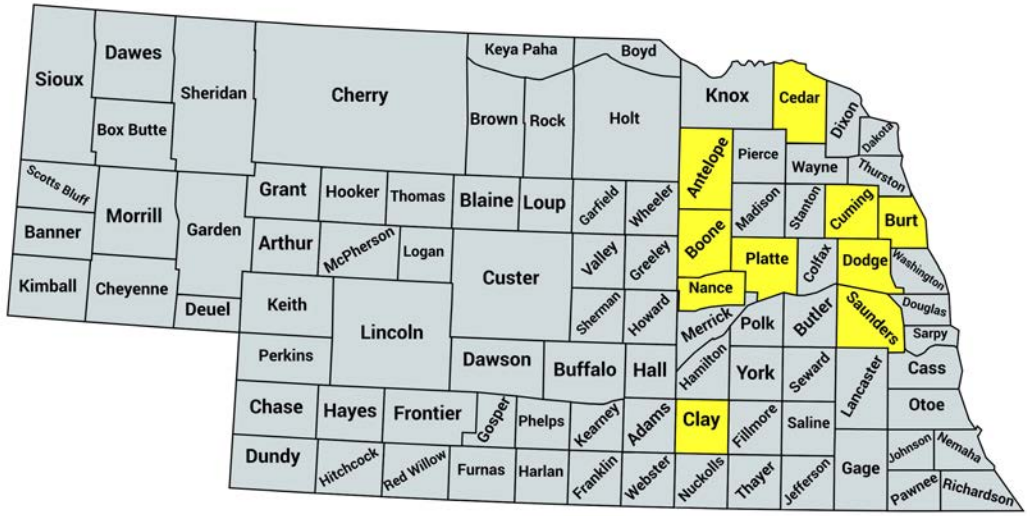
Soybean Examples

- Frogeye Leaf Spot (*Cercospora sojina*)
  - Small tan/gray lesions
  - Red/purple border
  - Upper leaves
  - Optimal temp (77-86 °F)
  - Humidity
  - Frequent rain/irrigation
- Management:
  - Variety selection
  - Crop rotation/residue management
  - Scout around flowering
  - Foliar fungicides—multiple Modes of Action (MOAs)
- Resistance concerns
  - **2019** - QoI Fungicide Resistance Confirmed in *Cercospora sojina* causing Frogeye Leaf Spot in (all) 10 Nebraska counties sampled
  - **2020** – 47 counties total sampled across NE. Still waiting for lab results.
- https://iwilltakeaction.com/uploads/files/57229-17-ta-knowyourdiseaserisk-fact-sheet-final.pdf

Frogeye Leaf Spot



Final Thoughts

- Every operation is different, see what works best for you.
- Determine where you can cut costs and be profitable.
- Pay attention to economic thresholds, crop value, time of year, crop growth stage, and management costs.
- Ask questions and don't be afraid to try something different.

Resources

- CropWatch Website: http://cropwatch.unl.edu/
- Crop Protection Network: http://cropprotectionnetwork.org

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In-Season Insect Pest Management Decisions

Julie A. Peterson
Entomology Extension Specialist
@PetersonInsects

University of Nebraska Lincoln

Integrated Pest Management

Host Plant Resistance

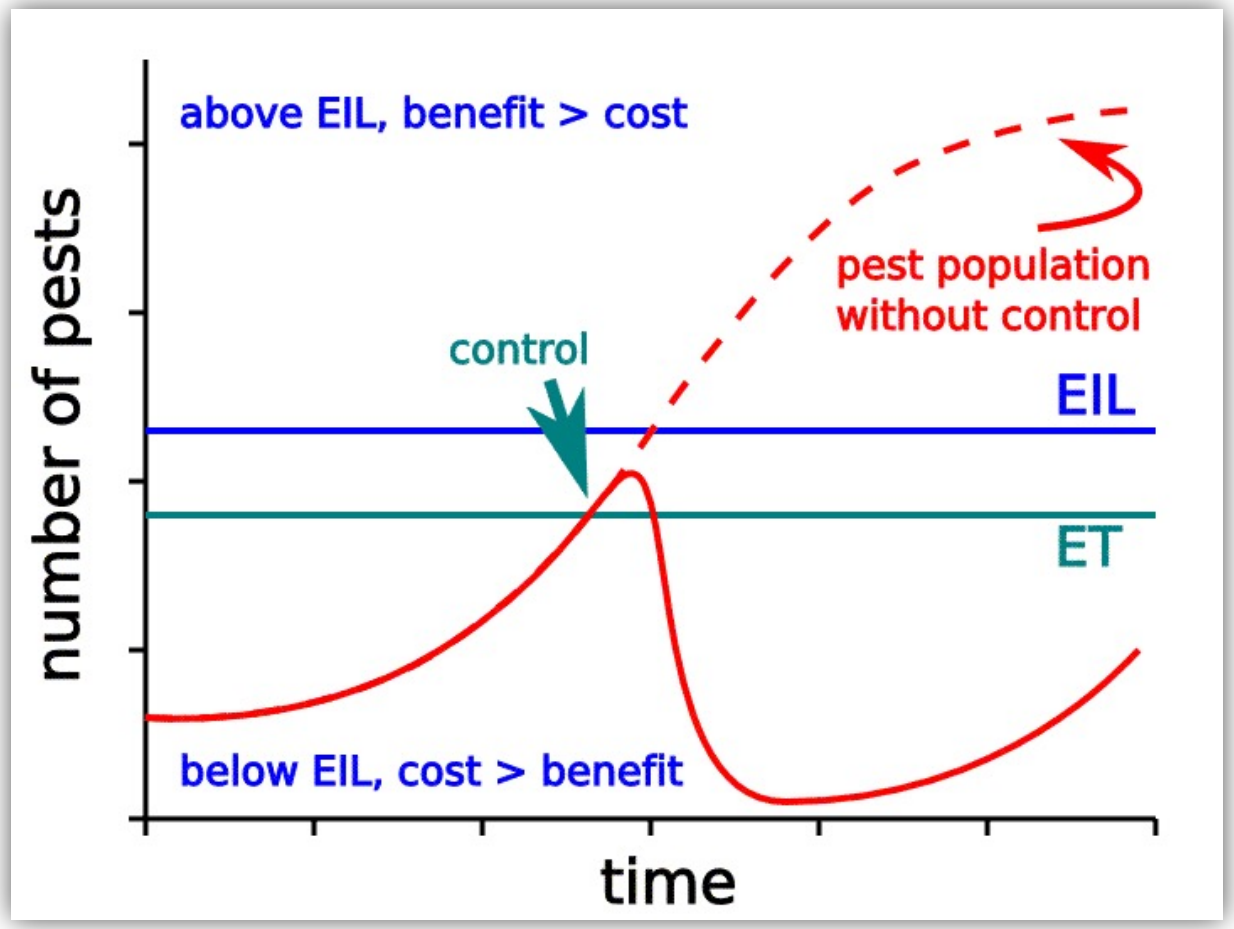
Cultural Control

Biological Control

Chemical Control

How is the Economic Threshold Determined?

- ET: The point at which you need to make a decision to treat, before you reach the Economic Injury Level
- The Economic Threshold is determined based on how quickly the insect population will grow, to give you the chance to treat, prior to reaching the Economic Injury Level
- The ET is always lower (smaller) than the EIL
- So, to know the ET, we need to know the EIL first

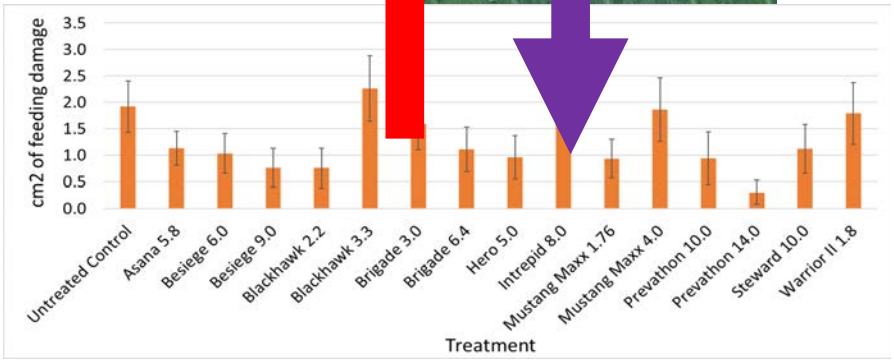


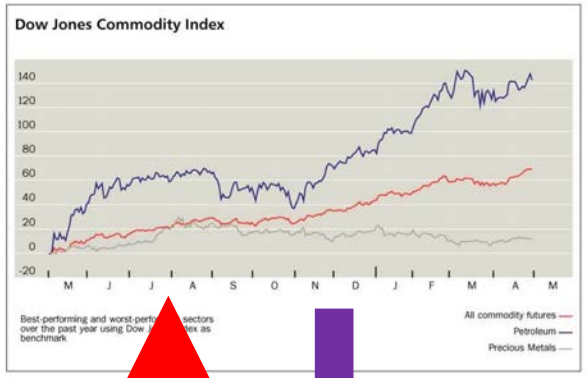
How do we know the ET & EIL?

Cost of controlling the pest

Effectiveness of your control strategy

$$EIL = \frac{C}{V \times I \times D \times K}$$

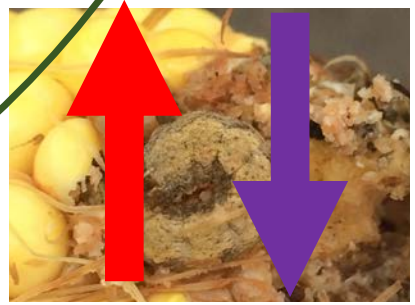


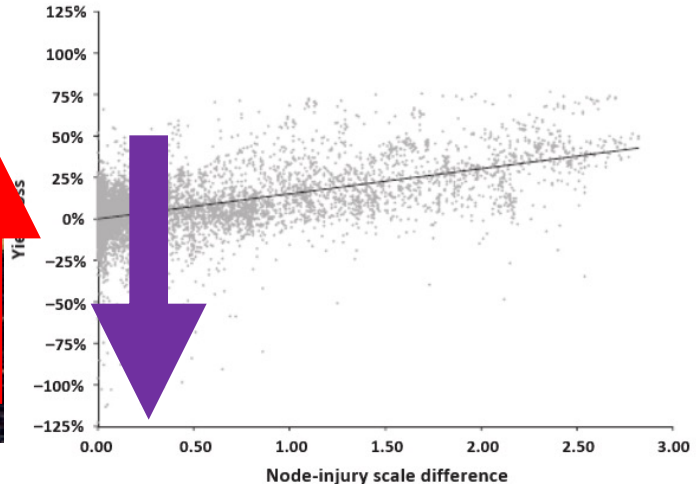


Value of the crop

Injury per pest

Damage to crop from injury

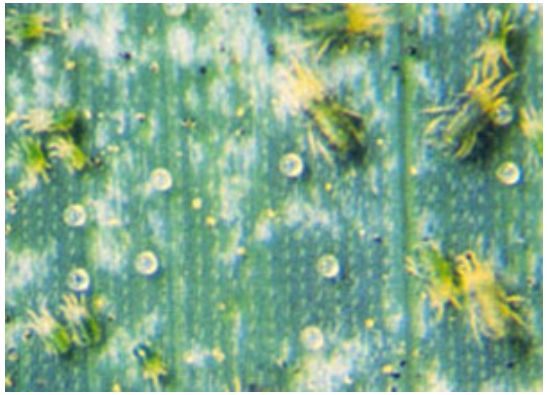




Extra Considerations for the ET+EIL

- Life stage of pest
- Biology of the pest
- Growth stage of crop
  - Many ET's change based on the growth stage or time of the year

- Resistance considerations
- Making decisions about next year



5 vs. 30

Table 5.1 - Economic thresholds in % infested plants with a WBC egg mass

Crop value ($/bu)	Management cost, $/acre					
	4	8	10	12	14	16
4% larval survival						
3	15	29	37	44	51	59
5	9	18	22	26	31	35
7	6	13	16	19	22	25
20% larval survival						
3	3	6	7	9	10	12
5	2	4	4	5	6	7
7	1	3	3	4	4	5

Importance of Scouting

- There is a time and cost associated with scouting
  - Your time or hire a crop consultant or agronomist
  - Almost always see an economic return on use of scouting vs. regular calendar sprays
    - Other benefits: less likely to develop resistance, expose people and environment to pesticides
- At least once per week, representative areas of the field
- Improve scouting efficiency and save time/money:
  - Predicting when pests will be present (degree day models)
  - Using passive sampling to help inform you
  - Speed scouting app to reduce # of plants to scout
  - Prioritizing most vulnerable crop fields

Resources

$ per acre at low and high end of label rates

- Nebraska Extension Guide for Weed, Disease, and Insect Management
- WBC Speed Scout App: WBC Speed Scout App
- ECB calculations worksheet
- CropWatch articles and Tweets

2021 Approximate Retail Price ($) Per Unit of Selected Insecticides for Field Crops

Survey price estimates in September 2020

Product	2021 Price ($) per Unit	Rate			Cost/acre ($)	
		Low	High	Unit	Low	High
Agree	$18/lb	0.5	2	lb/acre	9.00	36.00
Alias 4F	$140/gal	-	1.50	fl oz/acre	-	1.64
Arctic 3.2E	$80/gal	2.00	6.00	fl oz/acre	1.25	3.75
Asana XL	$75/gal	2.90	9.60	fl oz/acre	1.70	5.63
Baythroid XL	$350/gal	0.80	2.80	fl oz/acre	2.19	7.66
Belay	$105/gal	3.00	4.00	fl oz/acre	2.46	3.28
Besiege	$330/gal	5.00	10.00	fl oz/acre	12.89	25.78
Blackhawk	$120/lb	1.10	2.20	fl oz/acre	8.28	16.44
Brigade	$150/gal	0.15 2.10	0.30 6.40	fl oz 1000ft/row* fl oz/acre	3.06 2.46	6.13 7.50
Capture LFR	$360/gal	0.39	0.98	fl oz 1000ft/row*	19.11	48.02

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Resources

- Crop Watch - http://cropwatch.unl.edu/
  - Newsletter, efficacy trial data, and publications
- Market Journal – weekly episode or see videos at: http://marketjournal.unl.edu/soybeandiseases
- Videos – YouTube – UNL CropWatch channel
  - Short Corn/Soybean Disease videos
- Crop Protection Network http://cropprotectionnetwork.org
- Contacts:
  - Sarah Sivits (sarah.sivits@unl.edu)

A presentation by:

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Institute of Agriculture and Natural Resources

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