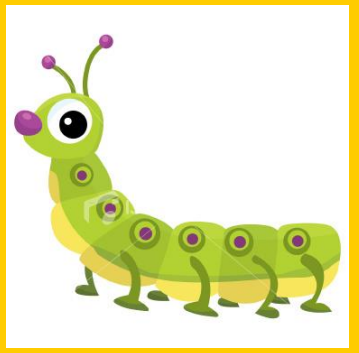
Soybean's Pest-a-Palooza in 2023



Janet Knodel & Patrick Beauzay, NDSU

Bruce Potter, UMN

2024 Advanced Crop Advisor Workshop

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The environment and crop pest populations

✓Host

- Quality/Nutrients/Species mix
- Genetics (resistance/tolerance)
- Rotation

✓Weather/Microclimate

- Temperature (DDs)
- Moisture
- Wind patterns

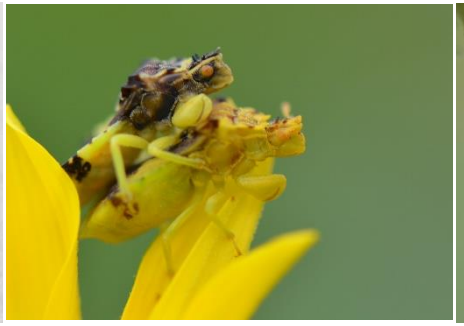
✓Natural enemies

- Generalists
- Specialists

✓Pesticides

- Timing
- Efficacy
- Resistance

Beneficials (the generalists)



Whitney Cranshaw, Colorado State University, Bugwood.org

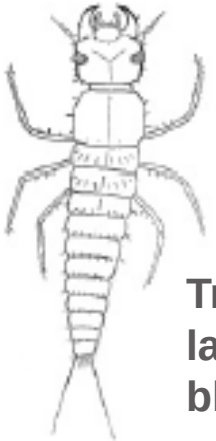
Photo: Ken Chamberlain, The Ohio State University, Bugwood.org

- Minute pirate bugs
- Ambush bugs
- Damsel bugs
- Assassin bugs
- Soldier bugs
- Syrphid larvae
- Lacewing larvae
- Ground beetles
- Lady beetles

Unless noted photos by Bruce Potter

Beneficials (the specialists)

- Parasitoids
- Bee fly larvae
- Aphid midges
- Blister beetle larvae



Triungulin or larvae of blister beetle

Photos: Bruce Potter

Beneficials (the specialists)

Nematodes

Horsehair worms

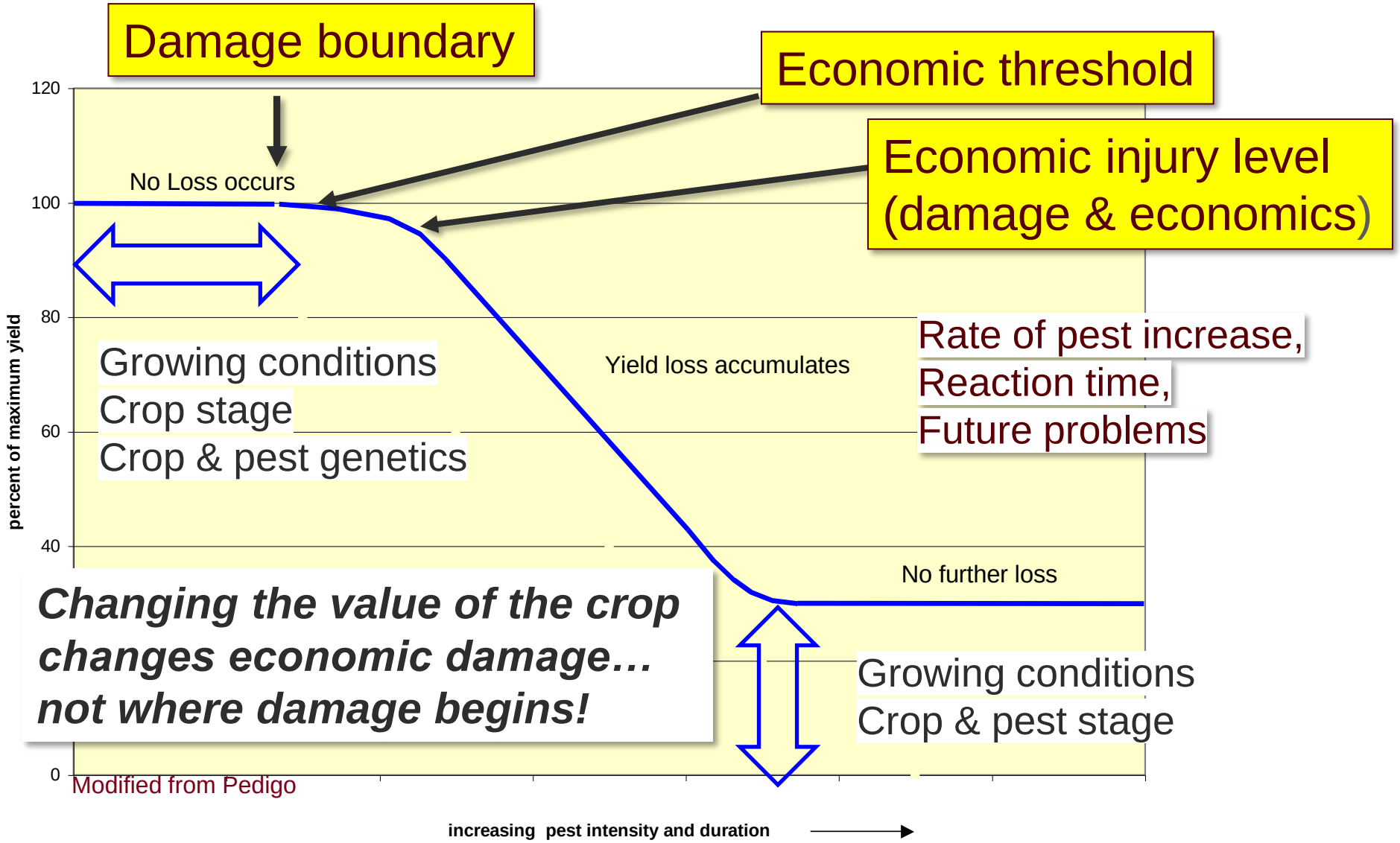
Virus

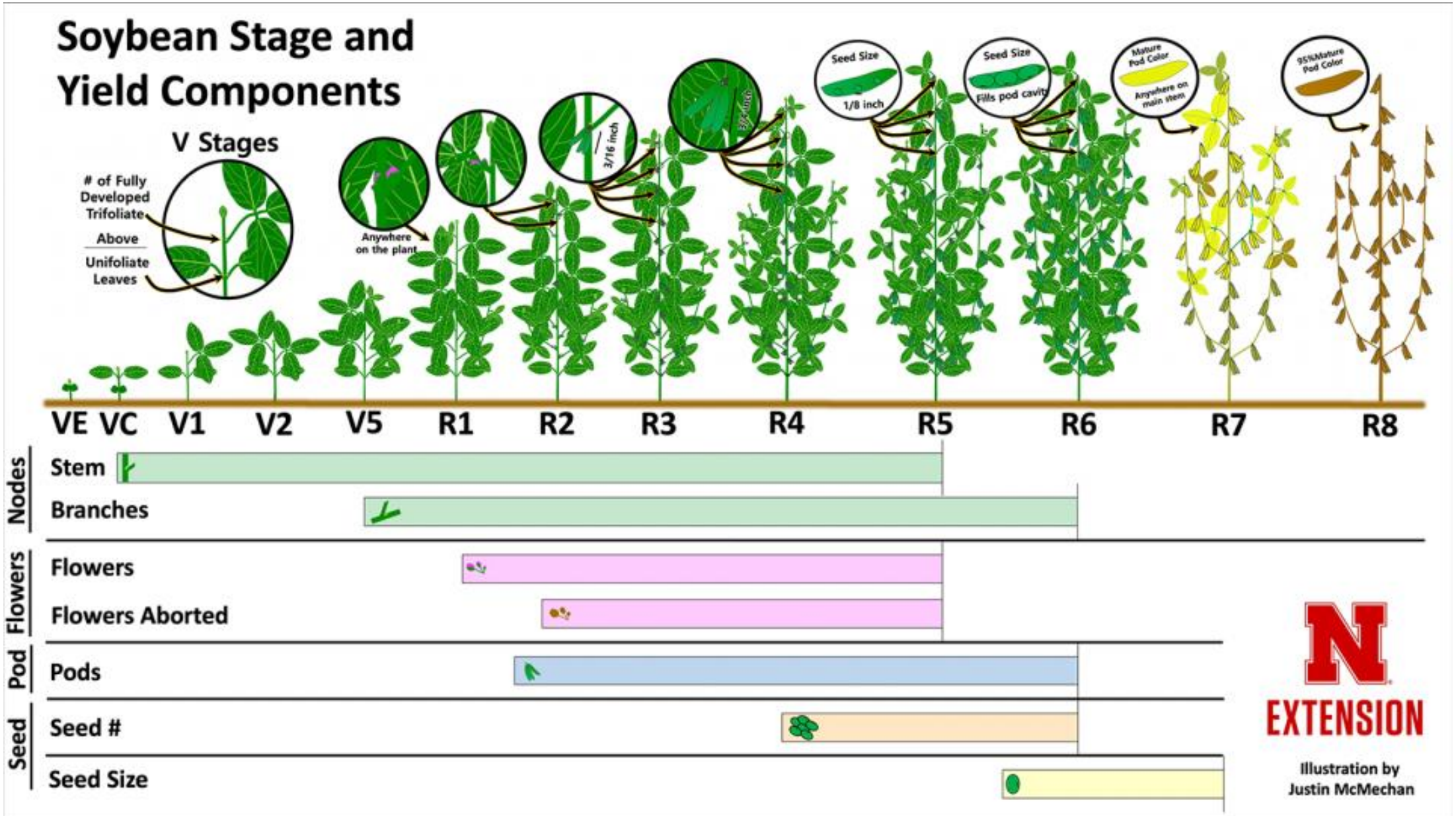
Bacteria

Microsporidians

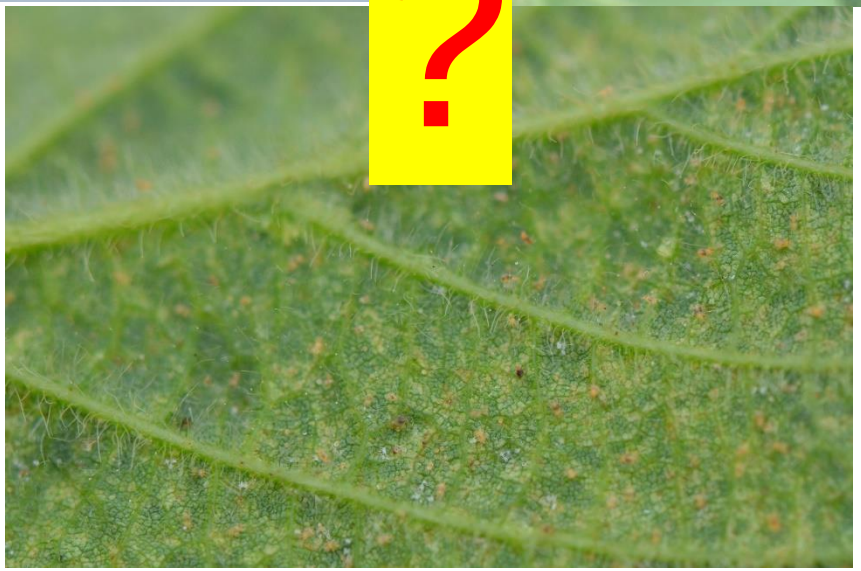
Fungi

How pest induced yield loss happens





?



The effect of multiple pests on:

Yield?
Weather?
Pesticide selection?

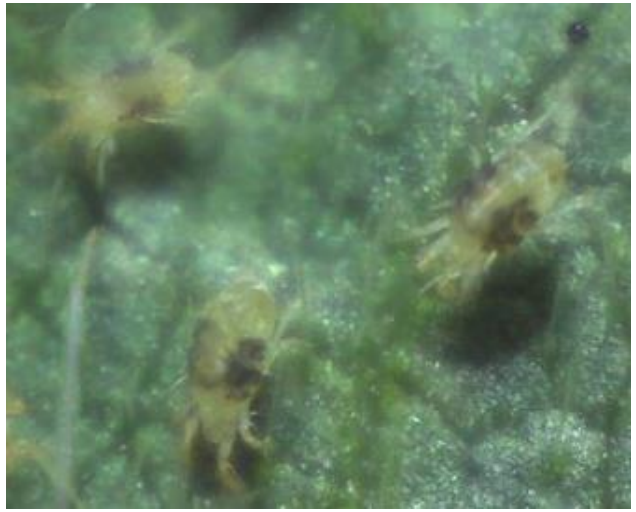
Would you spray this field?

Defoliators







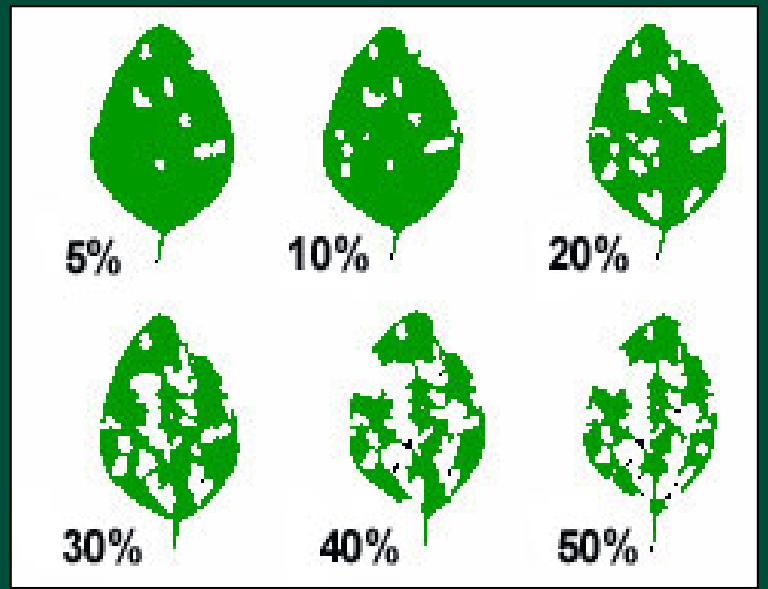
Bruce Potter 2024

Sampling and Estimating Damage Caused by Defoliating Insects

- **Percent Defoliation**
  - Often overestimated by field scouts
- **Number of insect per foot row**
  - Drop cloth

Economic Thresholds for Foliage-feeding Defoliators

- Lump all defoliating insects together
  - Caterpillars, grasshoppers, bean leaf beetle
  - Adjust for conditions (weather, disease, parasitism)
- Percent Defoliation
  - Vegetative - prebloom = above 30%
    Reproductive stage = above 20%



Guide to estimating damage caused by defoliating insects.

Defoliation & thresholds

- Defoliation thresholds for soybean
  - Standard (e.g., Shanovich et al. 2019)
    - 30% - vegetative stages
    - 20% - reproductive stages
  - New (Raudenbush, et al. 2021)
    - 30% - through flowering
    - 10% - pod & seed development

Economic Thresholds for Foliage-feeding Defoliators in Soybeans

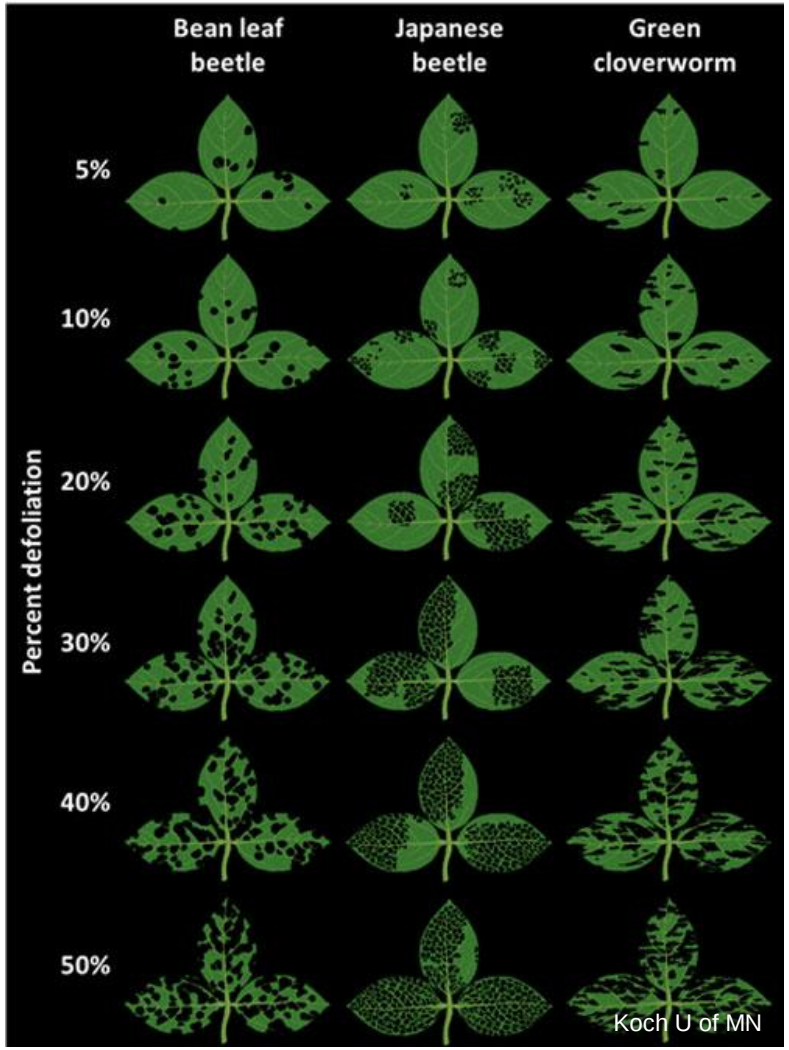
- Larvae (or caterpillars) per row foot
  - An average infestation of 4 to 8 larvae per row foot
  - Or 13-27 larvae per row meter
- As plants reach **flowering and pod filling**, defoliation poses a **greater risk for yield loss**.

Assumptions for assessing soybean defoliation

- Don’t panic
  - **Soybeans have spare leaves**

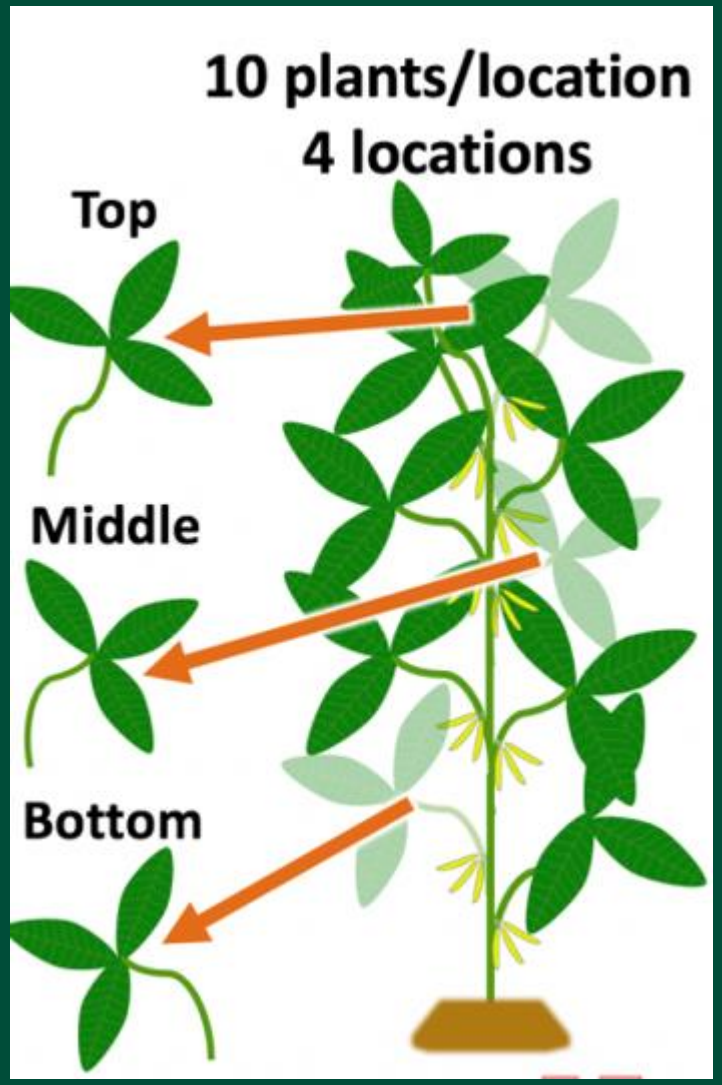
    Lower leaves can compensate
  - Make sure pests are still present
  - Most defoliators have distinct generations and feed for a limited time
- After R6.5 defoliation less critical

Defoliation Guides



Estimating Insect Defoliation in Soybeans

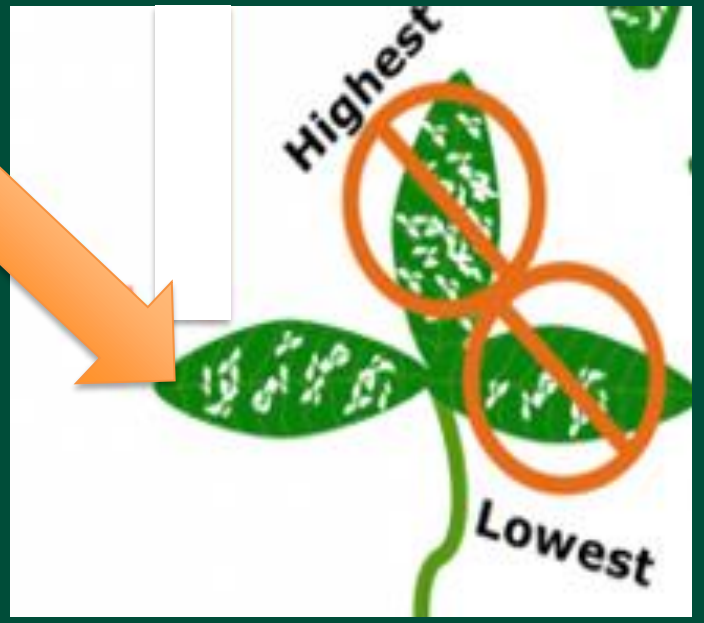
1. Scout from late vegetative to R6 crop stage
2. Walk at least 10 rows into field
3. W pattern in fields and sample 10 plants per location and 4 locations.
4. Remove leaves from top, middle and bottom of a randomly-selected plant.



Source - McMechan UNE

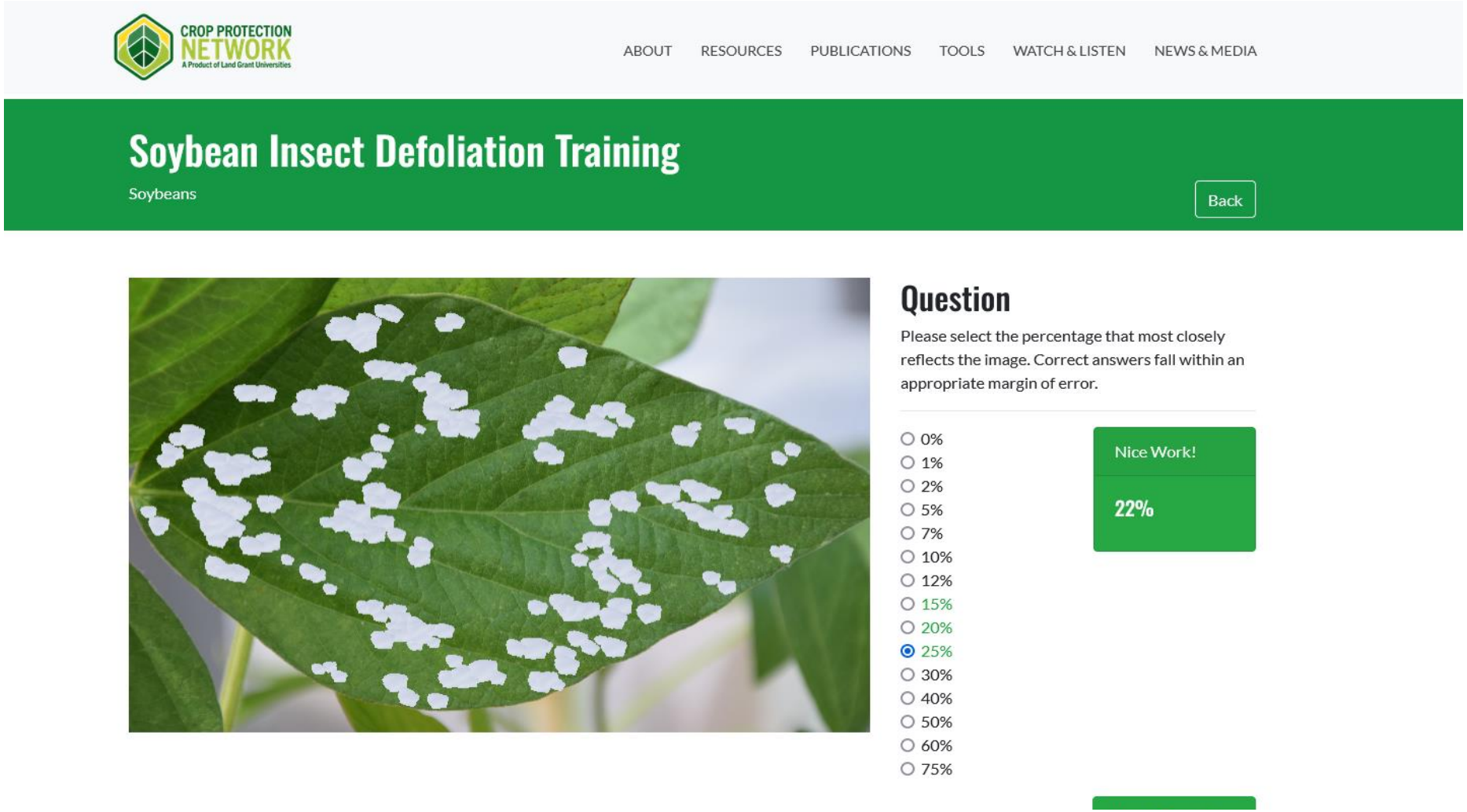
Estimating Insect Defoliation in Soybeans

3. Remove highest and lowest defoliated trifoliate. Keep other leaflet.
4. Repeat 1-3 on remaining plants
5. Repeat at remaining locations and record defoliation of all 40 leaves.
6. Calculate the average defoliation per field



Source - McMechan UNE

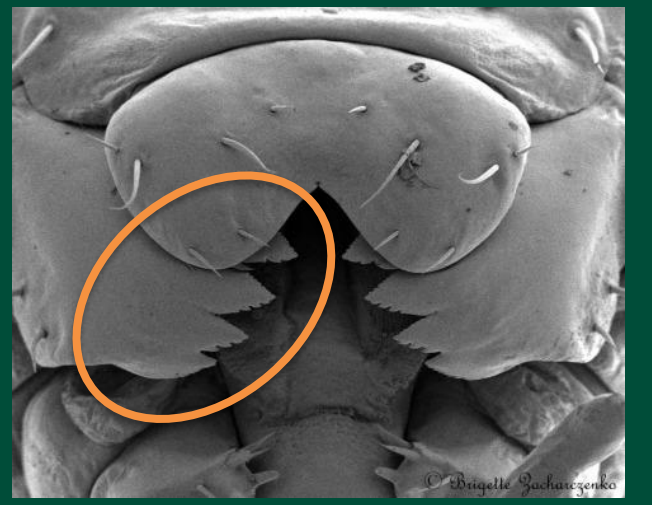
Defoliation Guides

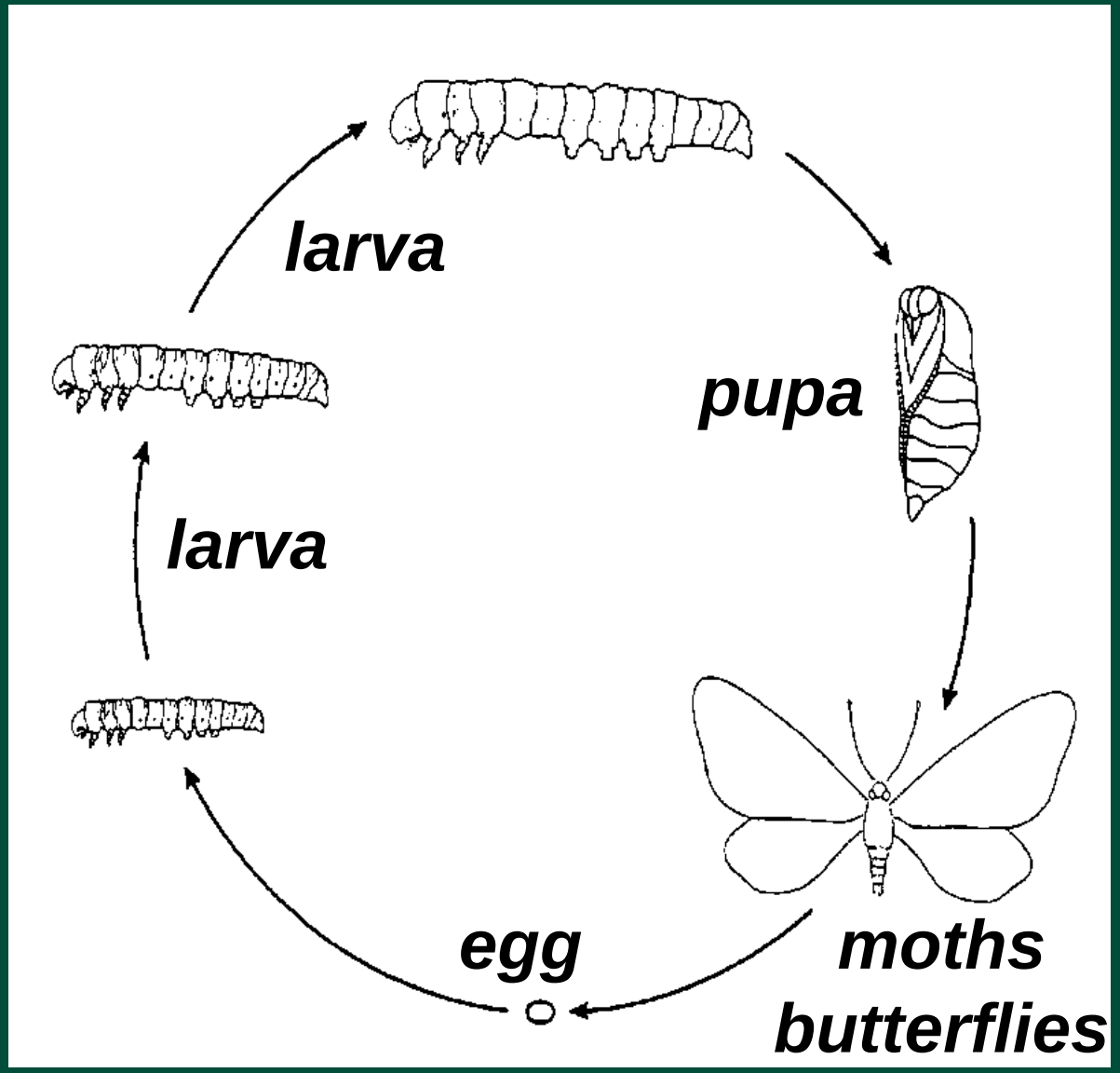


https://severity.cropprotectionnetwork.org/crop/soybeans/soybean-insect-defoliation-training

Life Cycle of Foliage-feeding Caterpillars

- **Complete Metamorphosis**
  - Egg to larval stages to pupae to adult
  - Larvae look different from adult
    - Chewing mouthparts
  - Pupal stage, called chrysalis for butterfly (inactive)
  - Adult moth / butterfly emerges from pupa / chrysalis





Foliage-feeding Caterpillars - Adult stage

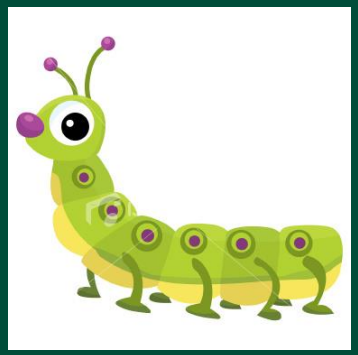
Foliage-feeding Caterpillars - Adult stage

Velvetbean caterpillar

Foliage-feeding Caterpillars - Adult stage

Alfalfa webworm

Foliage-feeding Caterpillars
Larval stage



Thistle caterpillar

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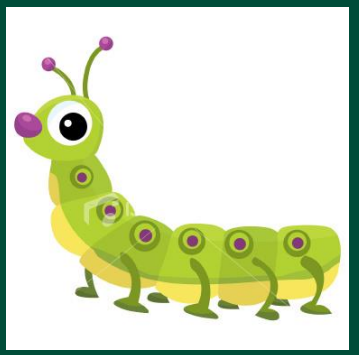
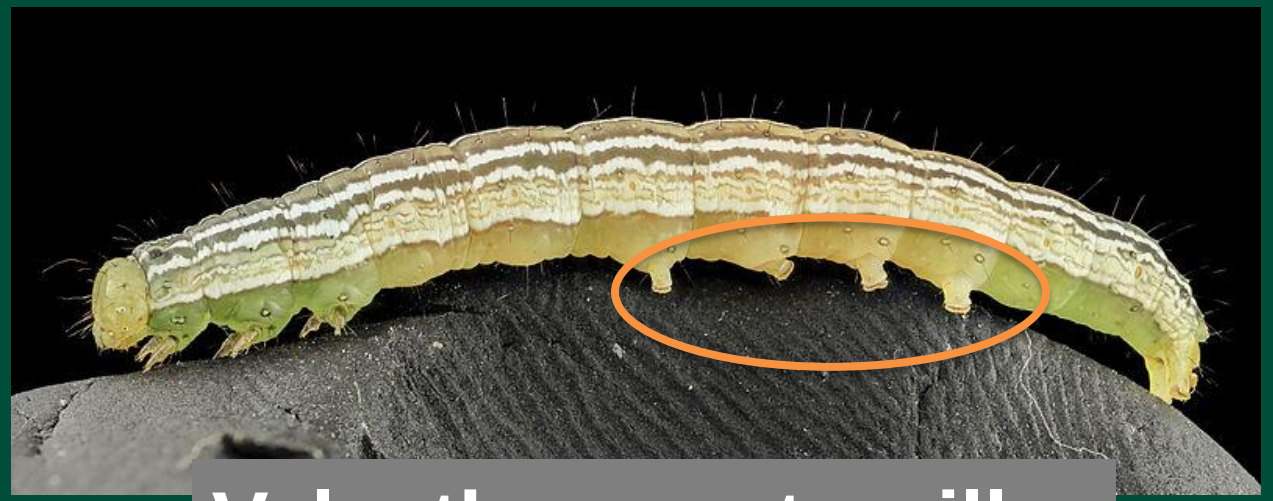
Foliage-feeding Caterpillars
Larval stage



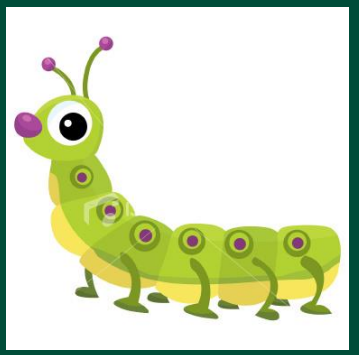
Green cloverworm



Velvetbean caterpillar

NDSU | EXTENSION

Foliage-feeding Caterpillars
Larval stage



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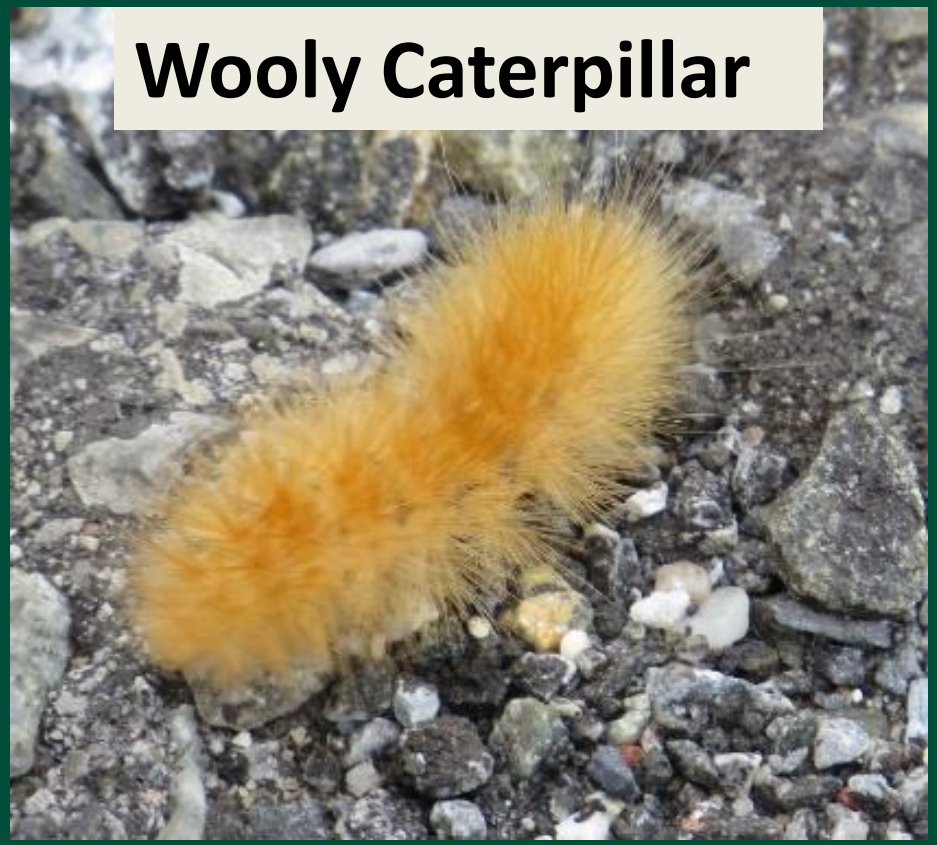
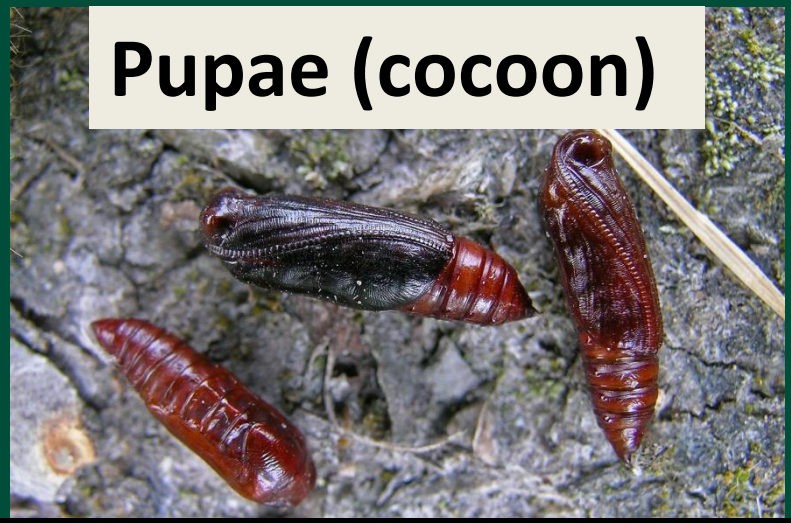
Foliage-feeding Caterpillars
Larval & ? stage





Natural Control

- Diseases
  - Fungal (*Nomuraea rileyi*)
  - Viral
    - Nuclear polyhedrosis virus
  - Favored by high humidity and warm temperatures
- Parasitic wasps
- Predators

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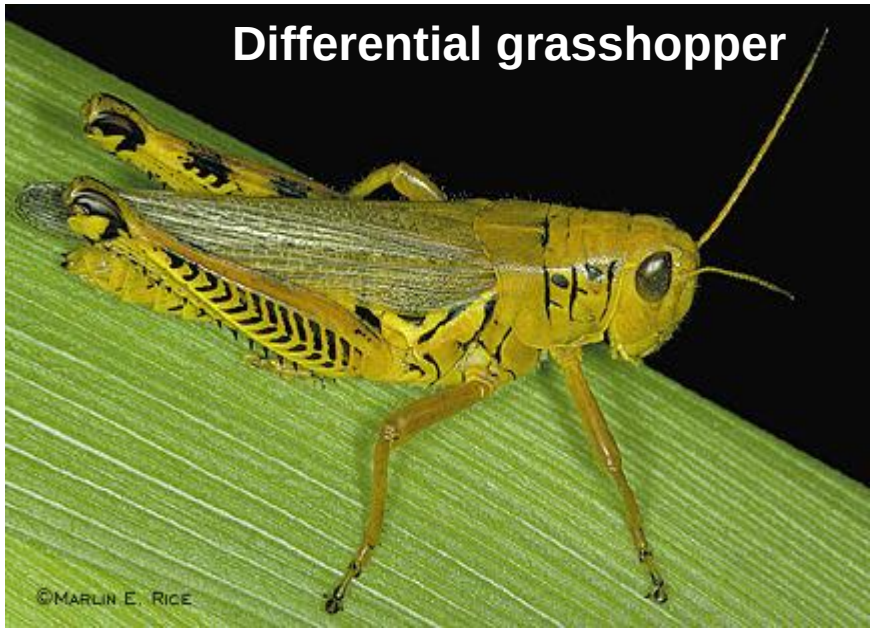
Natural Control

- **Predators**
  - **Ground beetles, predaceous stink bugs, birds, frogs, rodents, snakes**

Order Orthoptera - Grasshoppers

Two-stripped grasshopper



Only a few grasshoppers are major importance to cropland

- **Alfalfa, corn, soybean, small grains (barley, oats, winter wheat, HRSW), sunflower, flax**

Crop Damage - Grasshoppers

- Chewing mouthparts
  - Leaf stripping or defoliation
  - Pod or wheat head clipping
- Often higher feeding injury on field edges
- Population fluctuates low to outbreak levels depending on the weather
  - ✓ Areas with <25 inches of rain = Higher risk
  - ✓ Hot, dry weather 'Drought' = Increase risk
  - ✓ Cool, wet weather = Reduces populations and decrease risk

Pile of dead grasshoppers after wheat harvest 2022, McKenzie County, ND

Tammy Duchsherer, Scheresky Ag Services

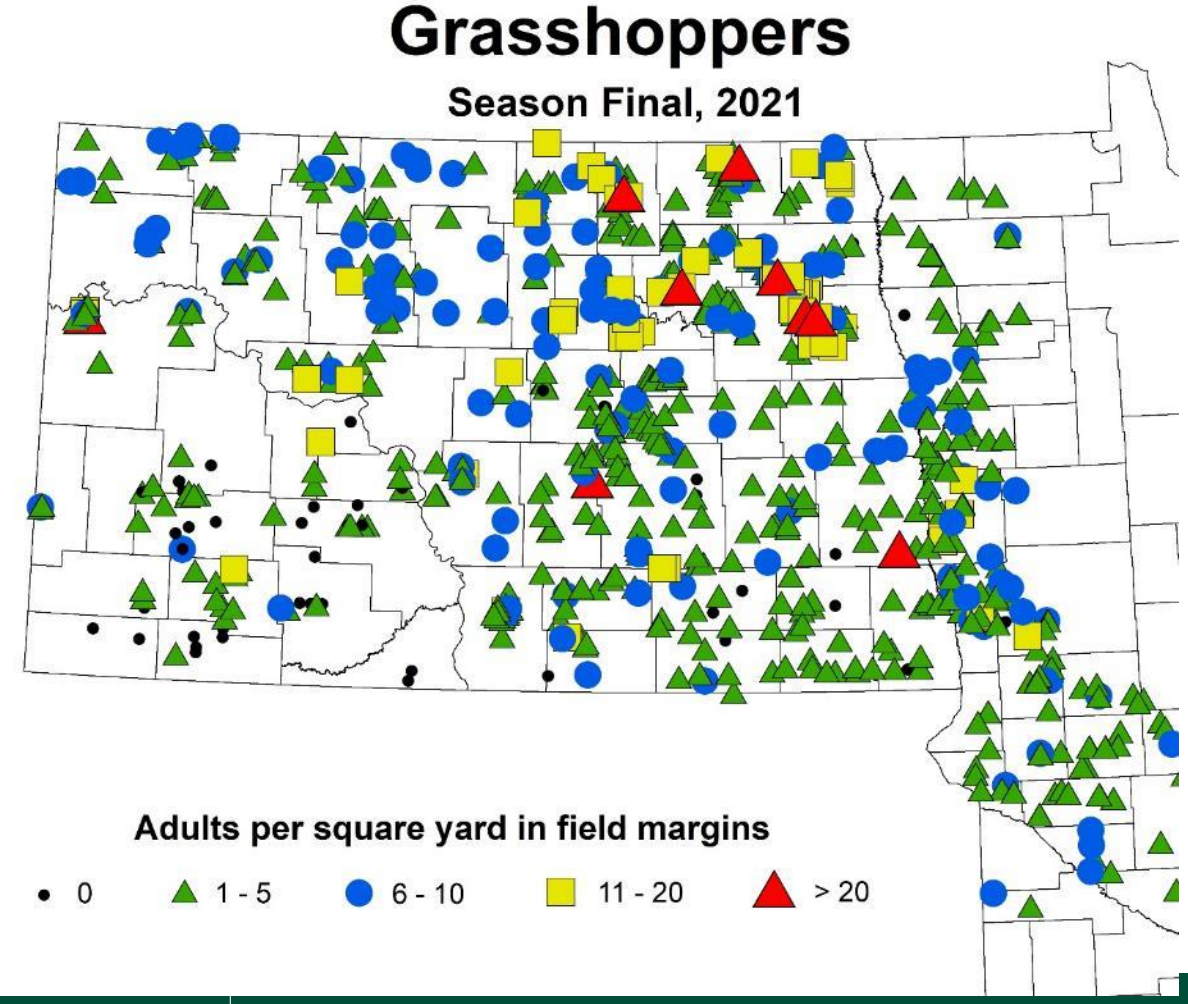
Crop Damage - Grasshoppers

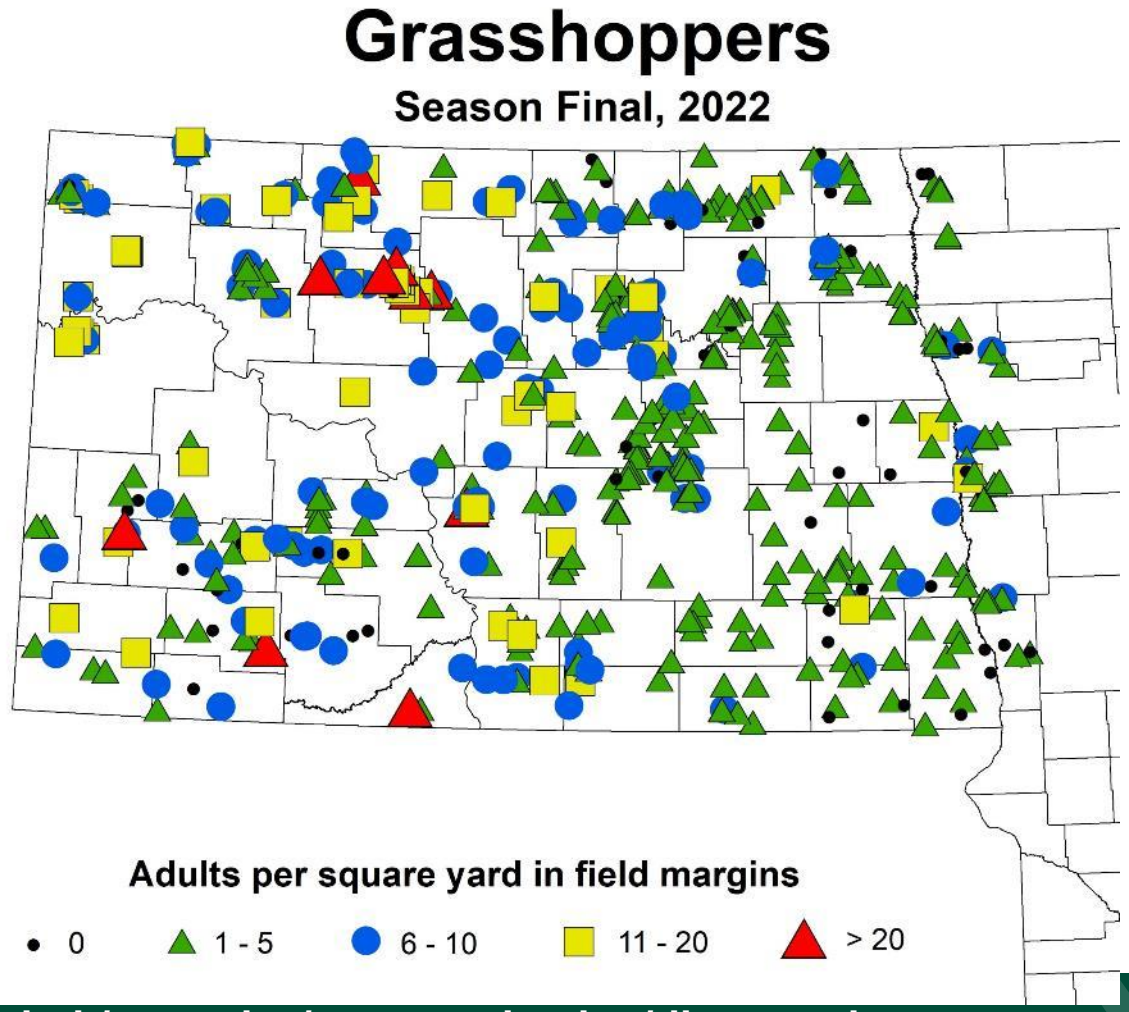
Sunflower defoliated by grasshoppers in SD 2020
Adam Varenhorst, SDSU

Grasshopper feeding directly on corn ear in ND 2020
Veronica Calles Torrez

Soybean field edge defoliated by grasshoppers 2021
Jeff Stachler, Griggs County

Grasshopper Maps 2021- 2022





https://www.ndsu.edu/agriculture/ag-hub/ag-topics/crop-production/diseases-insects-and-weeds/integrated-pest-management/grasshoppers

Nymph or Adult Grasshoppers - Thresholds

Rating	Nymphs per square yard		Adults per square yard	
	Margin	Field	Margin	Field
Light	25–35	15–25	10–20	3–7
Threatening (action threshold)	50–75	30–45	21–40	8–14
Severe	100–150	60–90	41–80	15–28
Very severe	200+	120+	80+	

4 - 180 degree sweeps = 1 square yard

15-inch sweep net

Insect supplier: Great Lakes IPM

Visually estimate number of grasshoppers in a square foot, repeat 18 times and then divide by 2 for # per square yard (9 square feet = 1 square yard)

New Insecticide

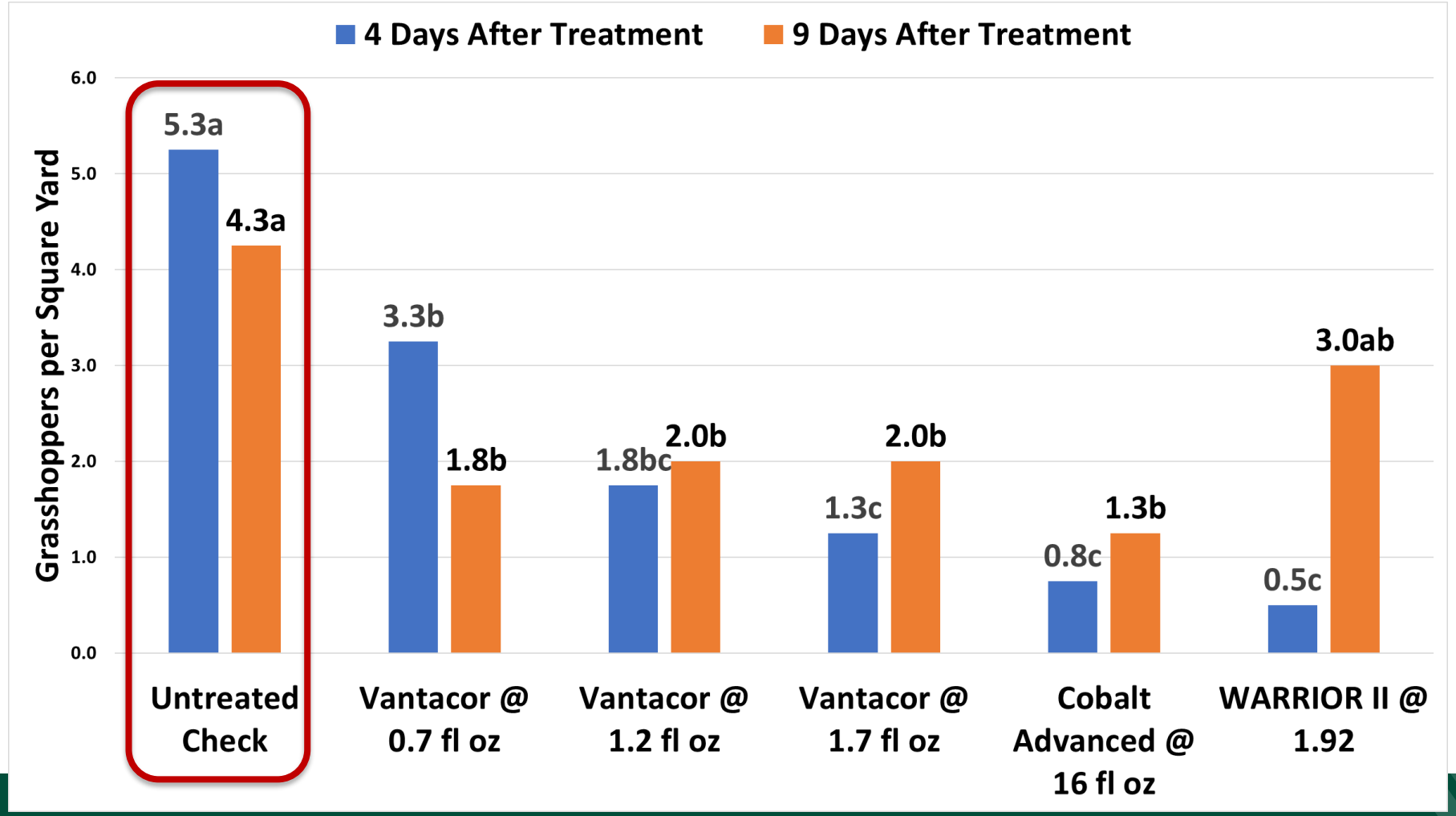
- **A.I. Chlorantraniliprole (Diamides, IRAC group 28)**
  - MOA – Muscle poison - *activate muscle ryanodine receptors, leading to contraction and paralysis*
  - Registered for foliar use in sunflower, soybean, corn, wheat and other crops
  - Above ground **lepidopteran pests, and grasshoppers**
  - **Grasshoppers** - use MSO adjuvant at 1% v/v and target 2nd-3rd instars

Grasshopper

Source: FMC Website

Adult Grasshopper Trial in Soybean, Casselton, 2021

B. Yarger, Dunn County, ND



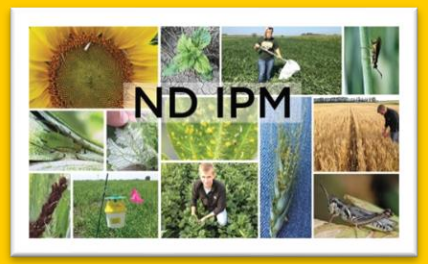
Soybean Insecticide - Grasshoppers

IRAC Class	Trade Name	Active Ingredient(s)	PHI	Rate Range (oz/acre)		Cost ($/acre)	
				Low	High	Low	High
15	Dimilin 2L	diflubenzuron	21 days	2	2	$ 4.22	$ 4.22
1B	Acephate 97 WDG	acephate	14 days	4	8	$ 1.72	$ 3.44
1B	Dimate 4E	dimethoate	21 days	16	16	$ 5.44	$ 5.44
3A	Fastac CS	alpha-cypermethrin	21 days	3.2	3.8	$ 4.32	$ 5.13
3A	Baythroid XL	beta-cyfluthrin	21 days	2	2.8	$ 5.16	$ 7.22
3A	Brigade, generics	bifenthrin	18 days	2.1	6.4	$ 2.27	$ 6.91
3A	Tombstone Helios	cyfluthrin	45 days	2	2.8	$ 4.30	$ 6.02
3A	Delta Gold	deltamethrin	21 days	1.5	2.4	$ 2.66	$ 4.25
3A	Asana XL	esfenvalerate	21 days	5.8	9.6	$ 3.07	$ 5.09
3A	Warrior II, generics	lambda-cyhalothrin	30 days	1.6	1.92	$ 4.24	$ 5.09
3A	Mustang Maxx	zeta-cypermethrin	21 days	3.2	4	$ 4.22	$ 5.28
22A	Steward EC	indoxacarb	14 days	4.6	11.3	$ 9.34	$ 22.94
28	Vantacor	clorantraniliprole	1 day	0.7	2.5	$ 10.31	$ 36.82

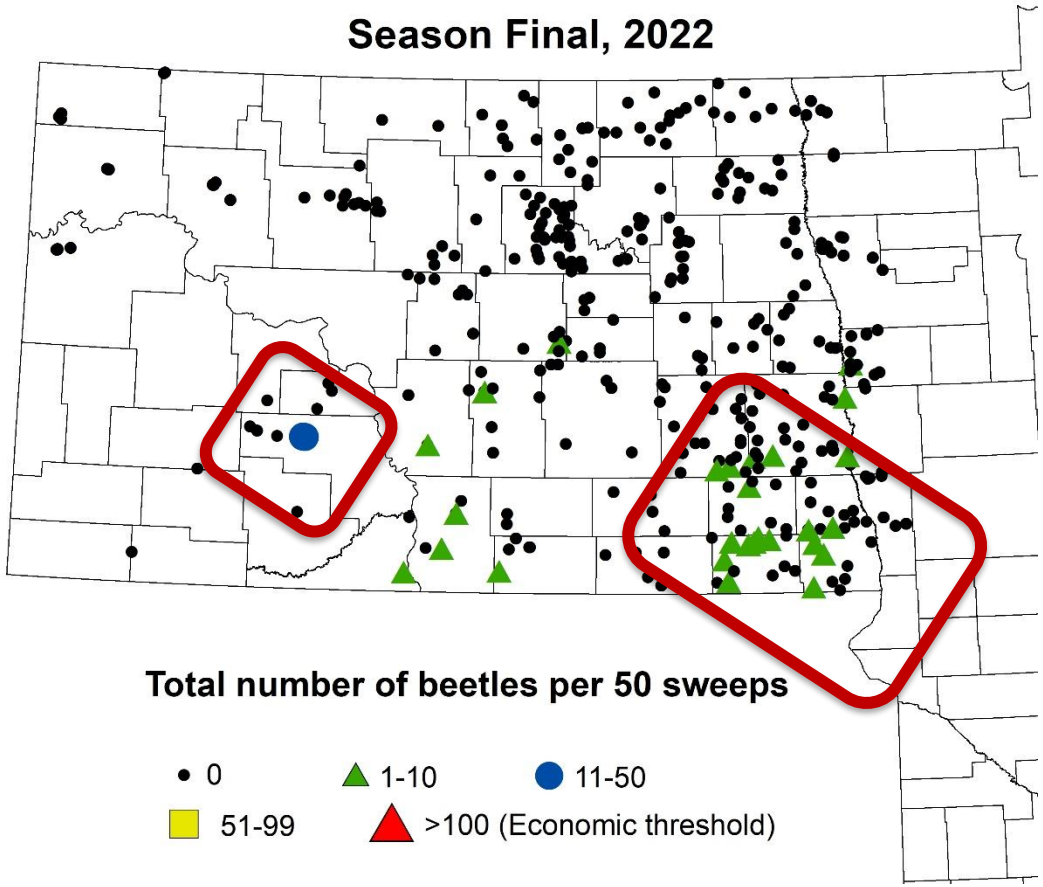
Bean Leaf Beetle – Increasing!

- **Adults**
  - **Overwinter**
  - **Color phases**
    - **Red, yellow**
- **Larvae**
  - **Slender larvae**
  - **White with brown head and anal plate**
- **2-3 generations per year**

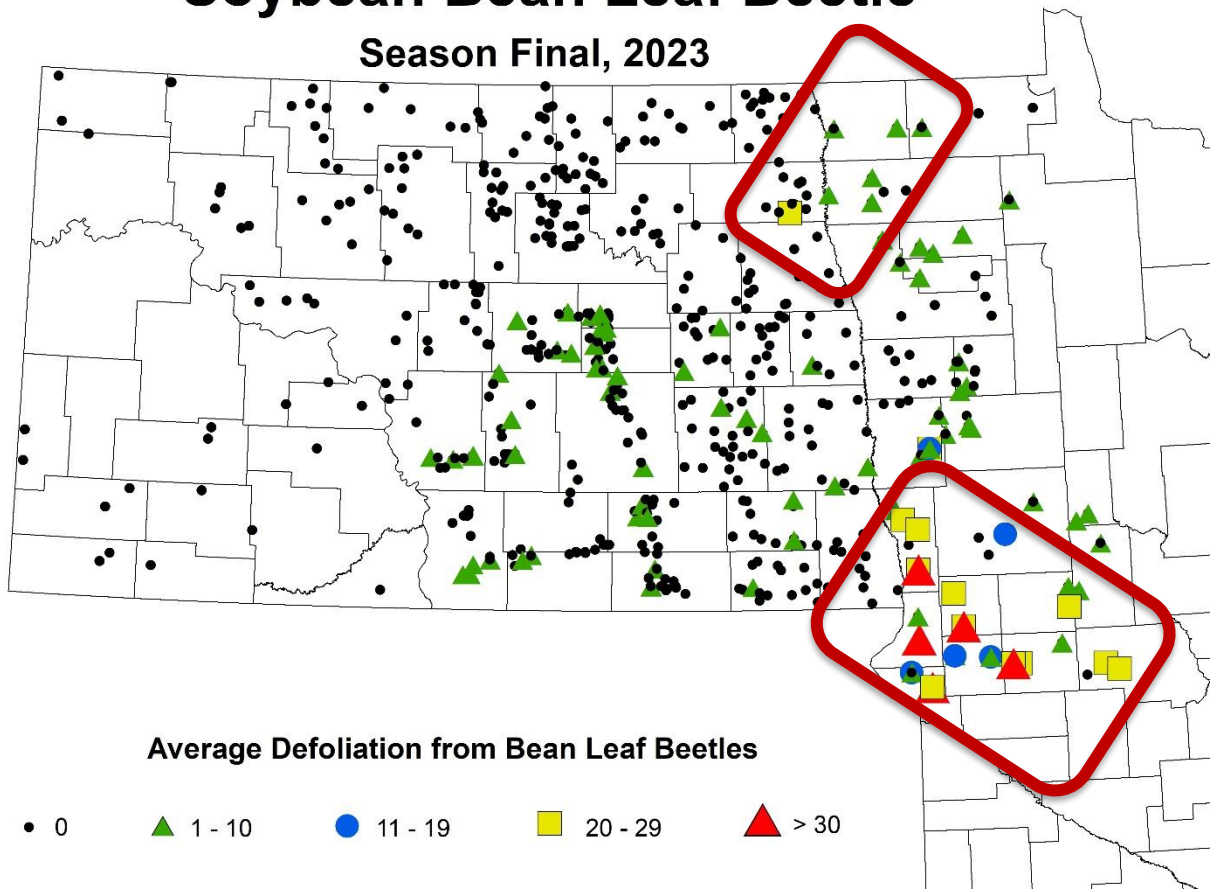
Bean Leaf Beetle 2022-2023



Soybean - Bean Leaf Beetle

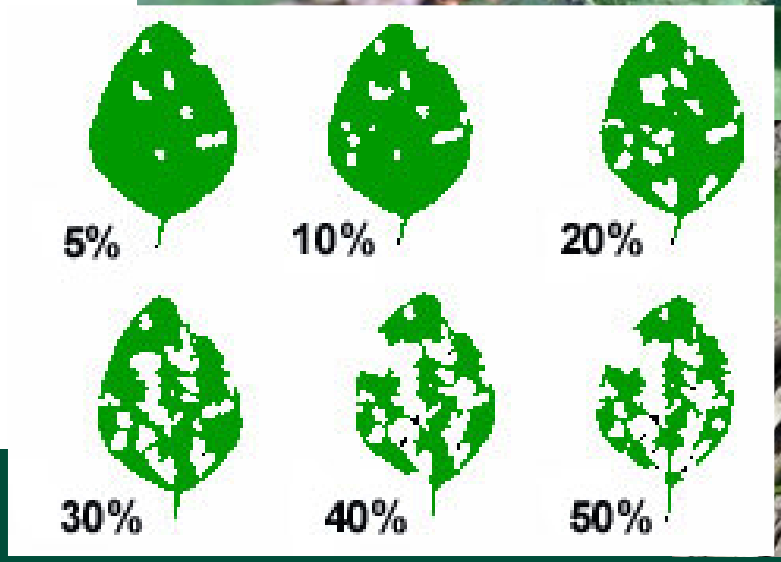


Soybean Bean Leaf Beetle



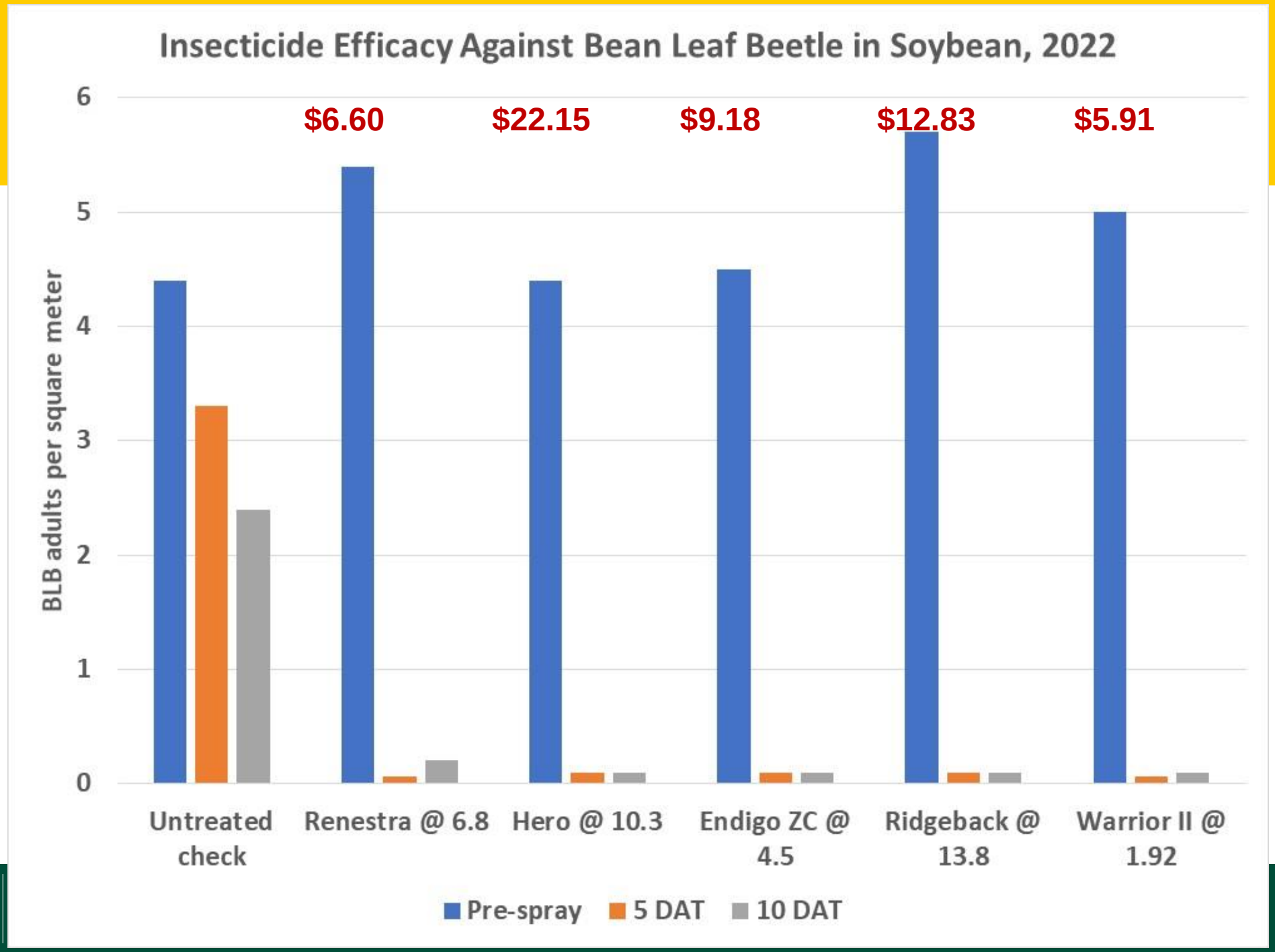
Bean Leaf Beetle - Damage

- **Adult**
  - **Chewing mouthparts**
  - **Foliage and pod**
- **Early feeding of 1st generation**
  - **Controlled by insecticidal seed treatments**
- **E.T.**
  - **Defoliation**
    - **30% vegetative stages**
    - **20% bloom R1 to early seed R6**



2022 Insecticide Trial for Bean Leaf Beetles in Soybeans

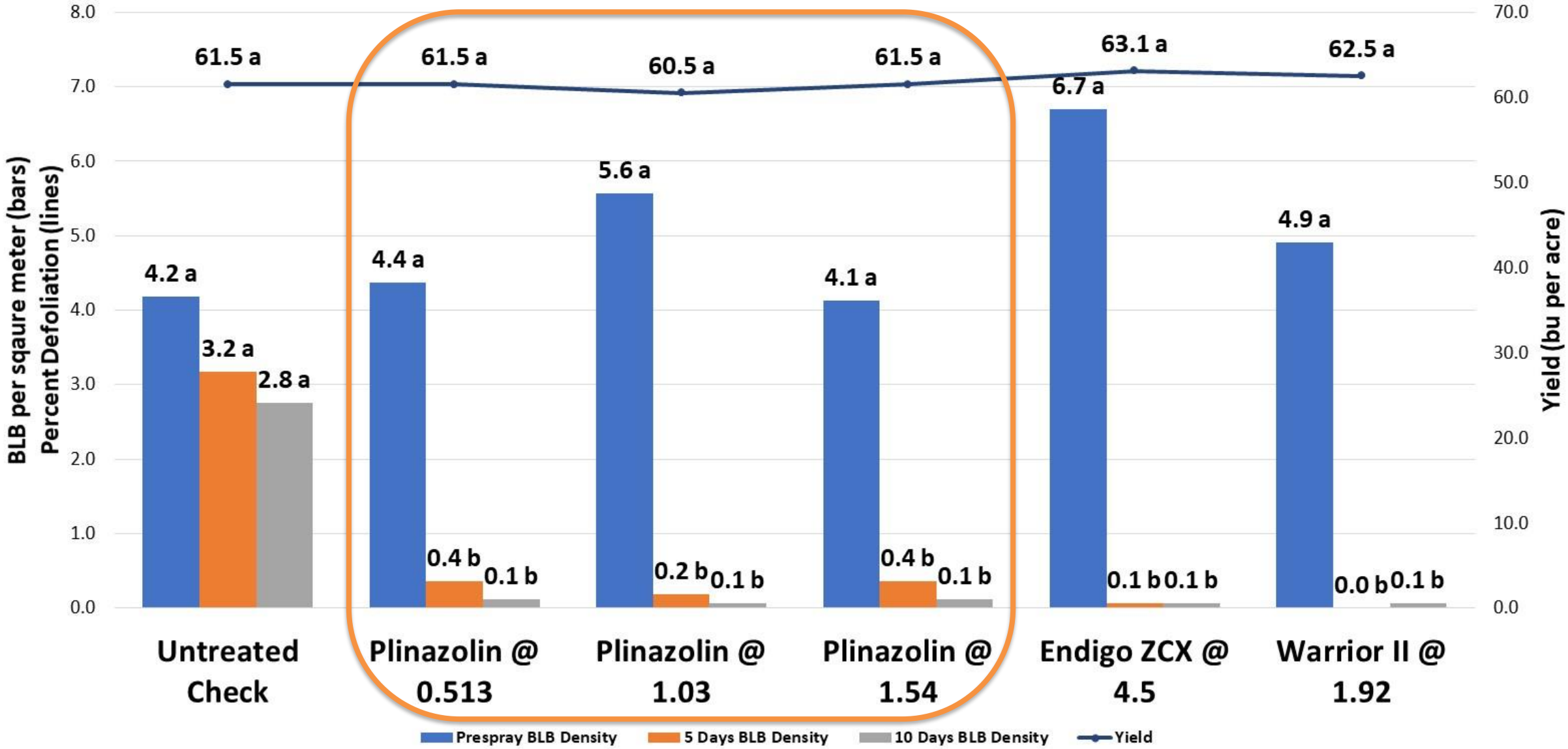
Treatment Name	Active Ingredient(s)	IRAC Group	Rate(s)	Cost
Untreated Check	---		---	---
Renestra (BASF)	afidopyropen alpha-cypermethrin	9D + 3A	6.8 fl oz/acre	$6.60
Hero (FMC)	bifenthrin zeta-cypermethrin	3A + 3A	10.3 fl oz/acre	$22.15
Endigo ZC (Syngenta)	lambda-cyhalothrin thiamethoxam	3A + 4A	4.5 fl oz/acre	$9.18
Ridgeback (Corteva)	bifenthrin sulfoxaflor	3A + 4C	13.8 fl oz/acre	$12.83
Warrior II (Syngenta)	lambda-cyhalothrin	3A	1.92 fl oz/acre	$5.91


Insecticide Efficacy Against Bean Leaf Beetle in Soybean, 2022
$6.60
$22.15
$9.18
$12.83
$5.91
BLB adults per square meter
0
1
2
3
4
5
6
Untreated check
Renestra @ 6.8
Hero @ 10.3
Endigo ZC @ 4.5
Ridgeback @ 13.8
Warrior II @ 1.92
Pre-spray
5 DAT
10 DAT

New Insecticide

- Syngenta Crop Protection
  - Plinazolin - active ingredient isocycloseram, Group 30
  - GABA receptor antagonists, neurotransmitter
  - Proposed trade name - VIRANTRA™
  - Corn, soybean, cotton in U.S.
  - RSSW in ND and SD; flea beetles in canola; **bean leaf beetle in soybean**; **grasshopper in soybean**/wheat, ST for wireworm in wheat/sunflower

Treatment Means for Bean Leaf Beetles per Square Meter and Yield in Soybean at Casselton, 2022



Phloem Feeders

Bruce Potter 2024

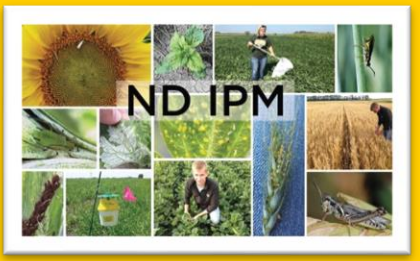
Soybean aphid

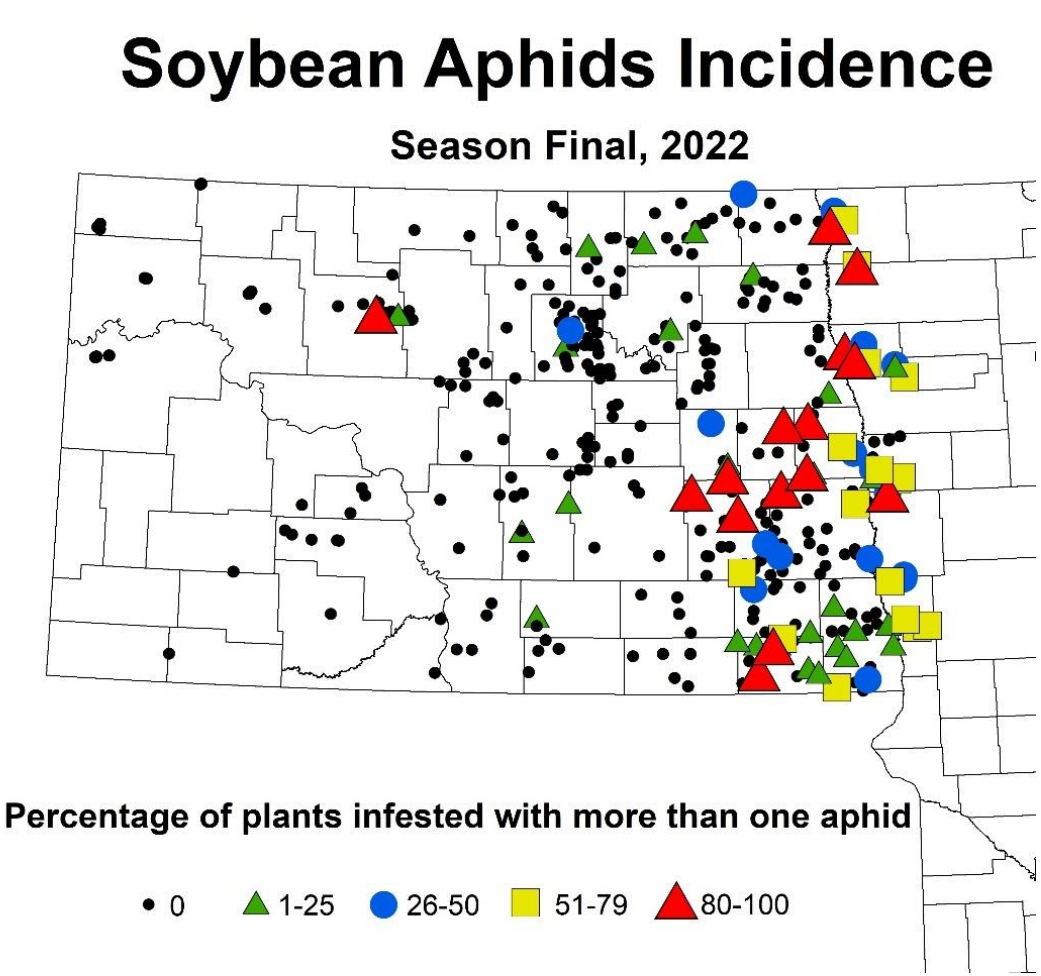
- Overwinter as eggs on buckthorn buds (sexual reproduction)
- Alates move to soybean in spring (asexual reproduction)
- Alates move between fields
  - *Moderate temps, moisture*
  - low K, High N
  - Arriving alates key on edge contrast

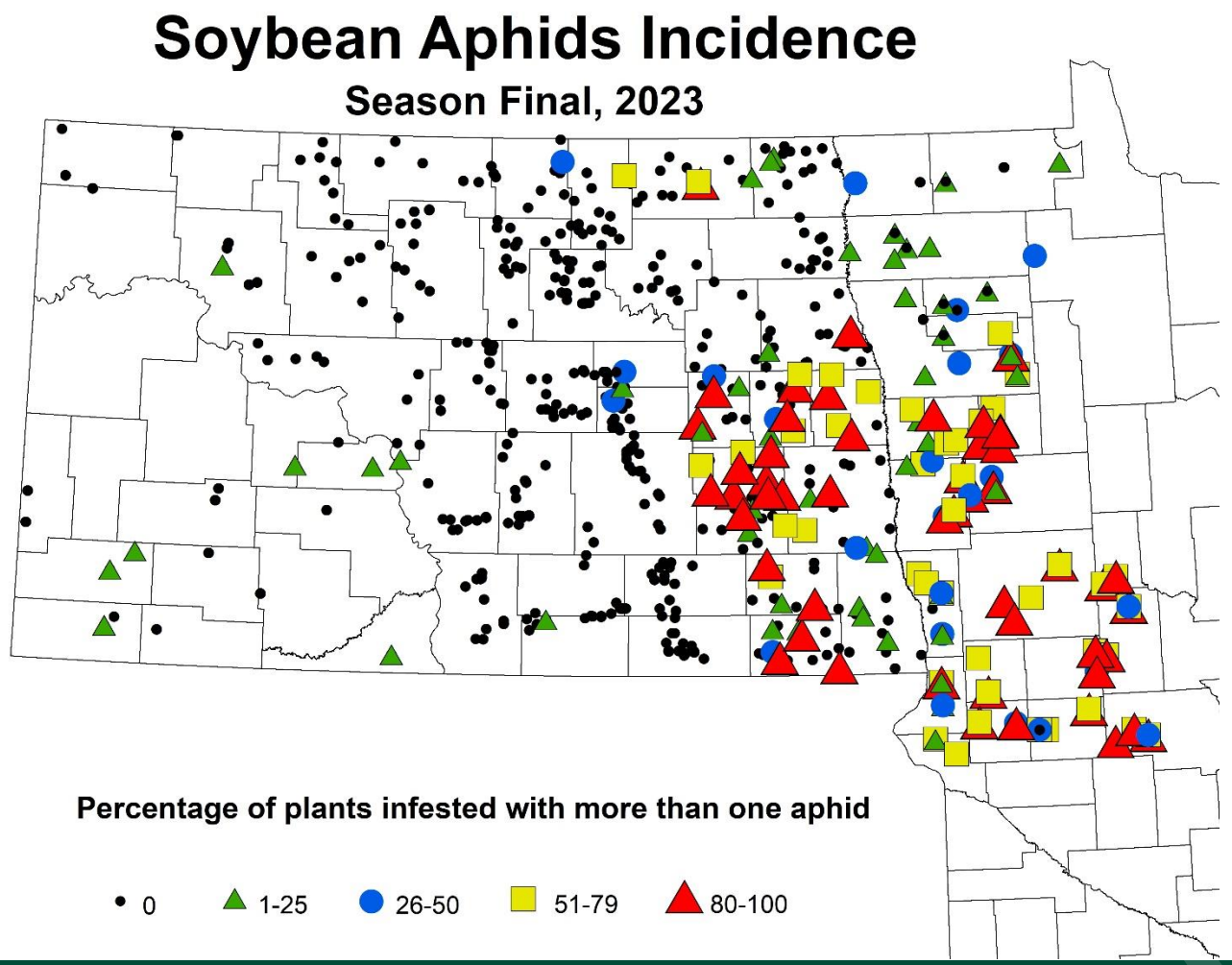
Phloem Feeders

Bruce Potter 2024

Soybean Aphid Maps 2022-2023

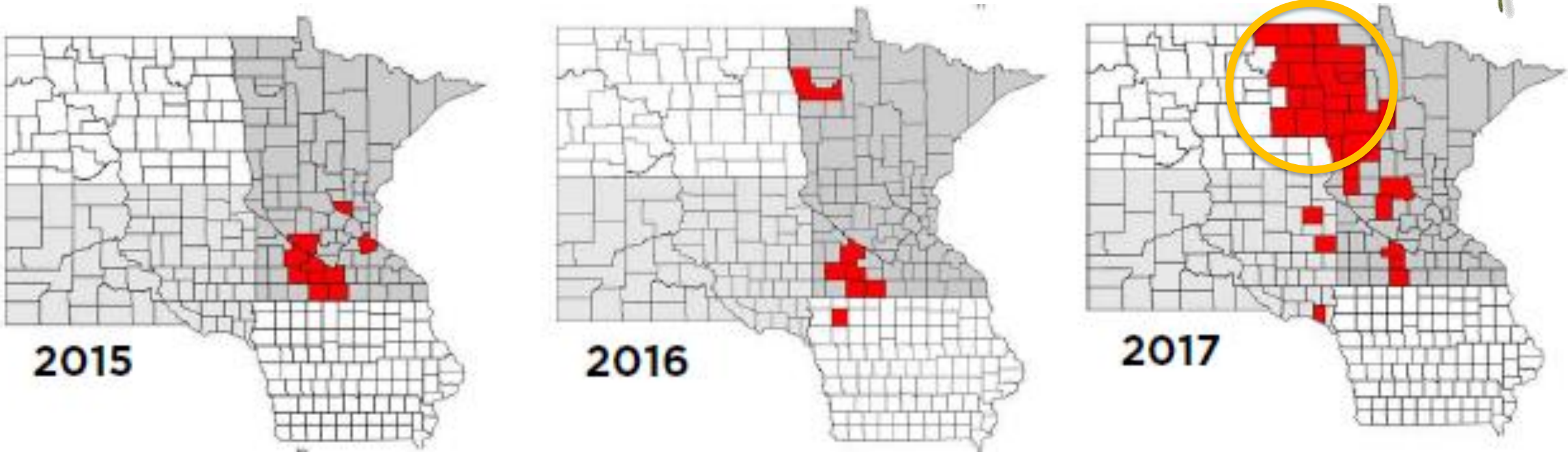




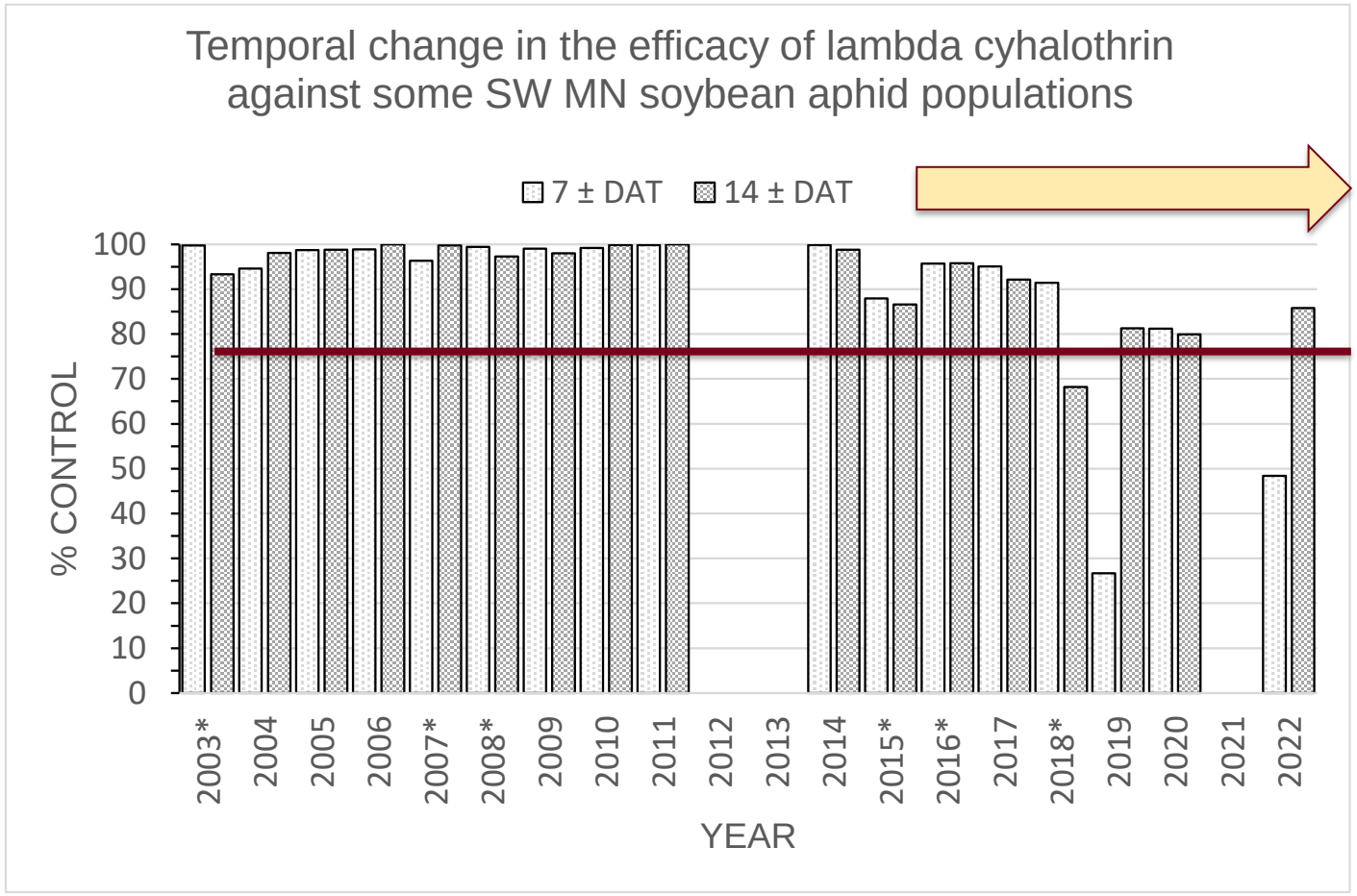


Insecticide Resistance Issues in ND, SD, MN & IA

- **Counties with Pyrethroid Performance Issues for Soybean Aphid in 2015 - 2017**



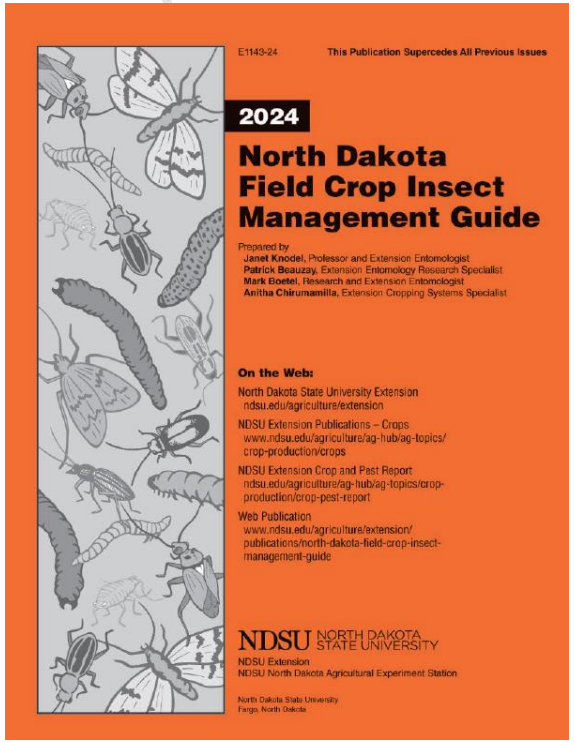
Pyrethroid (3A) resistant soybean aphids



* Site-year where soybean aphid populations caused yield loss

- Detected in 2015
- Cross-resistance
- Persists
- Effective insecticide options are:
  - ***(4C) sulfoxaflor***
  - ***(4D) flupyradifurone***
  - ***(9D) afidopyropen***
  - ***1B and 4A mixes***

Foliar Insecticides



Group #	Group	Active Ingredient	Product Examples (Trade Names)
1A	Carbamates	methomyl	Lannate LV, Nudrin LV, others
1B	Organophosphates	acephate	Acephate 97, Orthene 97, others
		dimethoate	Dimethoate 4E, Dimate 4E, others
3A	Pyrethroids and Pyrethrins	alpha-cypermethrin	Fastac CS
		beta-cyfluthrin	Baythroid XL
		bifenthrin	Bifender FC, Bifenture EC, Brigade 2EC, Discipline 2EC, Sniper, Tundra EC, others
		cyfluthrin	Tombstone Helios
		deltamethrin	Delta Gold
		esfenvalerate	Asana XL
		lambda-cyhalothrin	Grizzly Too, Lambda-Cy AG, LambdaStar, Province, Silencer, Warrior II, others
		permethrin	Permethrin, Perm-UP 3.2 EC, Arctic 3.2 EC, others
		zeta-cypermethrin	Mustang Maxx
4A	Neonicotinoids	clothianidin	Belay
		imidacloprid	Admire Pro, Nuprid 4F Max, others
4C	Sulfoxamines	sulfoxaflor	Transform WG
4D	Butenolides	flupyradifurone	Sivanto Prime
9D	Pyropenes	afidopyropen	Sefina

Foliar insecticides labeled for soybean aphid (2022)

Individual A.I.s Broad spectrum

Individual A.I.s **Broad spectrum**

Individual A.I.s Limited spectrum

Individual A.I Narrow spectrum

Group		Common name	Individual A.I. (examples)	Formulated mixtures (examples
1A	Carbamate	methomyl	Lannate, Nudrin,	
1B	Organophosphate	acephate	Acephate, Bracket 97 , Orthene 97,	
		chlorpyrifos	Chlorpyrifos, Govern, Hatchet, Lorsban Advanced, Nufos, Vulcan, etc. Warhawk, Whirlwind, Yuma	Cobalt, Cobalt Advanced, Stallion, Match-Up,Tundra Supreme
		dimethoate	Dimethoate, Dimate	
		alpha-cypermethrin	Fastac	Renestra
		beta-cyflufthrin	Baythroid	Leverage
		bifenthrin	Bifenture, Brigade 2EC, Discipline, Ethos XB, Fanfare,Tundra EC, Sniper, Silencer VC,Taiga Z, Warrior II	Elevest, Hero, Justice, Match-Up, Ridgeback, Skyraider,Triple Crown, Tundra Supreme
		cyfluthrin	Tombstone	
		zeta-cypermethrin	Mustang Maxx, Respect	Hero, Stallion Brand, Steed, Triple Crown
4A	Neonicotinoid	acetamiprid		Justice
		chlothianadin	Belay	
		imidacloprid	Advise4, Alias, Nuprid, Prey, Sherpa	Brigadier, Leverage, Skyraider, Triple Crown
		thiamethoxam		Endigo
4C	Sulfoximine	sulfoxaflor	Transform	Ridgeback
4D	Butenolide	flupyradifurone	Sivanto	
9D	Pyropene	afidopyropen	Inscalis(Sefina)	Renestra

Keep in mind: pyrethroids and neonicotinoids, alone and in mixes, can flare spider mites

Not a complete list of product trade names.

Products are mentioned for illustrative purposes only. Their inclusion does not mean endorsement and their absence does not imply disapproval.

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2023 Insecticide Trial for Soybean Aphids
Casselton Agronomy Farm

Group	Insecticide Treatment and Rate	Chemical Class (IRAC #)	Active Ingredient(s)
Pyrethroids	Baythroid XL 2.8 fl oz/acre	Pyrethroids (3A)	Beta-cyfluthrin
Pyrethroids	Brigade 3.2 fl oz/acre	Pyrethroids (3A)	Bifenthrin
Pyrethroids	Warrior II 1.6 fl oz/acre	Pyrethroids (3A)	Lambda-cyhalothrin
Pyrethroids	Mustang Maxx 4 fl oz/acre	Pyrethroids (3A)	Zeta-cypermethrin
Pyrethroids	Hero 10.3 fl oz/acre	Pyrethroids (3A)	Bifenthrin Zeta-cypermethrin
Pyrethroids	Asana XL 9.6 fl oz/acre	Pyrethroids (3A)	Esfenvalerate

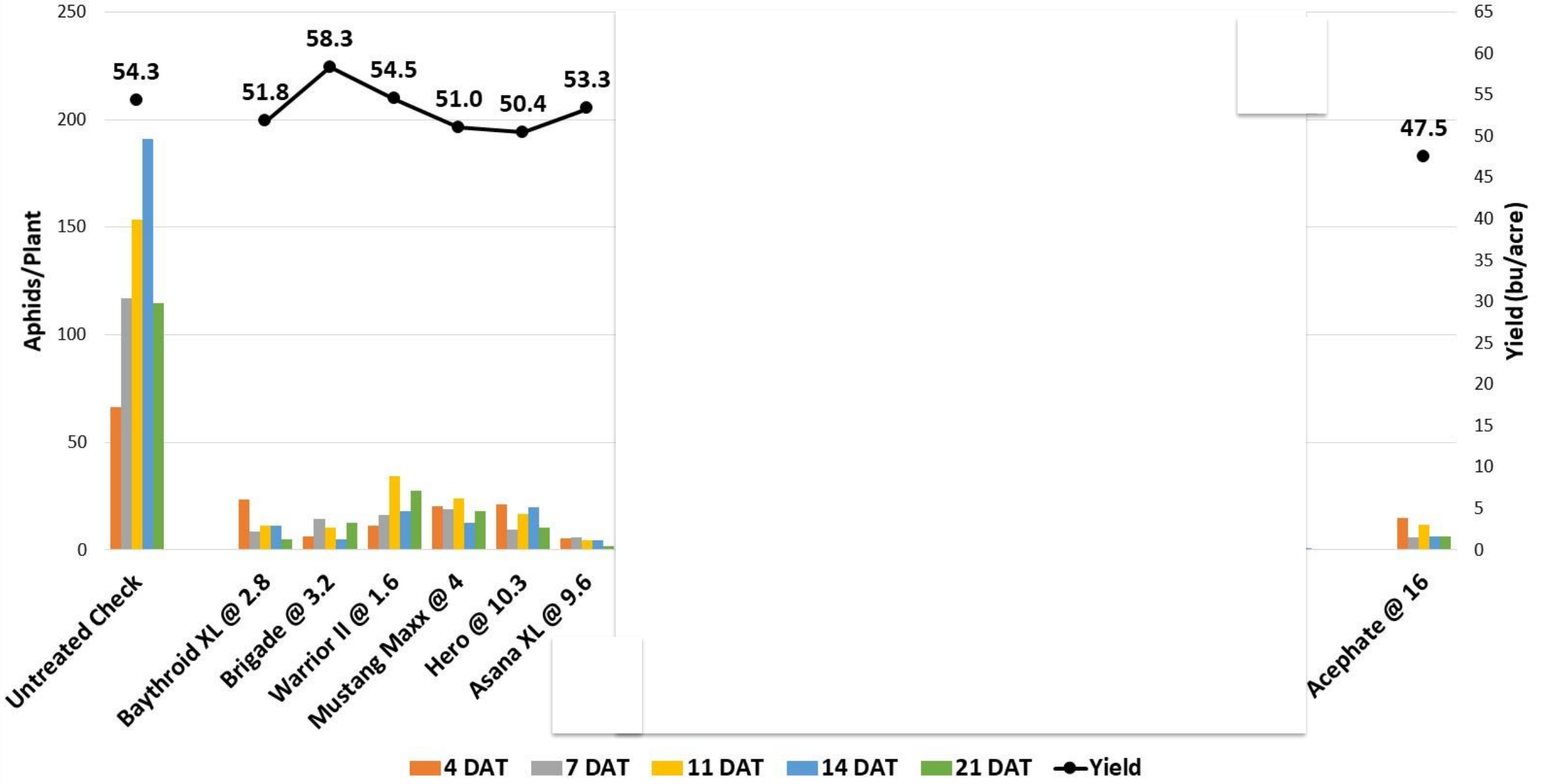
2023 Insecticide Trial for Soybean Aphids
Casselton Agronomy Farm

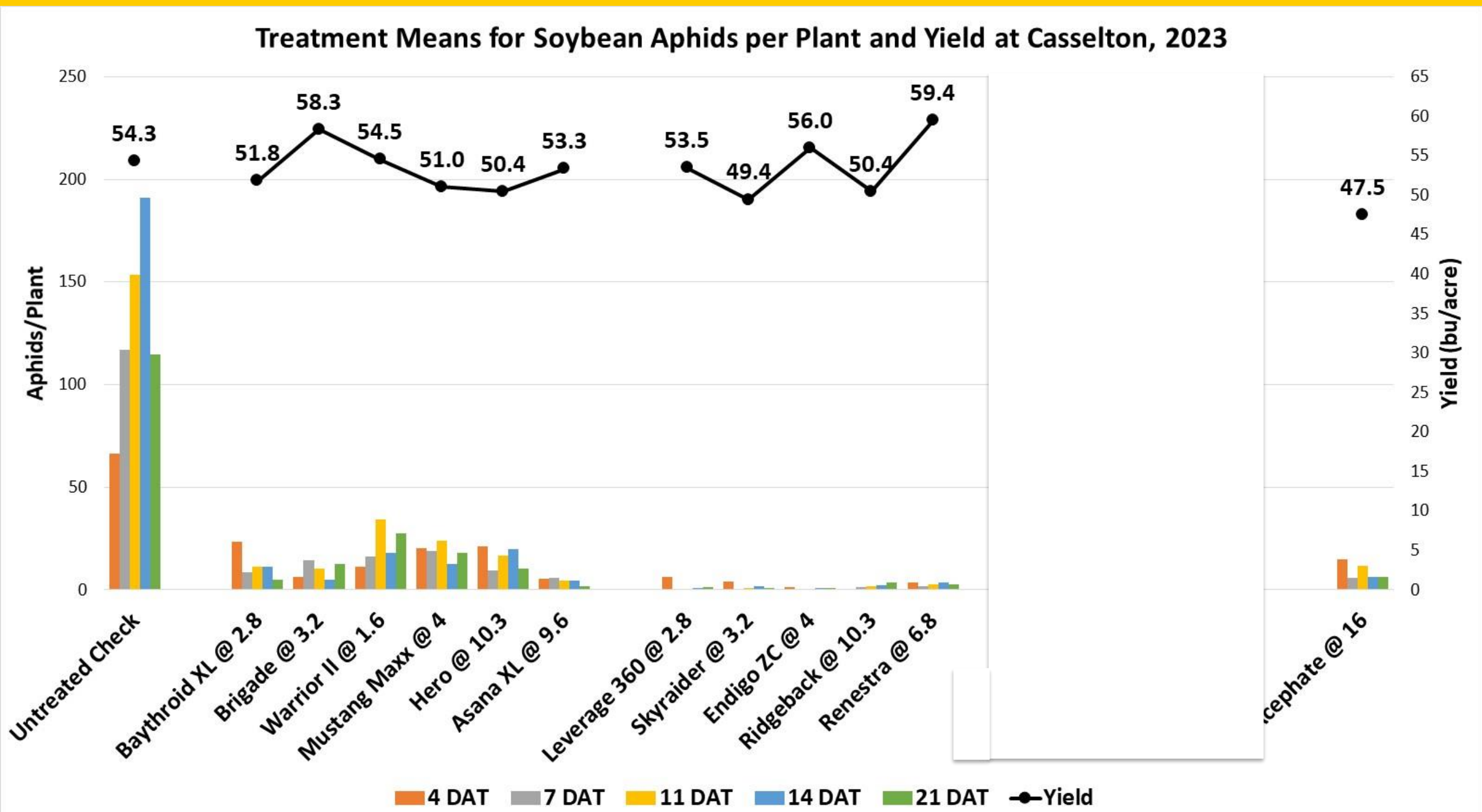
Group	Insecticide Treatment and Rate	Chemical Class (IRAC #)	Active Ingredient(s)
Premix	Leverage 360 2.8 fl oz/acre	Pyrethroids (3A) Neonicotinoids (4A)	Beta-cyfluthrin Imidacloprid
Premix	Skyraider 3.2 fl oz/acre	Pyrethroids (3A) Neonicotinoids (4A)	Bifenthrin Imidacloprid
Premix	Endigo ZC 4 fl oz/acre	Pyrethroids (3A) Neonicotinoids (4A)	Lambda-cyhalothrin Thiamethoxam
Premix	Ridgeback 10.3 fl oz/acre	Pyrethroids (3A) Sulfoxamines (4C)	Bifenthrin Sulfoxaflor
Premix	Renestra 6.8 fl oz/acre	Pyrethroids (3A) Pyropenes (9D)	Alpha-cypermethrin Afidopyropen

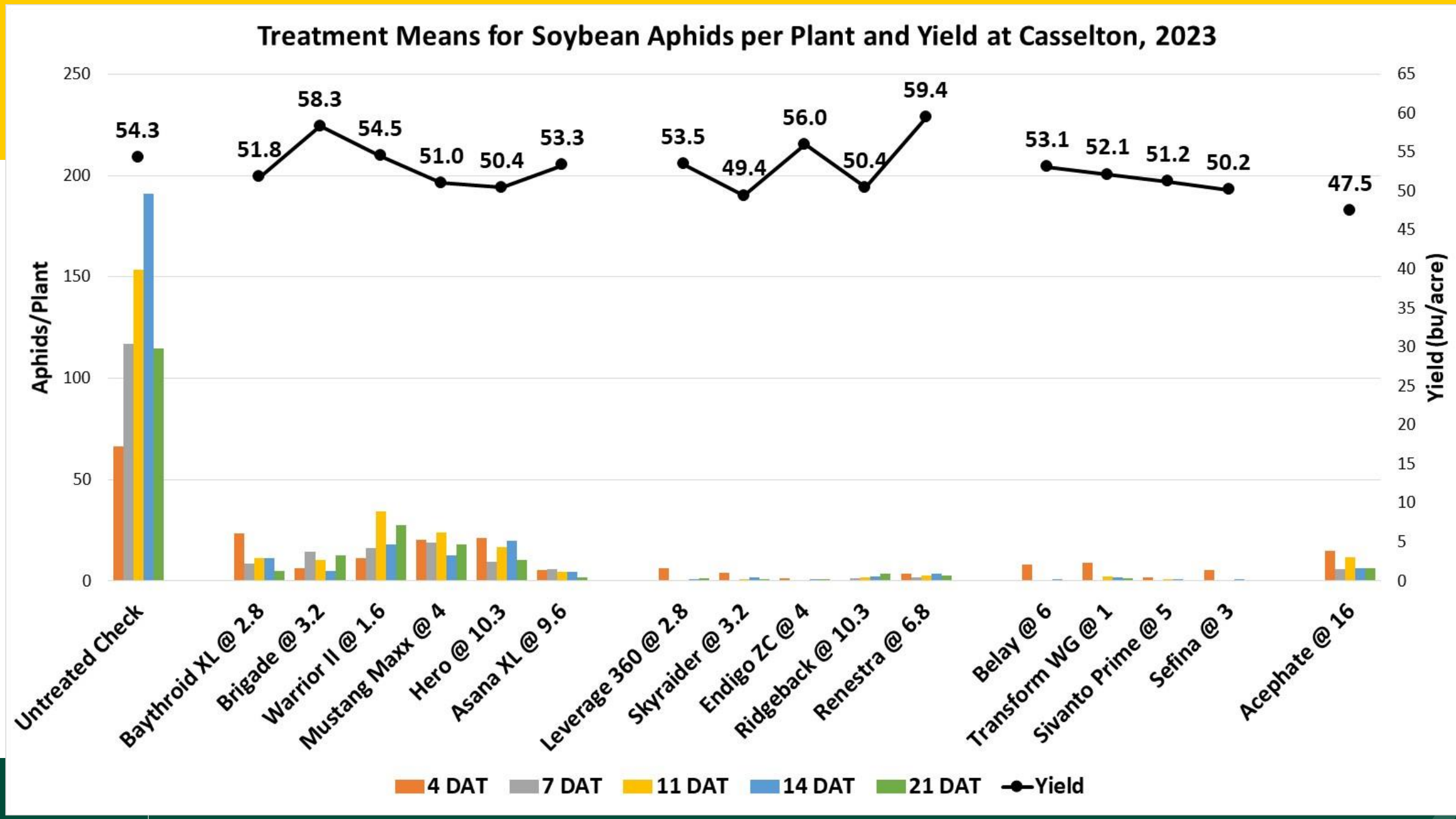
2023 Insecticide Trial for Soybean Aphids
Casselton Agronomy Farm

Group	Insecticide Treatment and Rate	Chemical Class (IRAC #)	Active Ingredient(s)
Aphid-specific insecticides	Belay 6 fl oz/acre	Neonicotinoid s(4A)	Clothianidin
Aphid-specific insecticides	Transform WG 1 oz/acre	Sulfoxamines (4C)	Sulfoxaflor
Aphid-specific insecticides	Sivanto Prime 5 fl oz/acre	Butenolides (4D)	Flupyradifurone
Aphid-specific insecticides	Sefina 3 fl oz/acre	Pyropenes (9D)	Afidopyropen
Acephate	Acephate 16 fl oz/acre	Organophosphates (1B)	Acephate

Treatment Means for Soybean Aphids per Plant and Yield at Casselton, 2023




Treatment Means for Soybean Aphids per Plant and Yield at Casselton, 2023
Aphids/Plant
Yield (bu/acre)
250
200
150
100
50
0
65
60
55
50
45
40
35
30
25
20
15
10
5
0
54.3
51.8
58.3
54.5
51.0
50.4
53.3
53.5
49.4
56.0
50.4
59.4
47.5
Untreated Check
Baythroid XL @ 2.8
Brigade @ 3.2
Warrior II @ 1.6
Mustang Maxx @ 4
Hero @ 10.3
Asana XL @ 9.6
Leverage 360 @ 2.8
Skyraider @ 3.2
Endigo ZC @ 4
Ridgeback @ 10.3
Renestra @ 6.8
cephate @ 16
4 DAT
7 DAT
11 DAT
14 DAT
21 DAT
Yield

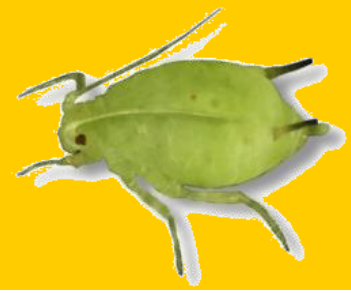

Treatment Means for Soybean Aphids per Plant and Yield at Casselton, 2023
Aphids/Plant
Yield (bu/acre)
250
200
150
100
50
0
65
60
55
50
45
40
35
30
25
20
15
10
5
0
54.3
51.8
58.3
54.5
51.0
50.4
53.3
53.5
49.4
56.0
50.4
59.4
53.1
52.1
51.2
50.2
47.5
Untreated Check
Baythroid XL @ 2.8
Brigade @ 3.2
Warrior II @ 1.6
Mustang Maxx @ 4
Hero @ 10.3
Asana XL @ 9.6
Leverage 360 @ 2.8
Skyraider @ 3.2
Endigo ZC @ 4
Ridgeback @ 10.3
Renestra @ 6.8
Belay @ 6
Transform WG @ 1
Sivanto Prime @ 5
Sefina @ 3
Acephate @ 16
4 DAT
7 DAT
11 DAT
14 DAT
21 DAT
Yield

Fitness Cost of Pyrethroid Resistant Soybean Aphids

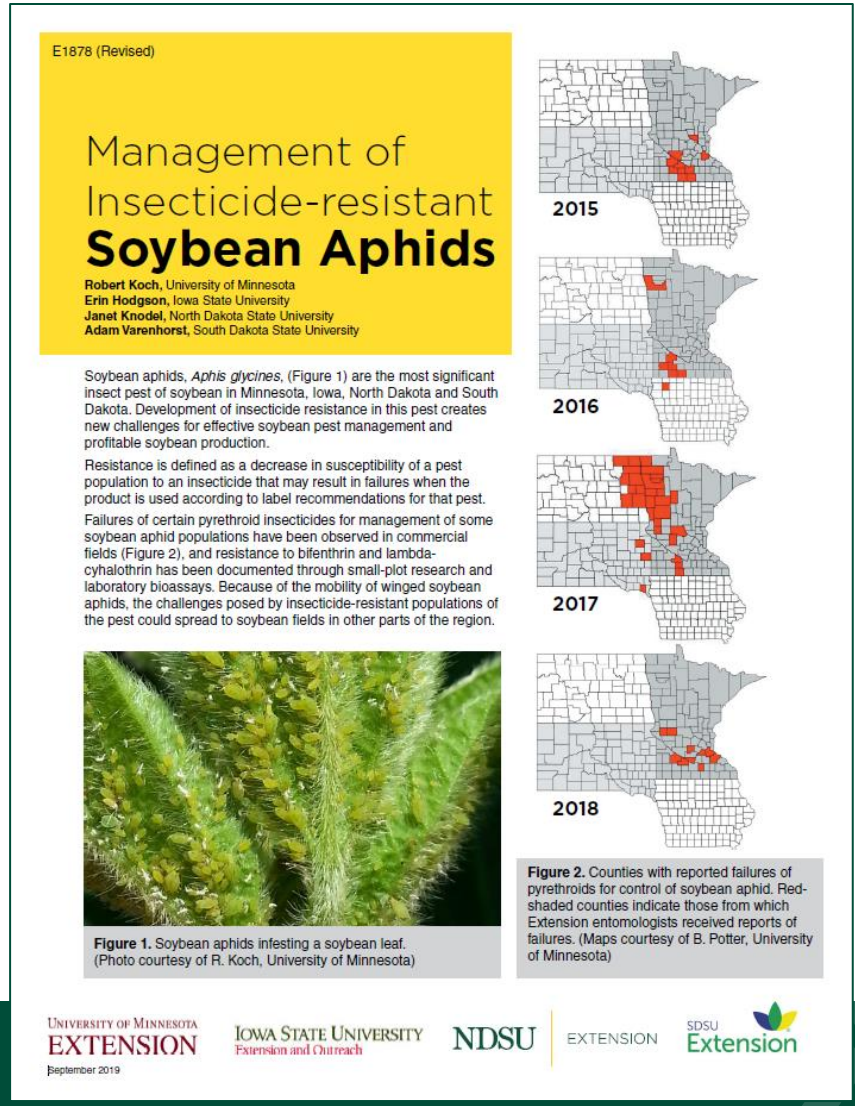
- Resistant phenotypes
  - **Higher fitness values**
  - HIGHER Rates of population increase
  - Larger aphid size
- Lack of reproductive fitness costs associated with pyrethroid-resistant soybean aphids **increases concerns for longevity of pyrethroid use for aphid management**

Source: Menger et al. 2022. JEE

Insecticide Resistance Management
An IPM Approach



- Know your pest(s)
- **Scout fields regularly**
- Use **Economic Threshold** to prevent unnecessary insecticide applications and conserve natural enemies
- **Rotate mode of action** (or insecticide class) if more than one application is necessary in a season



E1878 (Revised)

Management of Insecticide-resistant **Soybean Aphids**

Robert Koch, University of Minnesota
Erin Hodgson, Iowa State University
Janet Knodel, North Dakota State University
Adam Varenhorst, South Dakota State University

Soybean aphids, *Aphis glycines*, (Figure 1) are the most significant insect pest of soybean in Minnesota, Iowa, North Dakota and South Dakota. Development of insecticide resistance in this pest creates new challenges for effective soybean pest management and profitable soybean production.

Resistance is defined as a decrease in susceptibility of a pest population to an insecticide that may result in failures when the product is used according to label recommendations for that pest.

Failures of certain pyrethroid insecticides for management of some soybean aphid populations have been observed in commercial fields (Figure 2), and resistance to bifenthrin and lambda-cyhalothrin has been documented through small-plot research and laboratory bioassays. Because of the mobility of winged soybean aphids, the challenges posed by insecticide-resistant populations of the pest could spread to soybean fields in other parts of the region.

Figure 1. Soybean aphids infesting a soybean leaf. (Photo courtesy of R. Koch, University of Minnesota)

Figure 2. Counties with reported failures of pyrethroids for control of soybean aphid. Red-shaded counties indicate those from which Extension entomologists received reports of failures. (Maps courtesy of B. Potter, University of Minnesota)

University of Minnesota Extension | Iowa State University Extension and Outreach | NDSU Extension | SDSU Extension
September 2019

Twospotted spider mites

- Overwinter in perennial vegetation (typically outside the field)
- *Hot, dry and R-stage soybeans.*
- *Neozygotes* fungi control with wet weather

TSSM Infestation Scale (0-5) *Potter and Ostlie 1988*

0) No spider mites or injury observed.

1) Minor stippling on lower leaves, no premature yellowing observed

2) Stippling common on lower leaves, small areas or scattered plants with yellowing

3) Heavy stippling on lower leaves with some stippling progressing into middle canopy. Mites present in middle canopy with scattered colonies in upper canopy. Lower leaf yellowing common and some lower leaf loss. ***(Spray Threshold)***

4) Lower leaf yellowing readily apparent. Leaf drop common. Stippling, webbing and mites common in middle canopy. Mites and minor stippling present in the upper canopy. ***(Economic Loss)***

5) Lower leaf loss common, yellowing or browning moving up the plant into the middle canopy, stippling and distortion of upper leaves common. Mites present in high levels in middle and lower canopy

Treat before mites and damage are present above the middle of the soybean canopy!

Soybean pesticides for twospotted spider mite and multi-pest management

Insecticide group	Common name	Trade name	TS Spider mite	Soybean aphid	Grasshoppers	BLB/Caterpillars	Resistance	Comments
1B organophosphate	dimethoate	Several * (e.g. Dimethoate 4E)	X	X	X		TSSM	Chlorpyrifos R Short residual
3A pyrethroid	bifenthrin	Several * (e.g. Brigade 2E,Sniper 2E)	X	?	X	X	SBA	
6 chlorine channel	abamectin	Agri-Mek SC*	X					Avoid pyrethroid mixes
10B mite growth inhibitor	etoxazole	Zeal SC	X					Egg and immatures Mixes affect biocontrol
3A + 3A	bifenthrin + zeta-cypermethrin	Hero*	X	?	X	X	SBA	
3A+ 4A	bifenthrin+ imidacloprid	Swagger*, Skyraider*	X	X	X	X		Neonicitinoid mite flare
3A +	bifenthrin + chlorantraniprole	Elevest*	X	?	X	X	SBA	Tank mix a miticide
3A + 4C	bifenthrin + sulfoxaflor	Ridgeback*	X	X	X	X		

*** Restricted use pesticide**

Always read and follow label directions.

Products are mentioned for illustrative purposes only. Their inclusion does not mean endorsement and their absence does not imply disapproval.

Crop Protection Chemicals: Issues in insect pest control

- Timing of application
- Pesticide concentration (effective rate)
- Effective location
- Pesticide persistence
- Right pesticide to match pest(s) in field
- Population of the target pest
- Weather

Managing multiple pests

- ✓ Combine similar sources of injury (e.g. defoliators).
- ✓ Address the most pressing *economic* pest threat.
- ✓ Be aware of the relationships of pests to the crop, environment, and each other.
- ✓ Select chemical(s) to minimize impacts on beneficials and potential increase of other pests

Effects of multiple sources of defoliation

=

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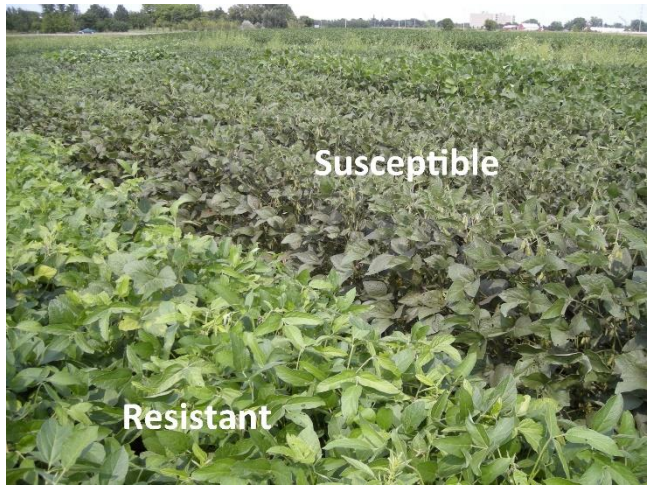


Effects of multiple sources of defoliation

=

?

Effects of multiple sources of defoliation

=

?

What would you do?

R4 Soybeans
Alfalfa on south
Next week's forecast:
Low 80s No rain

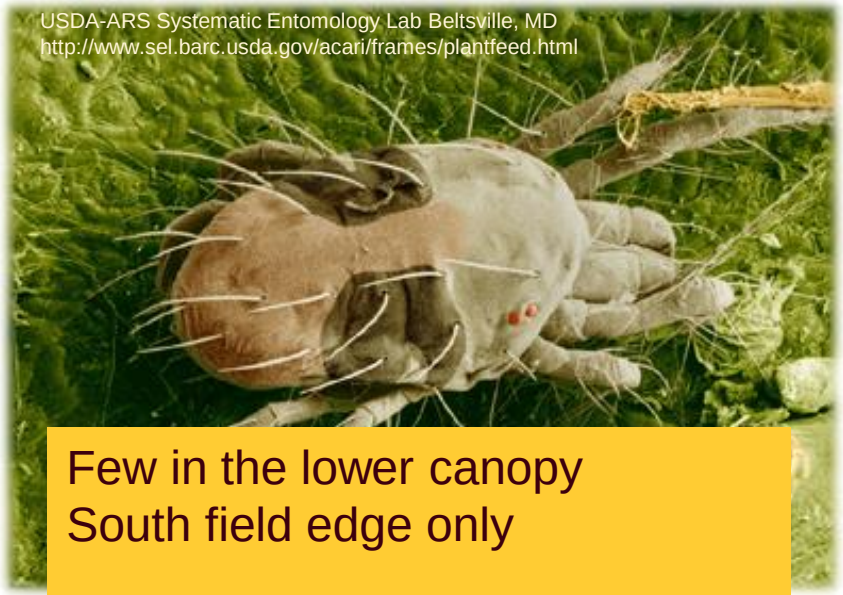
Few in the lower canopy
South field edge only

10% defoliation in the upper canopy.
No insect cause found.

~100/plant

What would you do?

R5 soybeans
Next week's forecast:
Mid and upper 80s.
No rain



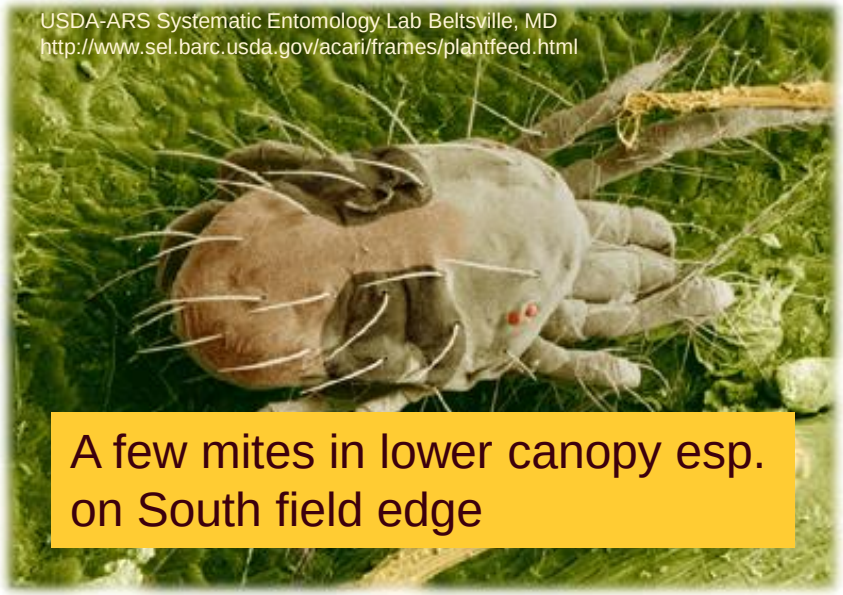
Few in the lower canopy
South field edge only

~30% upper canopy defoliation, with some mid-canopy with many small caterpillars and g-hopper nymphs on south field edge.

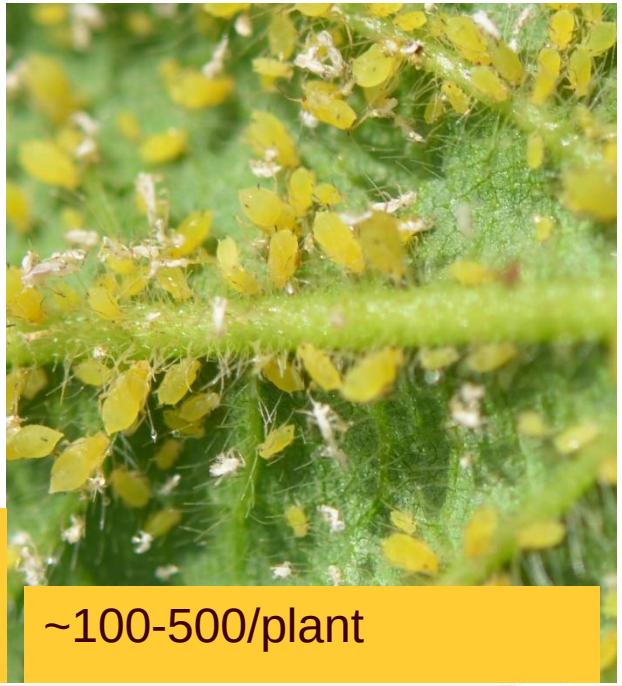
~20/plant less in field interior

What would you do?

Droughty R5 soybeans
Next week's forecast:
Windy and upper 80s.
No rain



A few mites in lower canopy esp. on South field edge



~5% upper canopy with some mid-canopy defoliation with large and small caterpillars.

~100-500/plant

janet.knodel@ndsu.edu

bpotter@umn.edu

patrick.beauzay@ndsu.edu

EXTENDING KNOWLEDGE ›› CHANGING LIVES

North Dakota Soybean Council
Our World Is Growing.

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MINNESOTA SOYBEAN
RESEARCH & PROMOTION COUNCIL