Field Crop Insect Pest Problems in North Dakota

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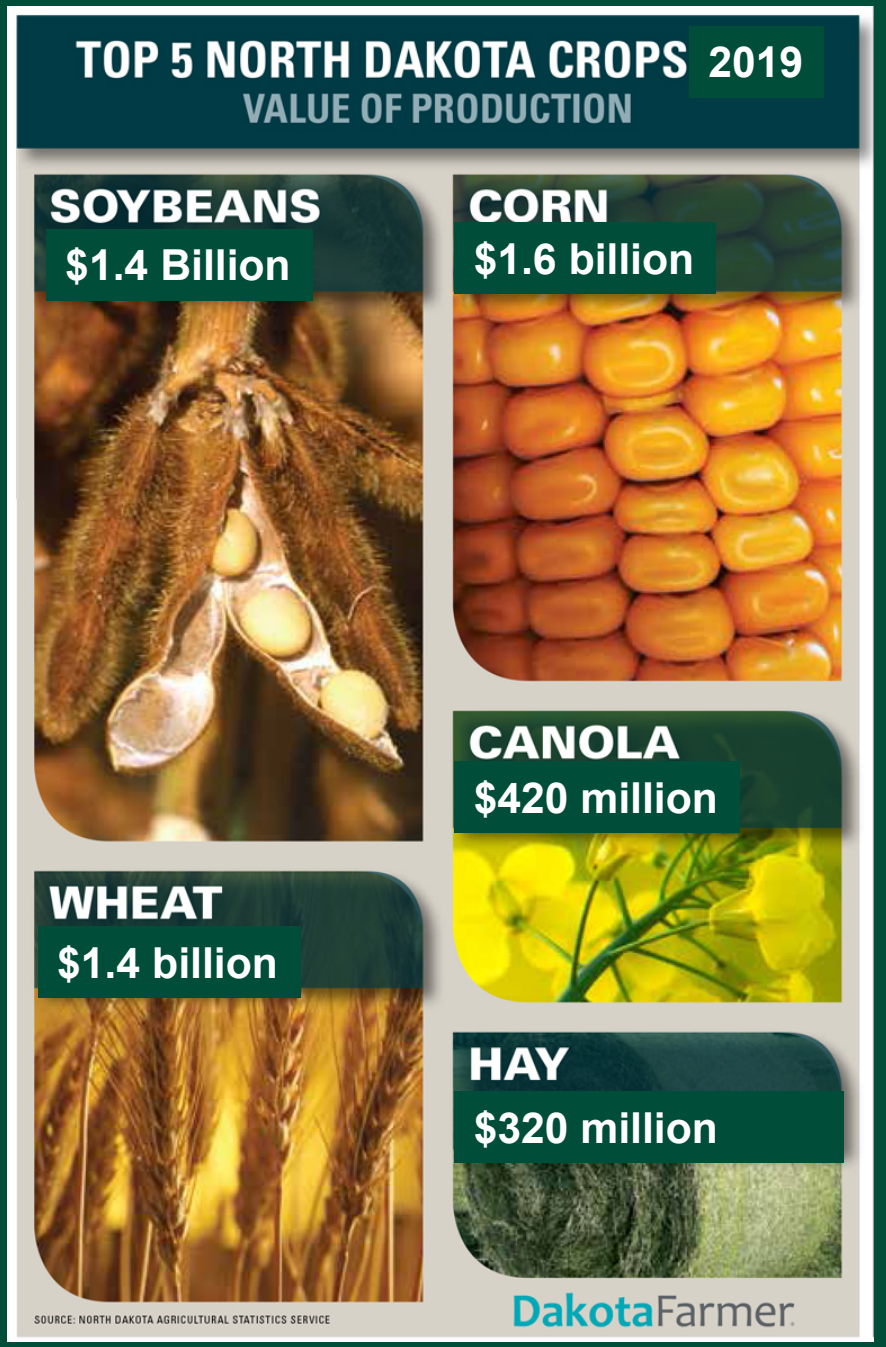
Soil and Crops 2020 – March 10-11, 2020

Agriculture in North Dakota

- 90% of land used for agriculture
- 40 million acre devoted to farming & ranching
- 24% of population is employed in the ag sector alone
- Economic impact is about $10.9 billion/year



#1 Crops of North Dakota

- Honey 2019
  - 3.8 million lbs
  - $71 million

North Dakota is #1

Rank	Crop	Percent of US total
1st	Spring wheat	53
1st	Durum wheat	51
1st	All wheat	18
1st	Dry edible peas	44
1st	All dry edible beans	29
1st	Pinto beans	51
1st	Barley	31
1st	Canola	86
1st	Flaxseed	92
1st	Honey	23
2nd	Navy beans	37
2nd	Lentils	40
2nd	Sunflowers, oil	37
3rd	Sugarbeets	16
4th	Safflower	5
4th	Oats	11
4th	Potatoes	6
8th	Soybeans	4
12th	Corn for grain	2

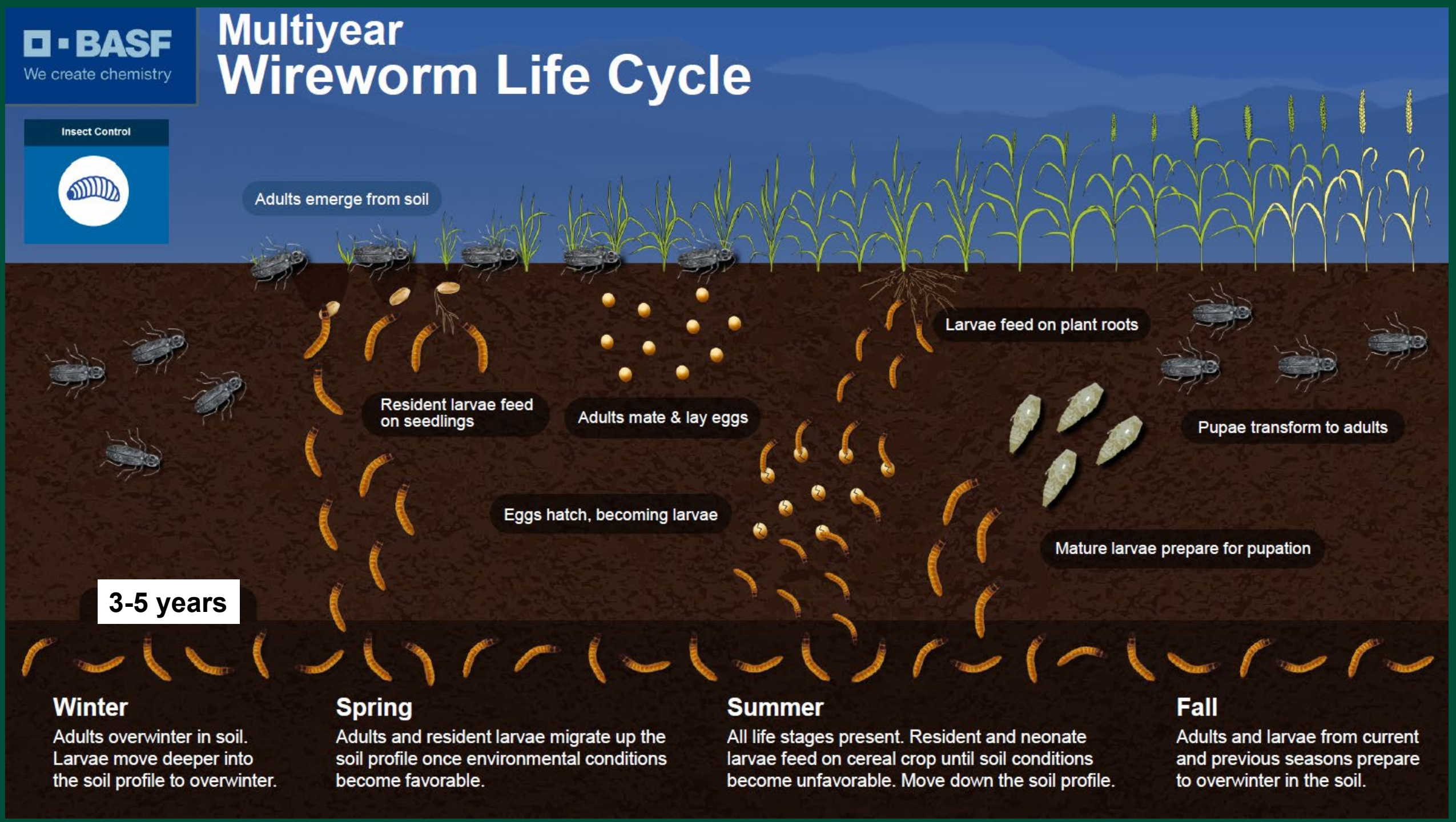
Wireworms

- **Family Elateridae (click beetles)**
- **885 wireworm species in N.A.**
  - Prairie grain wireworm (*Selatosumus aeripennis destructor*)
  - Sugarbeet wireworm (*Limonius californicus)*
- **Larvae feed on roots and tunnel in roots/stems**

BASF
We create chemistry

Insect Control

Multiyear Wireworm Life Cycle



Winter

Adults overwinter in soil. Larvae move deeper into the soil profile to overwinter.

Spring

Adults and resident larvae migrate up the soil profile once environmental conditions become favorable.

Summer

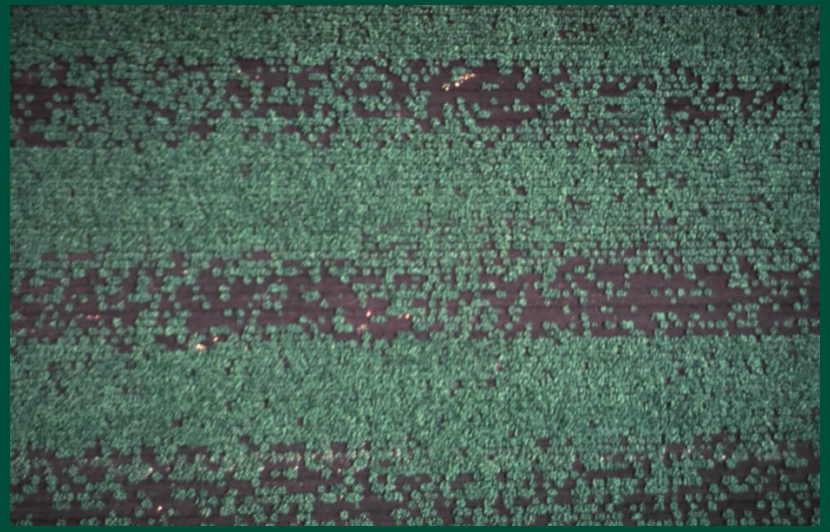
All life stages present. Resident and neonate larvae feed on cereal crop until soil conditions become unfavorable. Move down the soil profile.

Fall

Adults and larvae from current and previous seasons prepare to overwinter in the soil.

Wireworms

- Plant losses due to wireworm feeding are increasing!
- Stand loss – blank spots or ‘skips’ in the rows
- Make sure the problem is actually caused by wireworms



Wireworm Field Sampling

- Difficult to survey and to predict whether wireworms will be a problem
- Wide host range, but grasses are preferred
- Crops most at risk following small grains, corn or CRP/non-crop
- Threshold of more than one wireworm per trap

Photo credit: Dr. Wanner, Montana State University

Wireworm Bait Trap

1. Fill ½ full with vermiculite
2. Add wheat to bait trap
3. Top with vermiculite
4. Soak with water!

Wireworm Bait Trap

- Core holes for bait trap about 6 inches deep and 4 inches wide

Wireworm Bait Trapping

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Insecticide - Application Technology for Wireworm Management

- Insecticide seed treatments
- In-furrow treatment at plant
- FMC - 3RIVE 3D system
  - Planter attachment and delivers a foam formulation of insecticide to the furrow around the seed.
  - Eliminates the need for frequent refilling of water on the planter

Current Sunflower Insecticides Registered for Wireworm

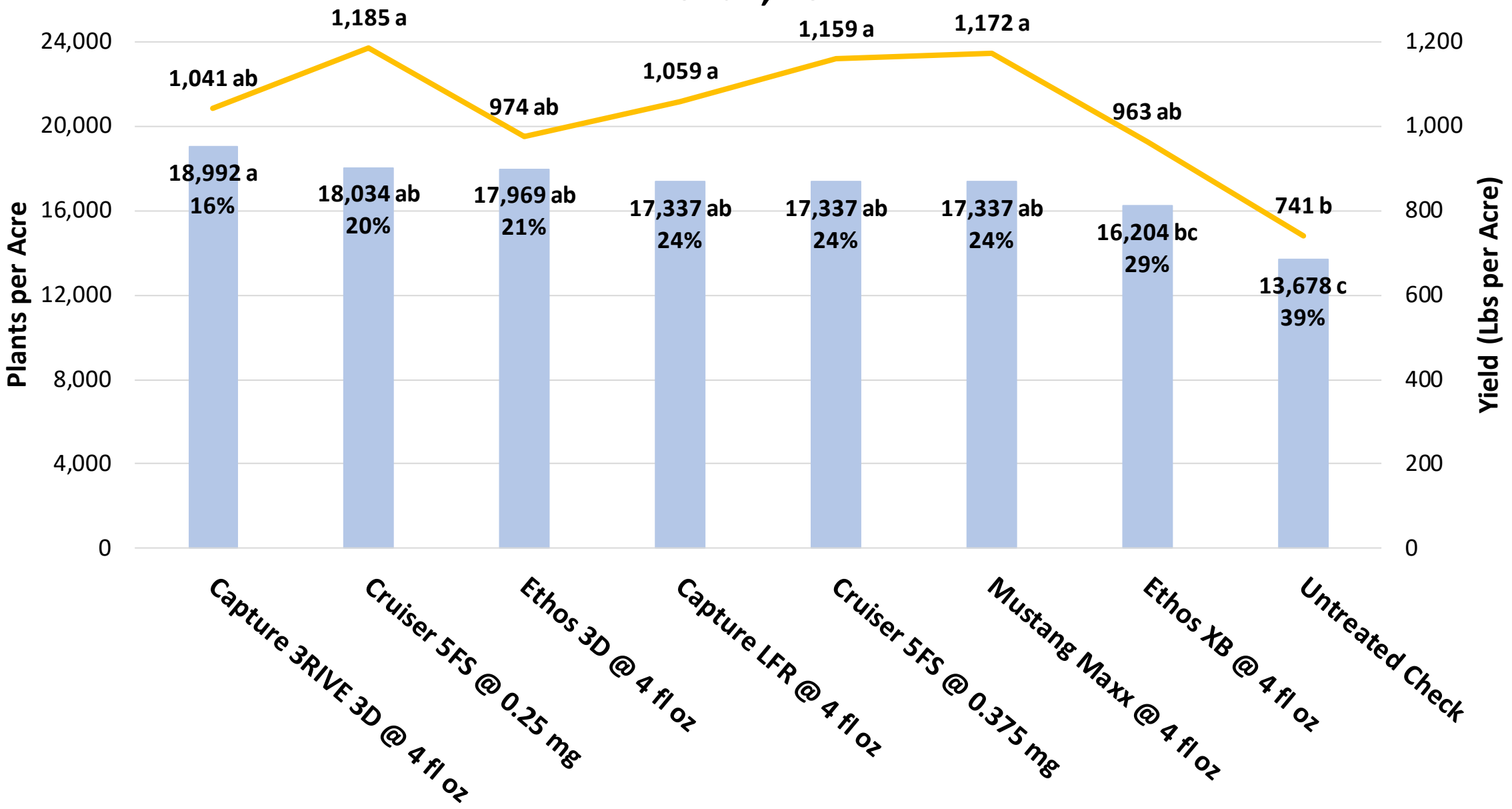
IRAC Group	Class	Active Ingredient	Products
3A	Synthetic Pyrethroid	Zeta-cypermethrin	Mustang Maxx (At plant)
3A	Synthetic Pyrethroid	Bifenthrin	Pending 2020 EPA label
4A	Neonicotinoid (seed treatment)	Imidacloprid	Dyna-Shield, Gaucho 600, Senator 600FS
4A	Neonicotinoid (seed treatment)	Thiamethoxam	Cruiser 5FS
28	Diamides (seed treatment)	Cyantraniliprole	Fortenza

In-furrow Pyrethroid and Neonic Seed Treatment Efficacy Trials in Sunflowers 2016-2019

Insecticide Class	Active Ingredient	Trade name	Rate
Neonicotinoid	Thiamethoxam	Cruiser 5FS	0.25 mg ai/seed
Neonicotinoid	Thiamethoxam	Cruiser 5FS	0.375 mg ai/seed
Pyrethroid	Zeta-cypermethrin	Mustang Maxx	4 fl oz/acre
Pyrethroid	Bifenthrin	Capture LFR	4-8 fl oz/acre
Pyrethroid	Bifenthrin	Ethos XB	4-8 fl oz/acre

Treatment Means for Plant Population and Yield
Mohall, 2017

22,500 target plant population



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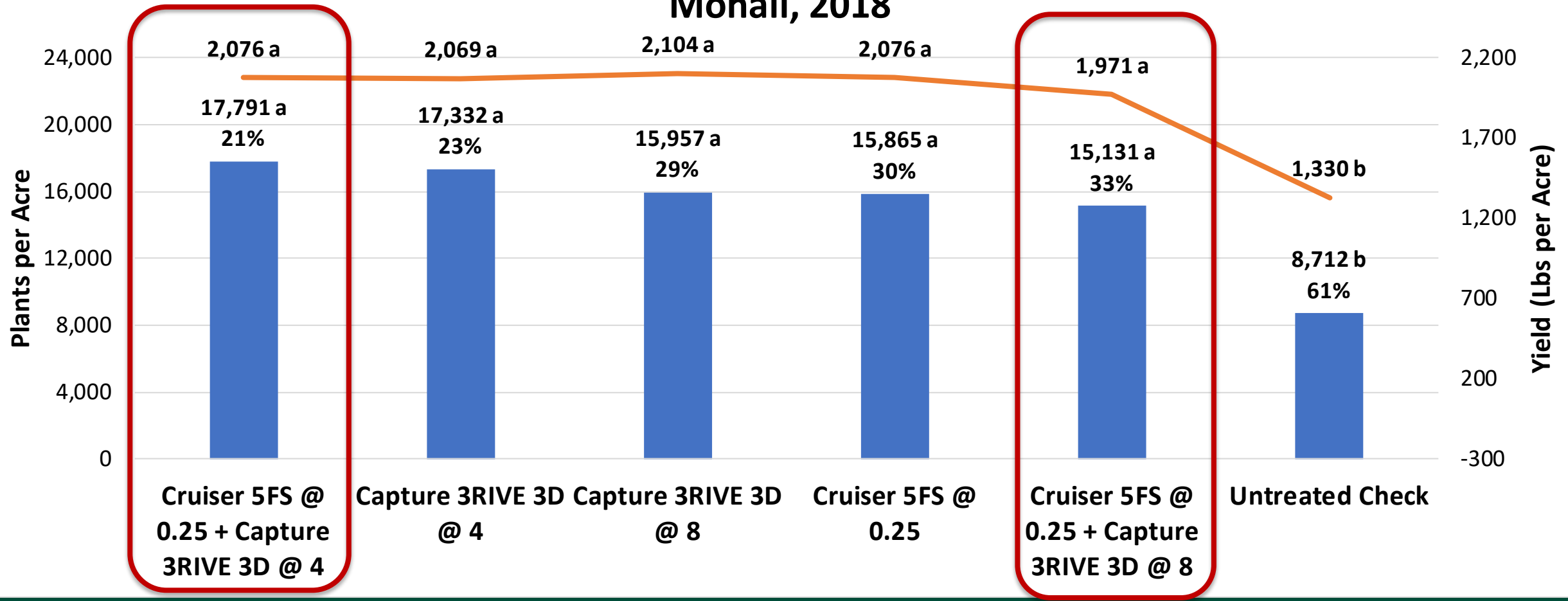

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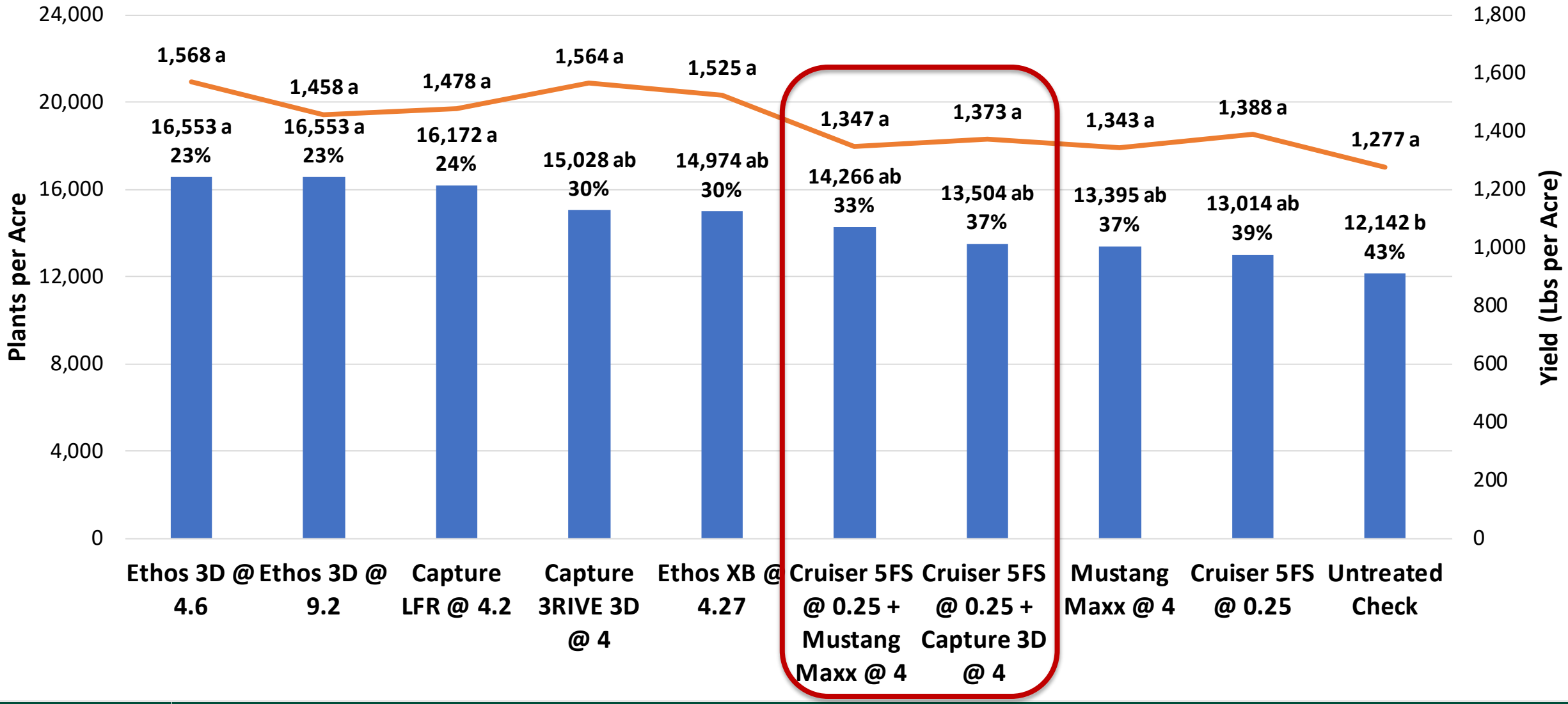
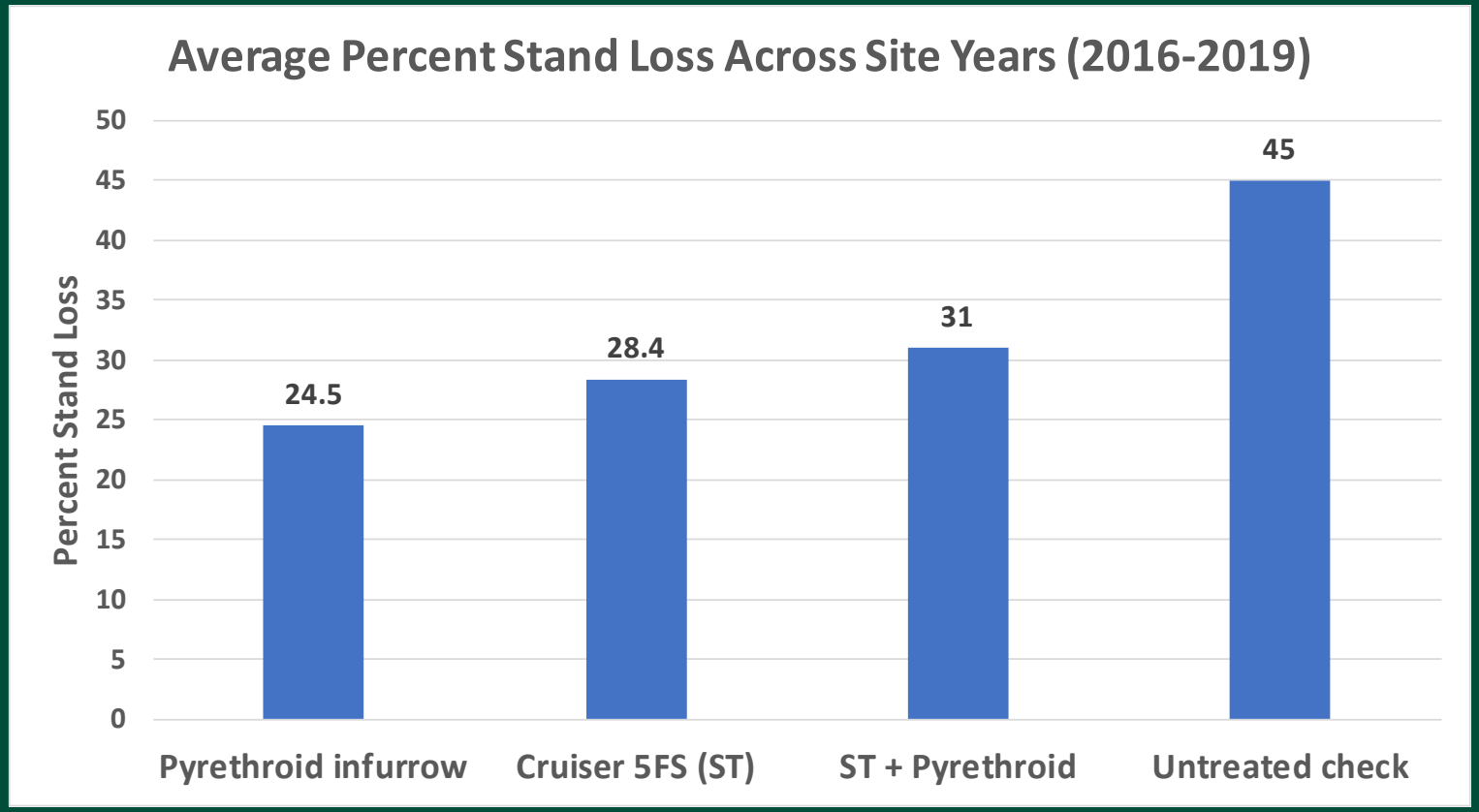


Wireworm 'Control'

- Increasing rates or stacking ST + in furrow pyrethroids did not improve efficacy
- Insecticide ST, in-furrow pyrethroid or 3RIVE 3D applications provided **'better' stand establishment than the untreated check**



Wireworm Stand Loss

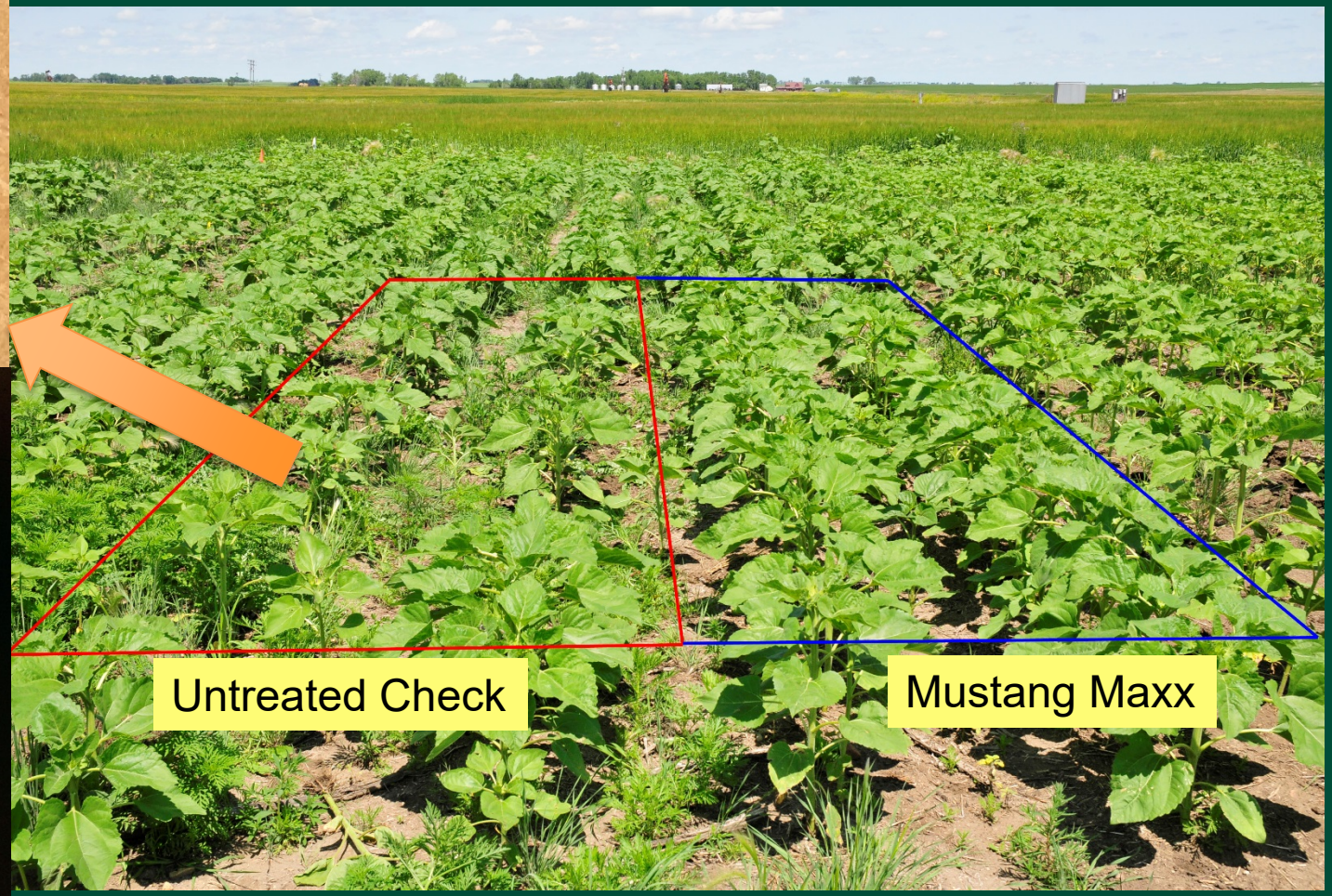


Photo by P. Beauzay

Wireworm 'Control'

- Current insecticides **do not provide mortality or long-term management of wireworms**
  - Neonicotinoid seed treatments (such as thiamethoxam) cause 'temporary' morbidity
  - Pyrethroids are repellents and nonlethal

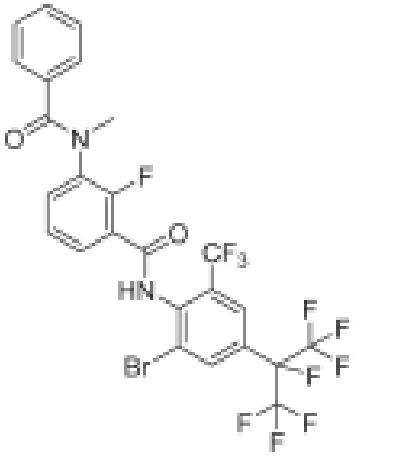
van Herk et al. 2015. Contact behavior and mortality of wireworms exposed to six classes of insecticide applied to wheat seed. J Pest Sci 88: 717-739.

Wireworm Pest Management

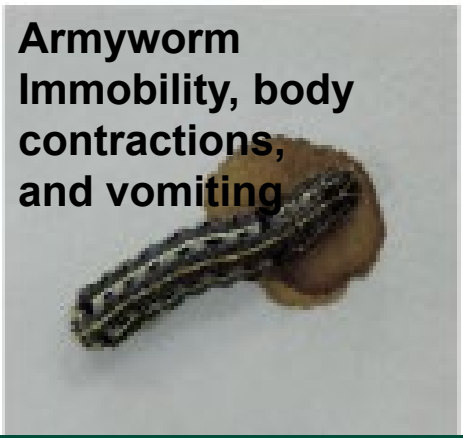
- Thiamethoxam seed treatment, in-furrow and 3rive applications of pyrethroids provided ‘improved’ protection over the untreated check
- Stacking seed treatment plus in-furrow pyrethroids did not improve control over single application
- Consider your crop rotation and know your field history with wireworm pressures
- Adjust seeding rate +10-20% to compensate for wireworm stand loss
- New Mode of Action – Syngenta and BASF

New Chemistry for Wireworm Control in Cereals from BASF

- Broflanilide, the new Group 30 insecticide
- Teraxxa Insecticide Seed Treatment
- Small grain cereals late this year
  - Crops: wheat, barley, rye, and triticale
- High activity against various pests, including Lepidopteran, Coleopteran, and Thysanopteran pests
- Not seeking registration for Teraxxa in sunflowers



Broflanilide (1)
Chemical Class; *Meta*-diamides



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Thank you!

Grower Jeff & Jerry Oberholtzer
Dr. Adam Varenhorst, SDSU

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Flea Beetles in 2019

Fall Canola Survey
Flea Beetle

***PI:** Janet Knodel*

Identifier:
Patrick Beauzay

Surveyors:
Ryan Buetow, DREC
Audrey Kalil, WREC
Scott Knoke, Benson Co. Ext.
Lesley Lubenow, LREC
T.J. Prochaska, NCREC

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Flea Beetles – *Phyllotreta species*

- **Adult beetle**
  - ⅛ inch long
  - Enlarged hind legs
- **Crucifer flea beetle**
  - Iridescent blue sheen on black wing covers
- **Striped flea beetle**
  - 2 yellow strips on black wing covers

Objective

- To provide information on the population levels and distribution of different species of flea beetles in canola throughout North Dakota during swathing (late August – Sept.)
- Differences in *Phyllotreta cruciferae* and *Phyllotreta striolata* tolerance to Neonicotinoid Seed Treatments

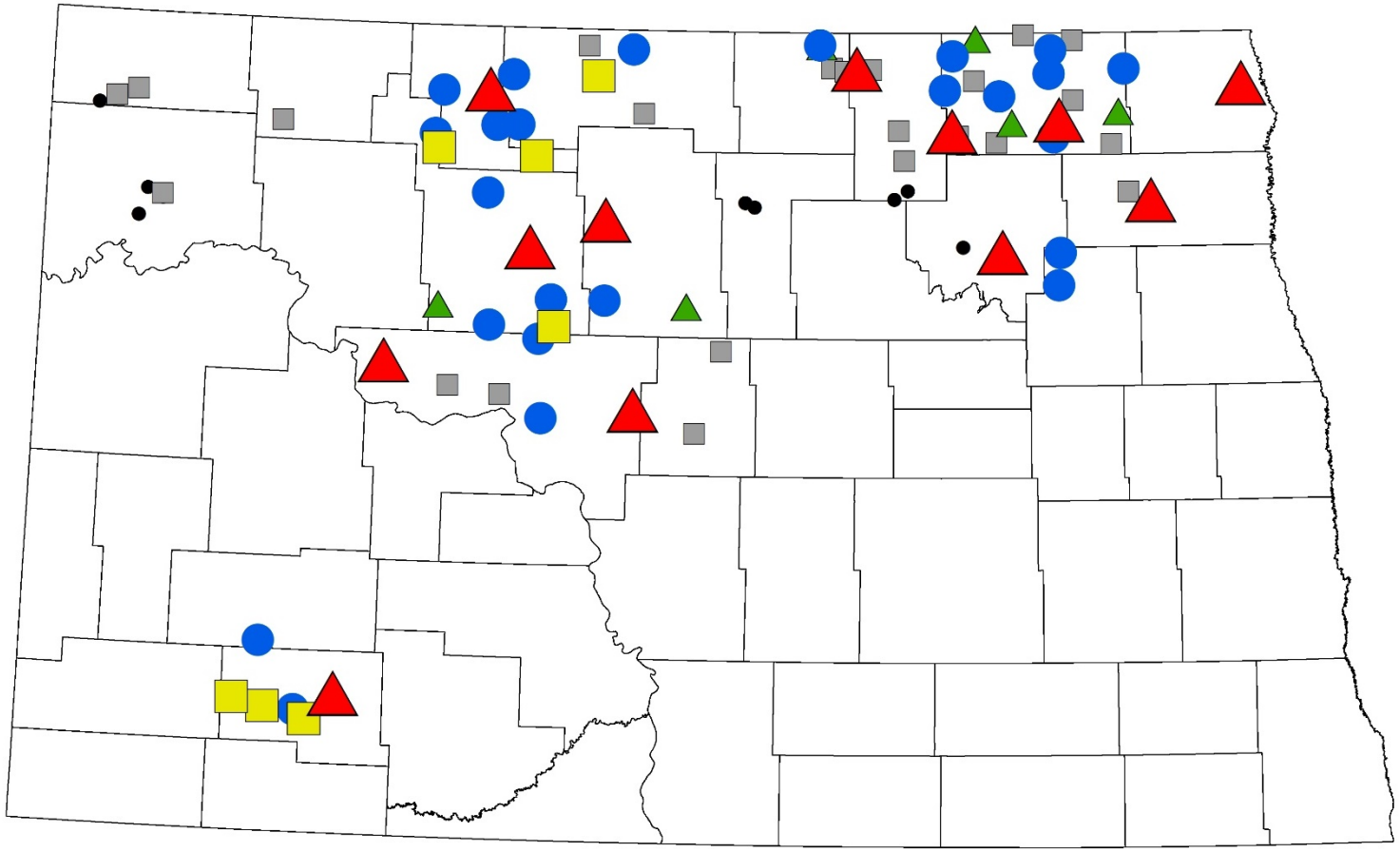
Tansy et al. 2008 J. Econ. Entomol. 101: 159-167.

Materials & Methods

- Surveyed swathed canola fields in NC, NW, SW and NE ND
- Collected flea beetles using 15-inch sweep net
- 20 sweeps per 5 locations (total of 100 sweeps per field site)
- Flea beetles placed in plastic bags and stored in freezer
- Flea beetle species identified and counted for each field site

2019 Canola Flea Beetle Survey

82 canola fields surveyed for flea beetles in 18 counties of ND



Total number of Flea Beetles Collected per 100 Sweeps

• 0 ■ 1-50 ▲ 51-100 ● 101-500 ■ 501-1000 ▲ >1000

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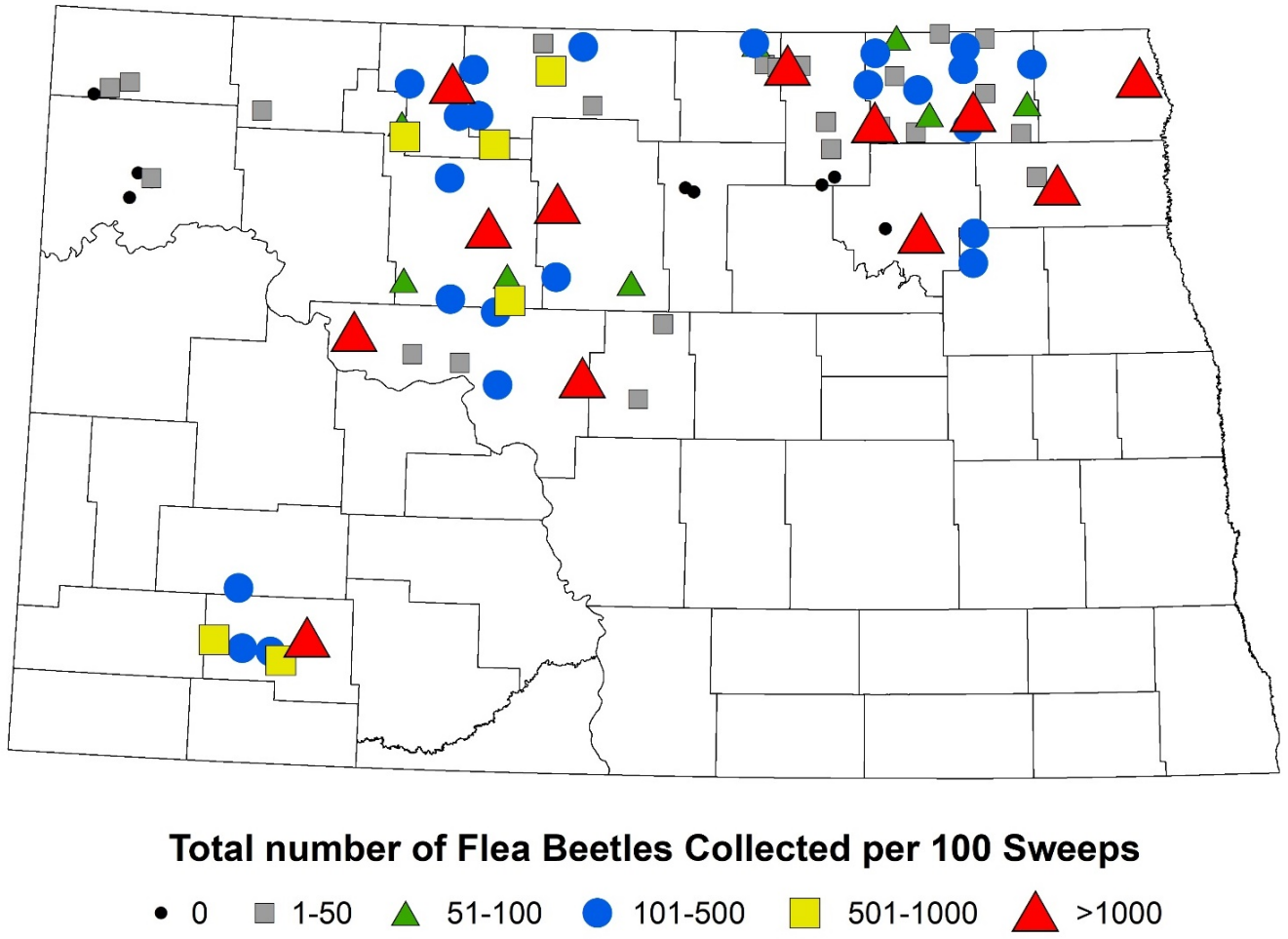
2019 Canola Flea Beetle Survey
Crucifer Flea Beetle (*Phyllotreta cruciferae*)



- 66,976 total specimens
- 99% of flea beetles collected
- 89% of the fields positive
- 17 counties out of 18

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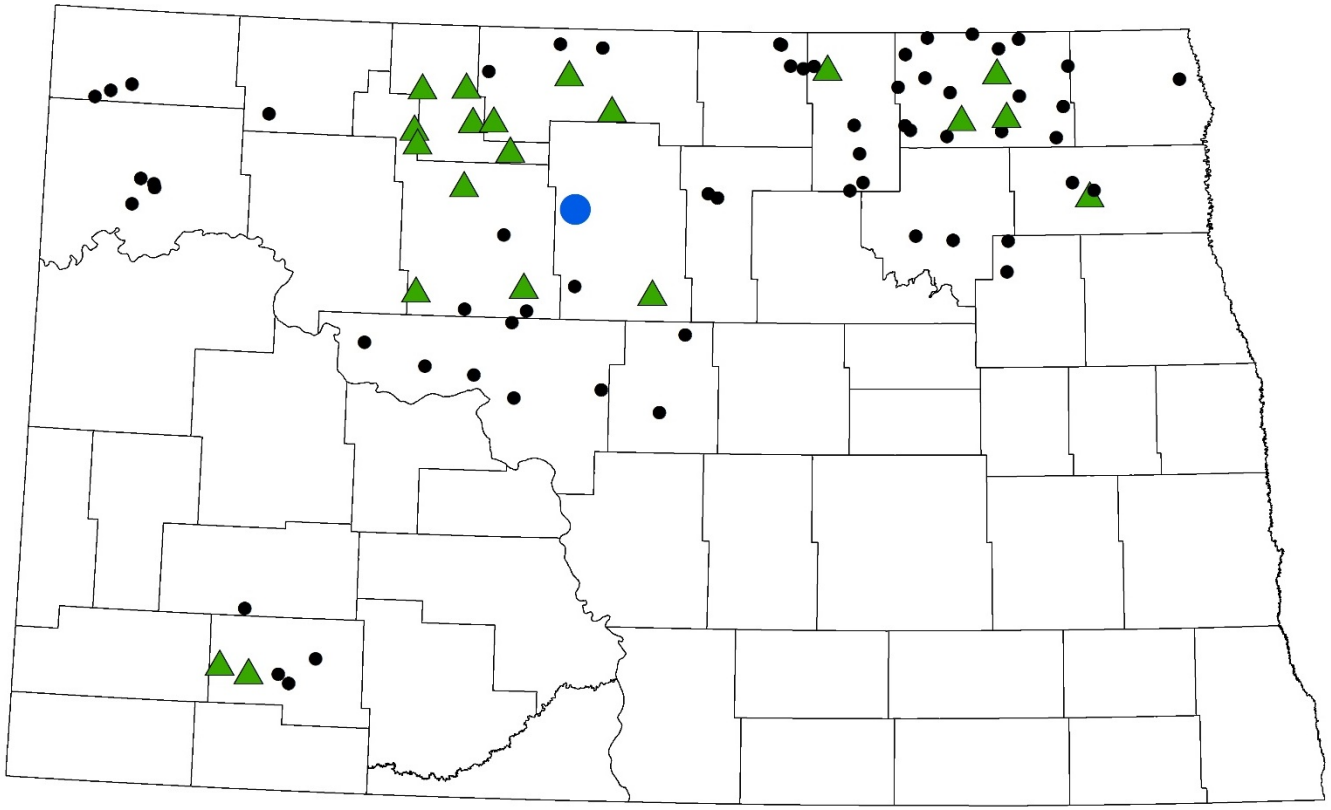
2019 Canola Flea Beetle Survey
Striped Flea Beetle (*Phyllotreta striolata*)



Total number of Flea Beetles Collected per 100 Sweeps

• 0 ▲ 1-25 ● 26-50 ■ 51-75 ▲ > 75

- 107 total specimens
- 0.2% of flea beetles collected
- 26% of the fields positive
- 8 counties out of 18

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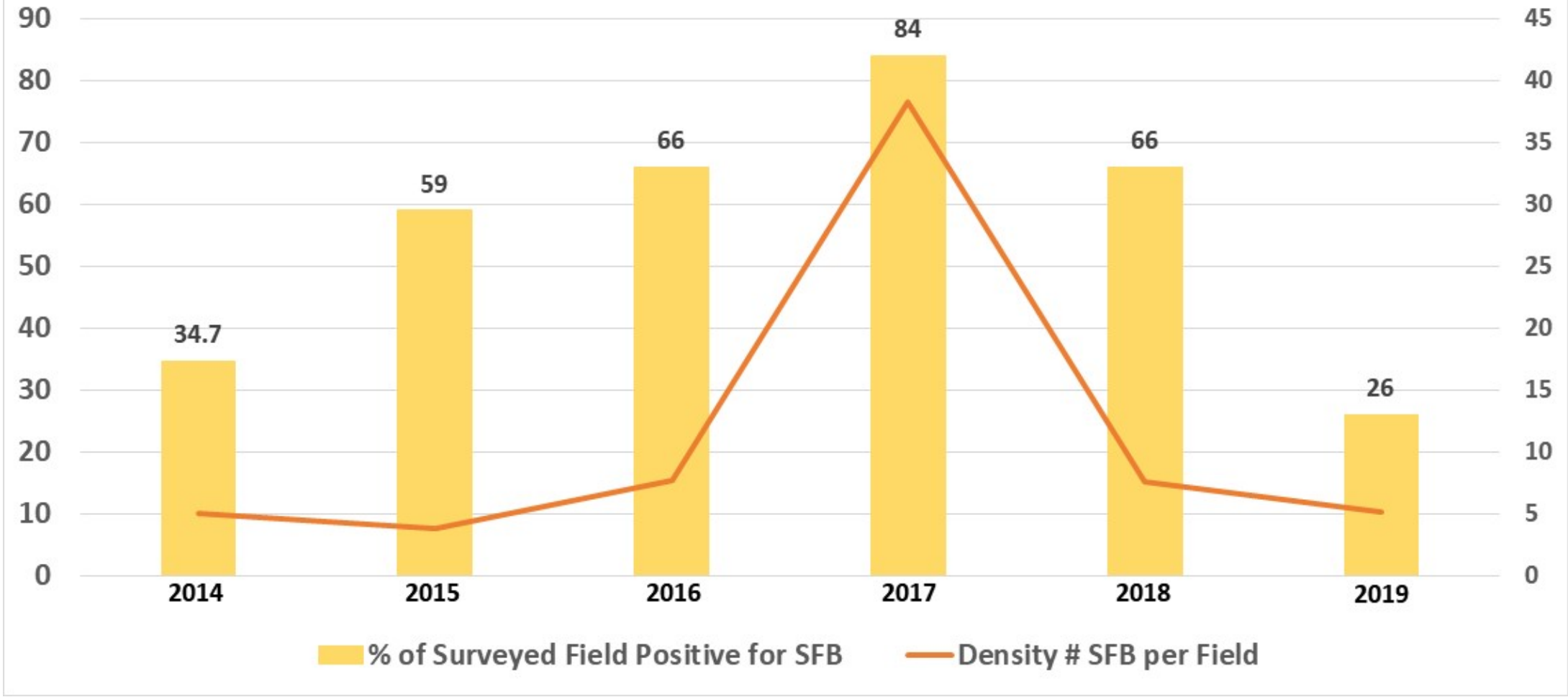
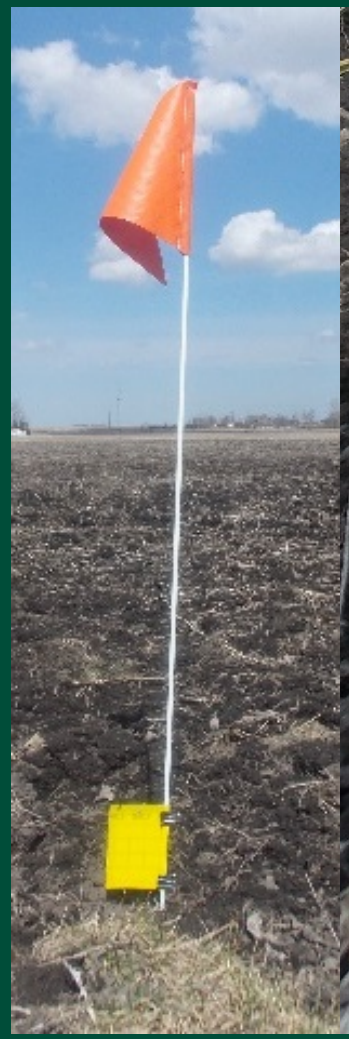
Striped Flea Beetle (SFB) Populations in Canola from 2014-2019



Spring Sticky Card Survey

- Timing: Spring 2017-2019
- 10 sticky cards in farmer field
- Changed 2x per week
- 5 counties:
  - NE – Cavalier and Towner
  - NC - Renville and Ward
  - SW – Stark



Striped vs. Crucifer Flea Beetles

At Peak Emergence

Typically, Crucifer flea beetle is #1

However, striped flea beetle dominates in some years in northeast and north central ND.

			----------Proportion %----------	
Nearest Town	**Dates for Max. Spring Numbers**	**Total flea beetles/trap/day**	***P.cruciferae***	***P. striolata***
Osnabrock 2019	Jun 3 - 6	2.57	93.4	6.6
Rock Lake 2019	May 28 - 30	16.95	92.9	7.1
Langdon W 2018	May 21 - 24	0.2	100	0
Rock Lake 2018	May 24 - 29	1.8	72.2	27.8
Langdon E 2017	May 29 – Jun 2	4.2	34.5	65.5
Cando 2017	May 29 – Jun 2	0.8	43.8	56.2
Mohall 2019	Jun 3 – Jun 6	4.07	75.4	24.6
Kenmare 2019	May 23 - 27	0.15	86.7	13.3
Mohall 2018	May 24 - 28	0.65	23.1	76.9
Kenmare 2018	Jun 7 - 11	0.38	65.8	34.2
Mohall 2017	Jun 2 - 6	0.78	96.2	3.8
Kenmare 2017	Jun 2 - 6	0.7	46.5	53.5
Dickinson 2019	May 31 - Jun 3	1.88	97.9	2.1
Dickinson 2018	May 29 - Jun 1	6.9	94.7	4.3
Dickinson 2017	Jun 1 - 5	2.4	92.7	7.3

Conclusions

- *Phyllotreta cruciferae* (crucifer flea beetle)
  - Continues to be the most common and widely distributed flea beetle species found in the 2014-2019 Canola Surveys in North Dakota
- *Phyllotreta striolata* (striped flea beetle, SFB)
  - Second most common flea beetle species in canola
  - Incidence of fields with SFB decreased and density continued to be low since 2014
  - Important baseline data on its current abundance and distribution in ND
  - Future survey efforts will help document any increases in striped flea beetle populations, distributions as well as species shift due to potential insecticide resistance in North Dakota

SEED TREATMENTS VS. BOTH SPECIES OF FLEA BEETLES

Canola

Insecticide Recommendations

Registered Insecticides - 2020

Seed Treatment Insecticides

** Restricted Use Pesticide*

Neonicotinoid, Group 4A:

thiamethoxam - Helix Vibrance, Helix XTra

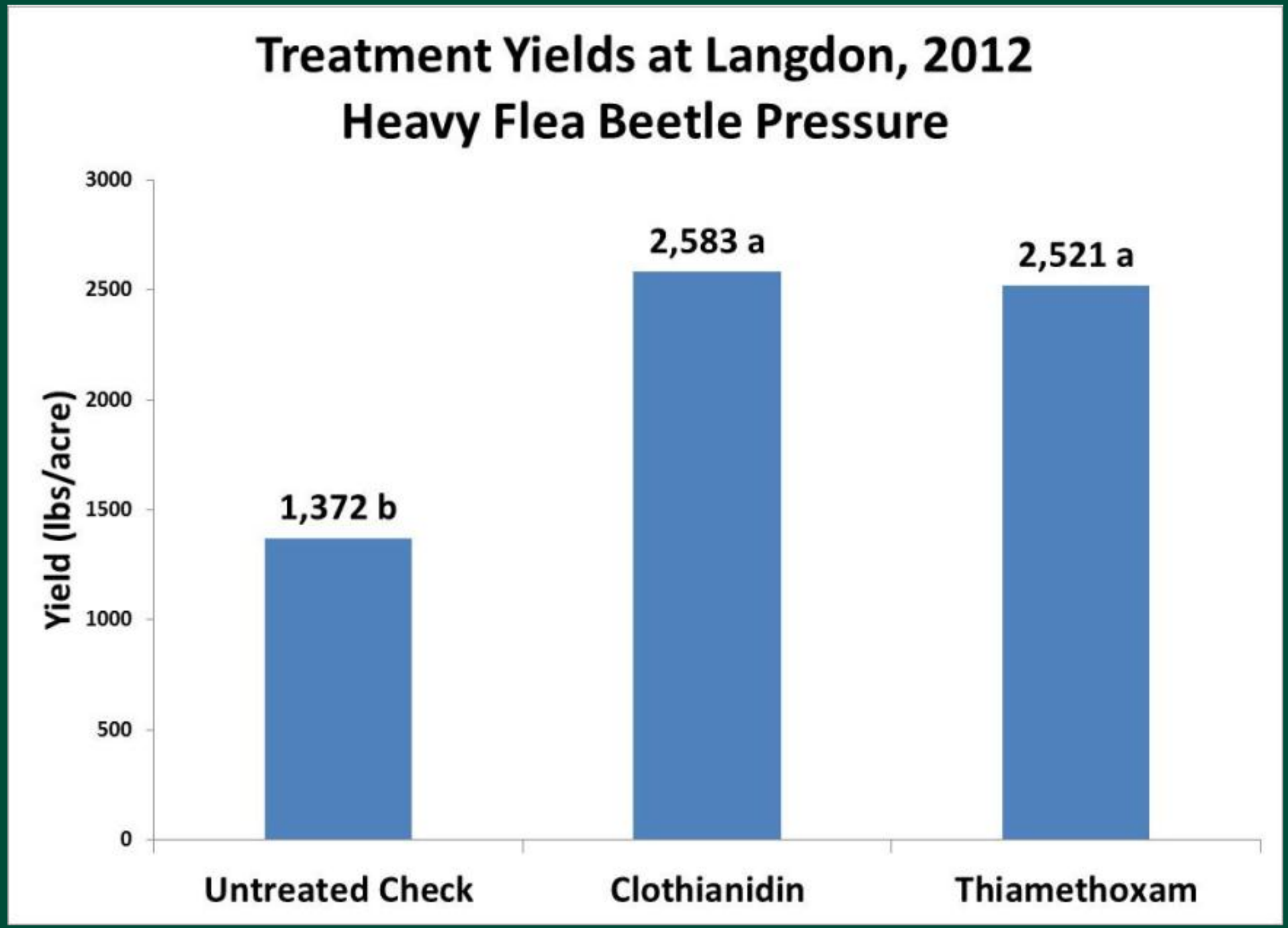
clothianidin - NipsIt INSIDE, Prosper EverGol

imidacloprid - Attendant 480FS, Dyna-Shield Imidacloprid 5, Gaucho 600, Senator 600 FS

Diamides, Group 28:

cyantranilliprole - Fortenza, Lumiderm

Always Read and Follow Labels.

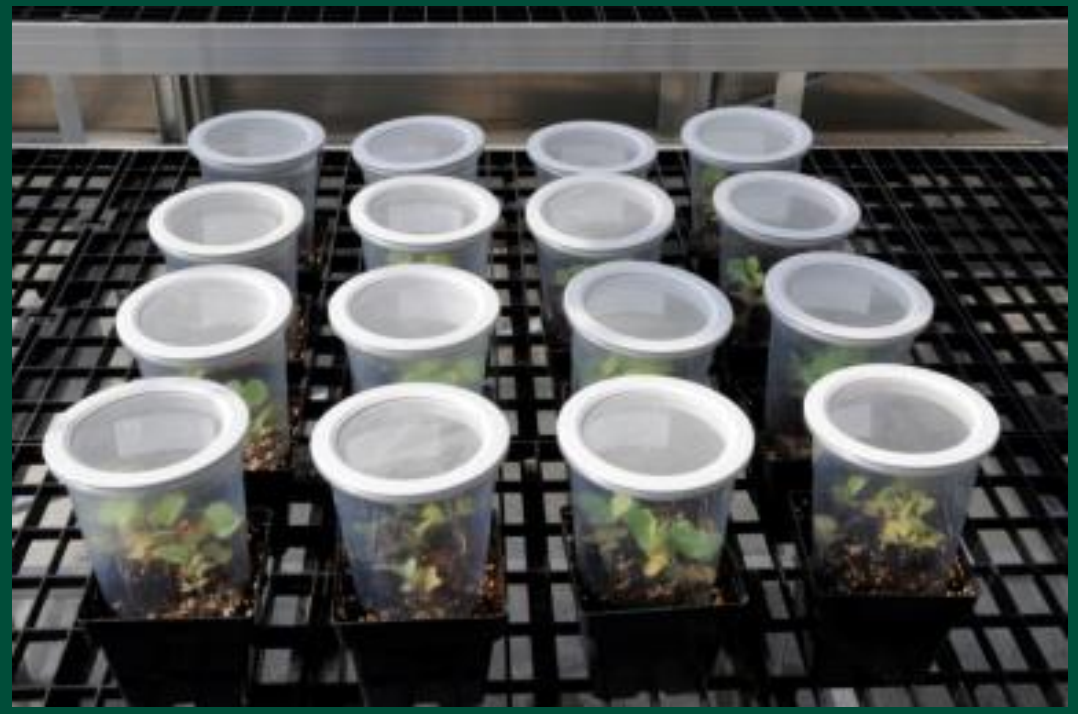

Treatment Yields at Langdon, 2012
Heavy Flea Beetle Pressure
Yield (lbs/acre)
3000
2500
2000
1500
1000
500
0
1,372 b
2,583 a
2,521 a
Untreated Check
Clothianidin
Thiamethoxam

Greenhouse Bioassay Study

- **Flea Beetles Rearing**
  - Collected crucifer and striped flea beetles in spring 2019 from Langdon area
  - Flea beetles fed untreated canola and organic kale every three days
- **4 treatments**
  - Untreated check
  - Thiamethoxam (Helix Xtra, Helix Vibrance) at 400 g/100 kg
  - Clothianidin (Prosper EverGol) at 200.8 g/100 kg
  - Cyantraniliprole (Lumiderm, Fortenza) 1000 g/100 kg

Materials and Methods

- 5 canola seedlings per pot
- 10 flea beetles per pot
  (or 2 flea beetles per seedling)
- 6 replications, RCBD
- 2 plant ages:
  - 7 and 14 DAP

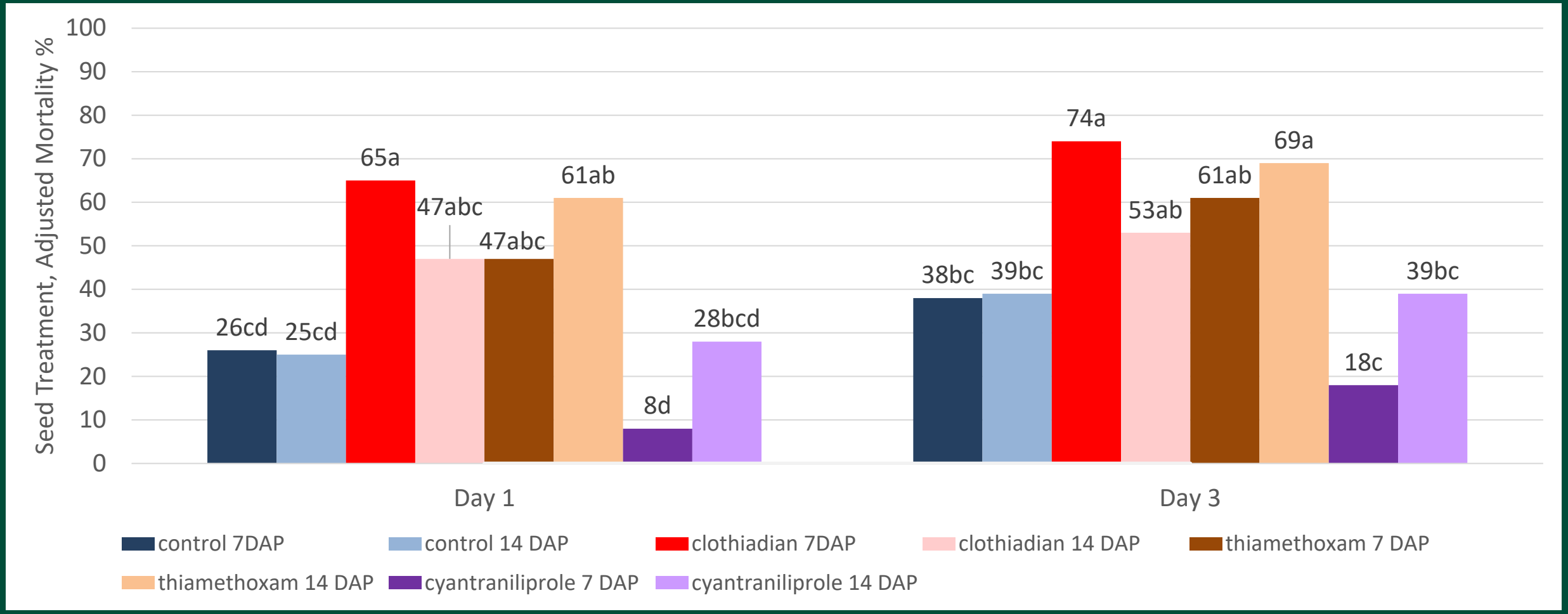


Materials and Methods

- Live flea beetles counted and recorded for each pot at 1, 3, 7, 10 & 14 days after introduction (up to 10 days for the 14 DAP plants)
- Corrected Mortality (Schneider-Orelli, 1947)
  - M (%) = (t – c) / (100 – c) * 100
  - t = percent mortality in treatments
  - c = percent mortality in controls (untreated checks)
- Data analyzed using PROC GLM in SAS statistical software
- Treatment means compared using pairwise t-tests at $\alpha = 0.05$

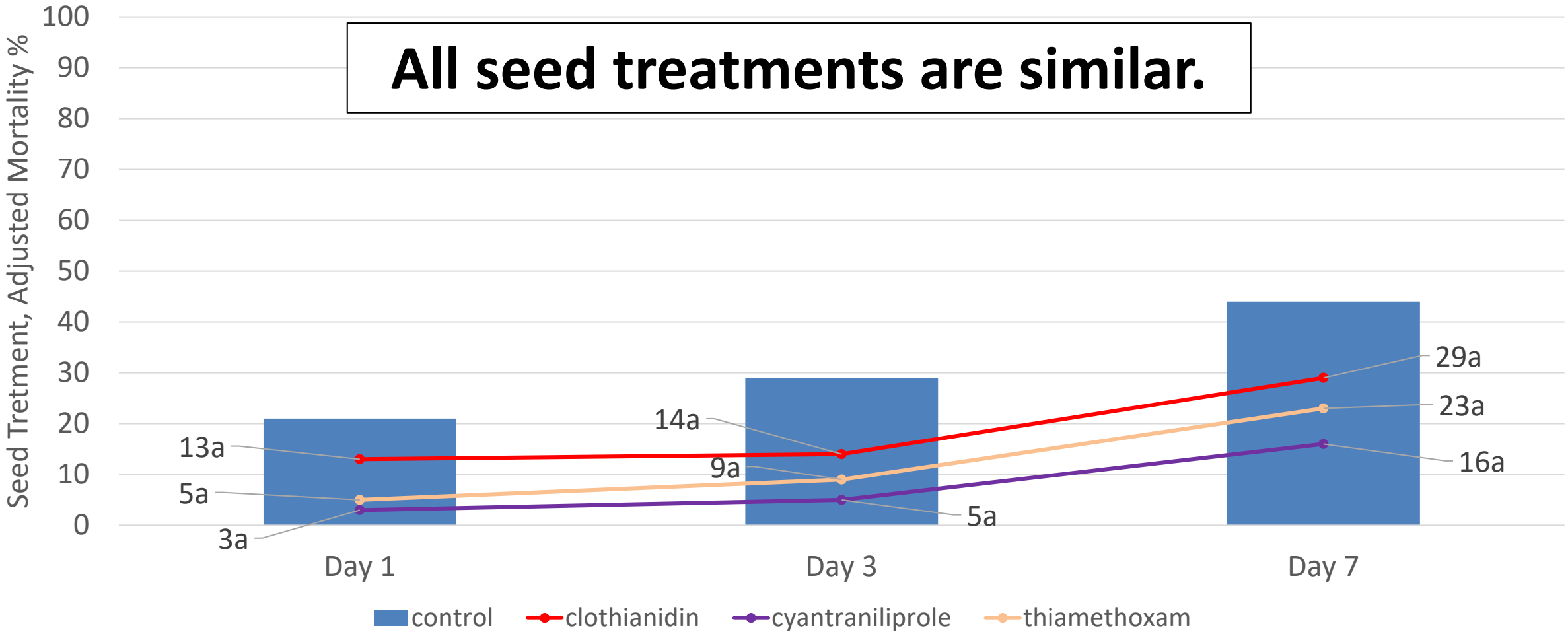
2019 Seed Treatment Mortality to *P. cruciferae* - Langdon

Day 1 and Day 3: clothianidin = thiamethoxam > cyantraniliprole



Seed Treatment Mortality to *P. striolata* - Langdon

All seed treatments are similar.



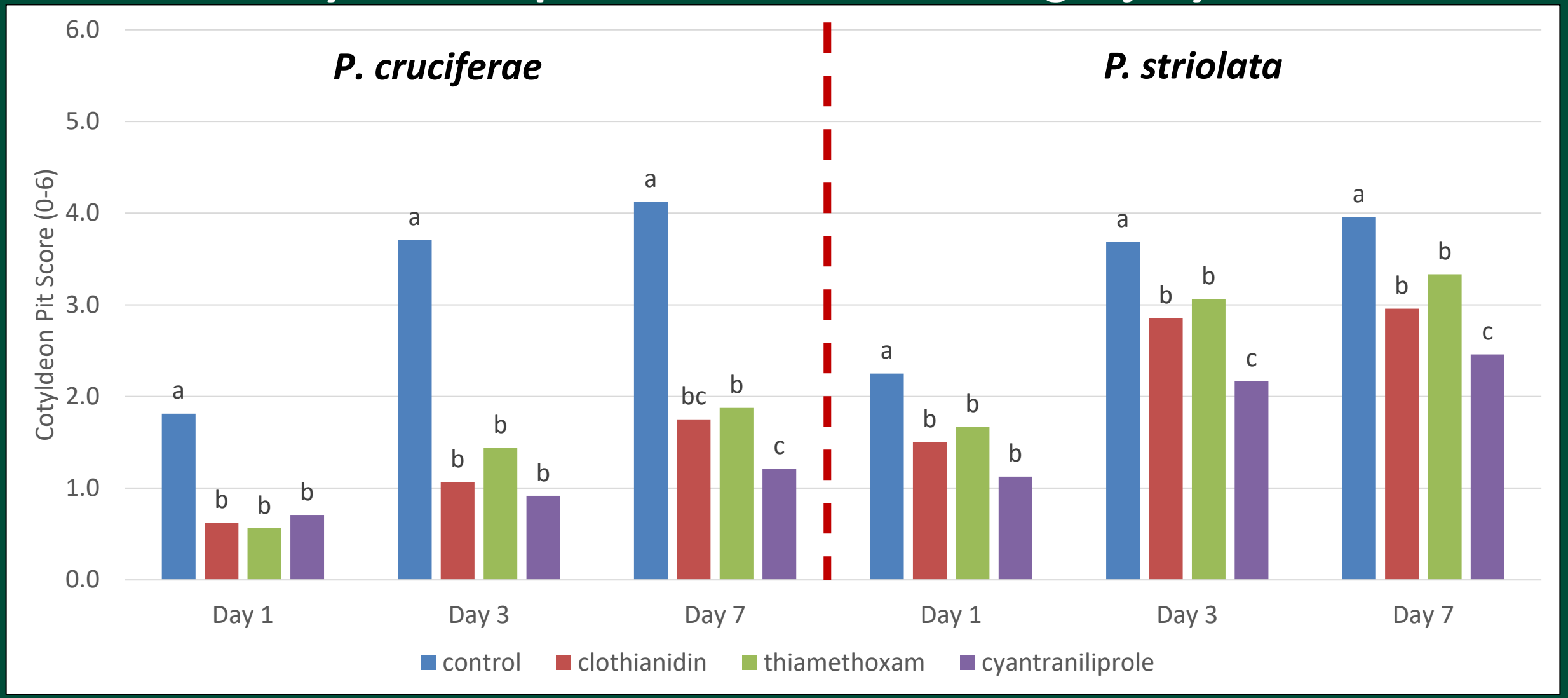
Canola Seedling Flea Beetle Damage Rating Scale

- 1 = 0-3 pits per seedling
- 2 = 4-9 pits per seedling
- 3 = 10-15 pits per seedling
- 4 = 16-25 pits per seedling
- 5 = >25 pits per seedling
- 6 = dead seedling

Damage ratings taken at 1-leaf, 2-4 leaf, and 4-6 leaf stages (approximately once per week)

2019 Spring Generation – Feeding Injury

P. striolata had higher feeding injury scores than *P. cruciferae,* and cyantraniliprole had lower feeding injury scores



Conclusion

- Striped flea beetles had higher survival (or lower mortality) and higher feeding injury ratings than crucifer flea beetles for all insecticide seed treatments tested.
- Continue to survey flea beetle populations and to conduct insecticide bioassays in greenhouse.

Swede Midge Trap Survey

- *PI: Janet J. Knodel*
- Identifier: *Patrick Beauzay*
- *Trappers:*
- *NE: Lesley Lubenow, Anitha Chirumamilla, Lindy Berg, Samantha Lahman, Traci Murphy*
- *NC: T.J. Prochaska, LoAyne Voigt, Sara Clemens*
- *NW: Audrey Kalil, Nicole Stanhope*
- *SW: Ryan Buetow, Kia Ward*

Order Diptera
Family Cecidomyiidae
Contarinia nasturtii (Kieffer)

Photo: Susan Ellis, www.forestryimages.org

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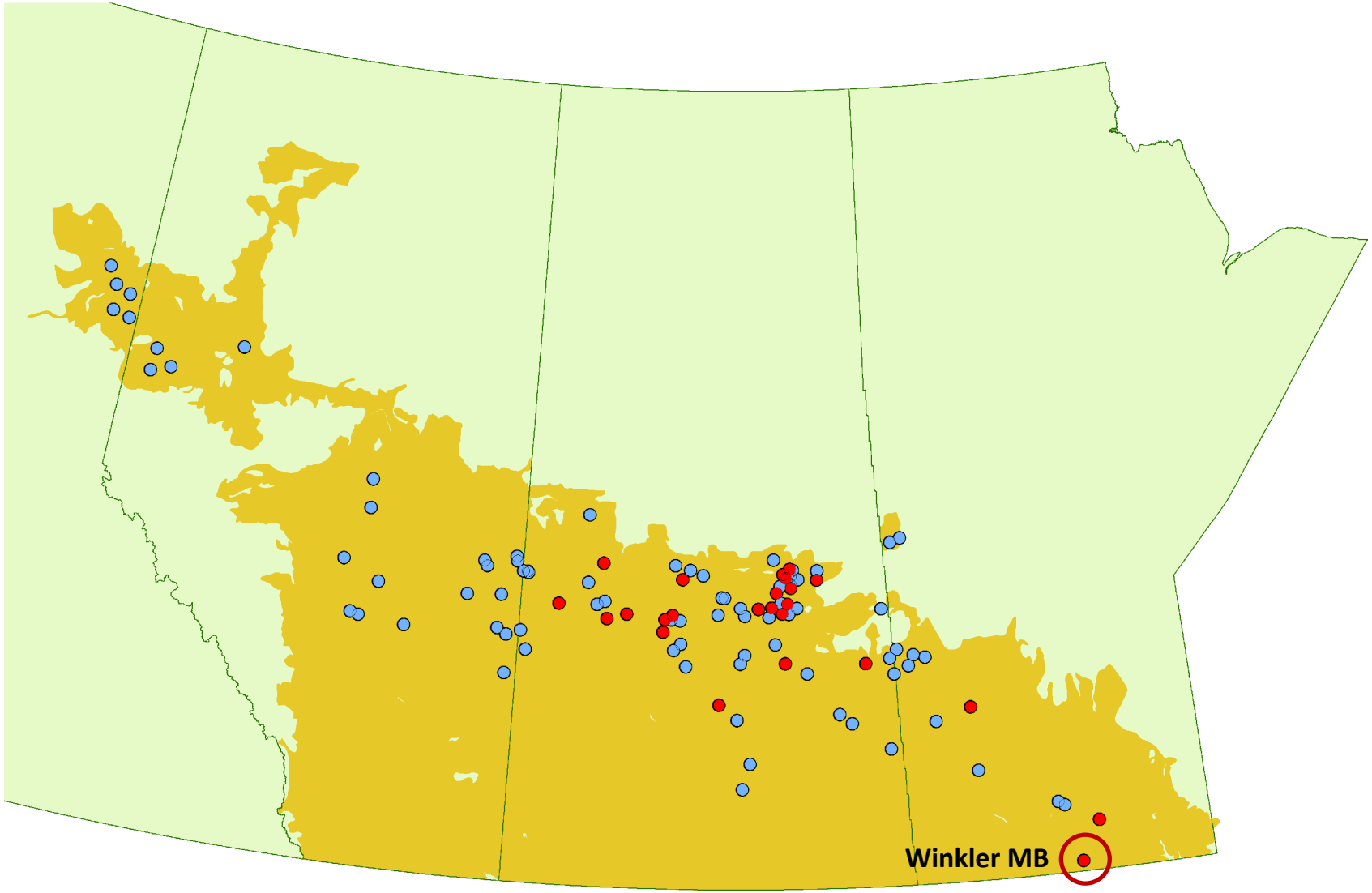
Hosts and Crop Damage

- Hosts – canola, cabbage, radish, others **Brassicaceae**
- Larval feeding caused plant injury
- Deformed, crumpled leaves, shoots and/or flowers
- Leaf, shoots and flower galls
- Misshapen growing points and growth of secondary shoots

Photos: Julie Kikkert, Cornell Cooperative Extension, www.forestryimages.org

2014 Swede Midge Survey

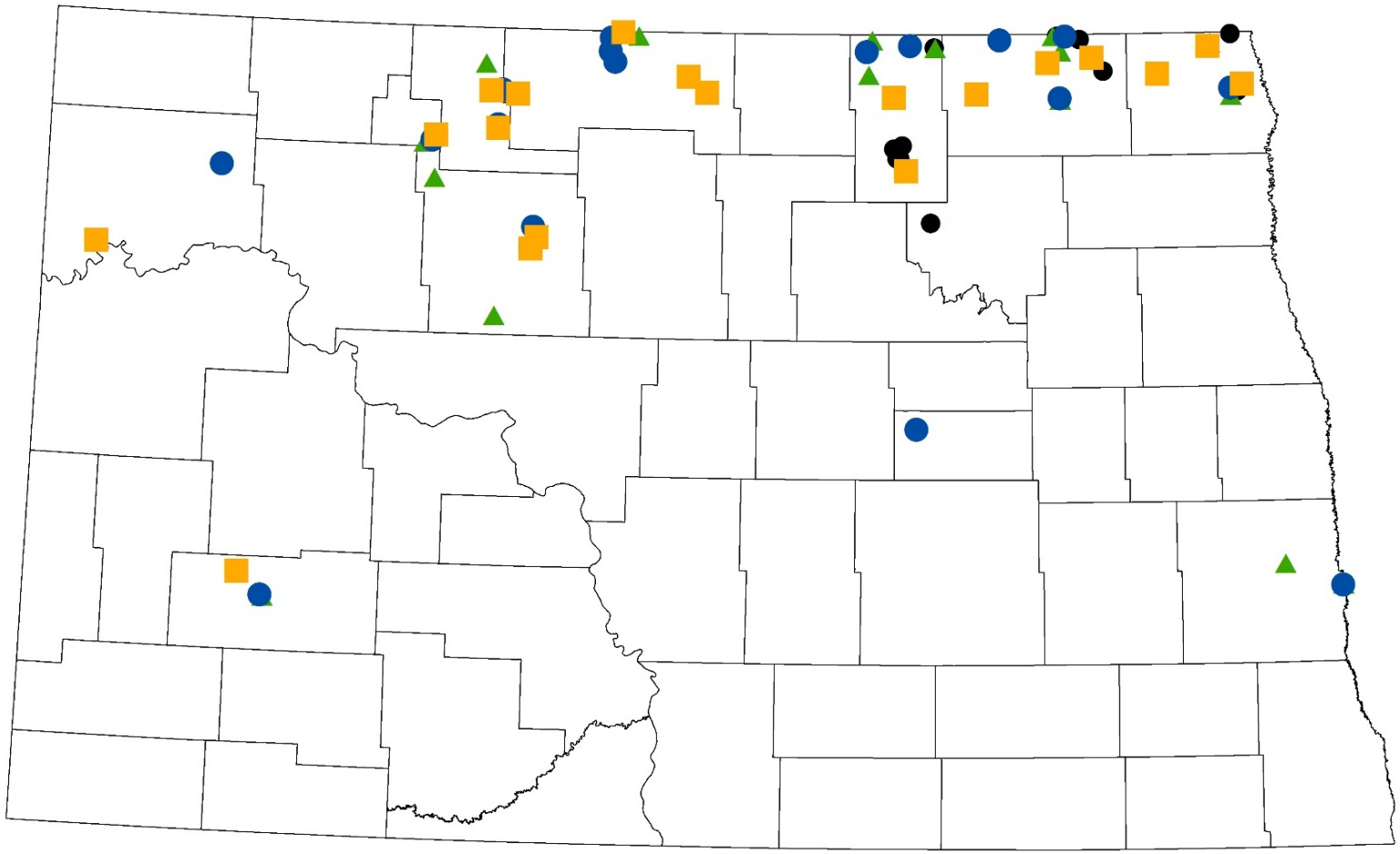
Larvae Present: Absent:



Swede Midge Trap Survey

- Used commercially available pheromone lure & delta trap (Scentry Red LPD trap)
- Monitored from mid-June (rosette) through mid-August (ripening crop stage)
- Traps checked weekly (sticky trap bottoms replaced)
- Trap bottoms stored in freezer

Swede Midge Surveys in North Dakota 2015, 2017, 2018 and 2019



Year trapped (all negative results)

● 2015 ▲ 2017 ● 2018 ■ 2019

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Add the ‘New’ Canola Flower Midge to Surveys
Contarinia brassicola

- Family Cecidomyiidae, Order Diptera (flies)
- Hosts – canola (*Brassica napus and B. rapa)*
- Light brown, Small, <2mm long

Photographs from 2019 Mori et al. Can. Entomol. 151:131-148

Pea Leaf Weevil *Sitona lineata* L.

- Discovered in Beech, Golden Valley County, SW ND in fall 2016
- Feeds on field peas, faba beans
- Non-hosts – chickpea, lentil
- Secondary hosts – alfalfa, clover (larvae do not develop)

Figure 1: Adult *S. lineatus* on pea leaf (Photo: L. Dosdall).

Figure 2: Dorsal view of adult *S. lineatus* (Photo: H. Goulet).

Pea Leaf Weevil Feeding Injury

- Adult – chew feeding notches on leaves; often higher on field edges or fields next to pastures or riparian areas.
- Larva – chew and tunnel in nitrogen-fixing nodules
- Reduce nitrogen fixation by plant and results in poor plant growth and lower seed yields

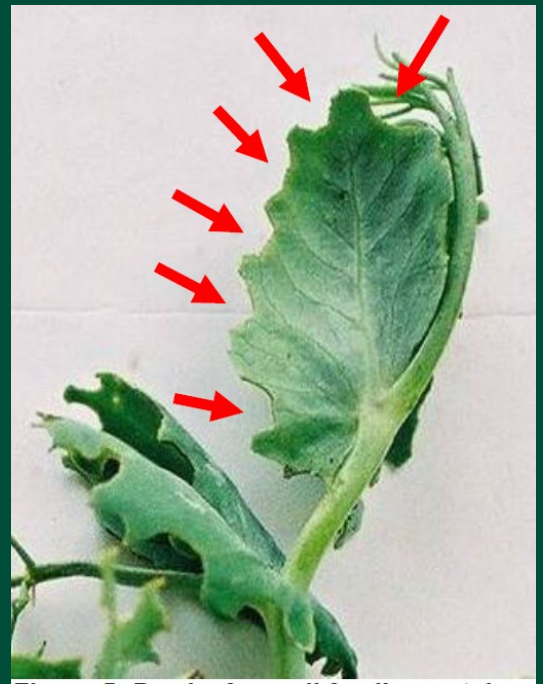


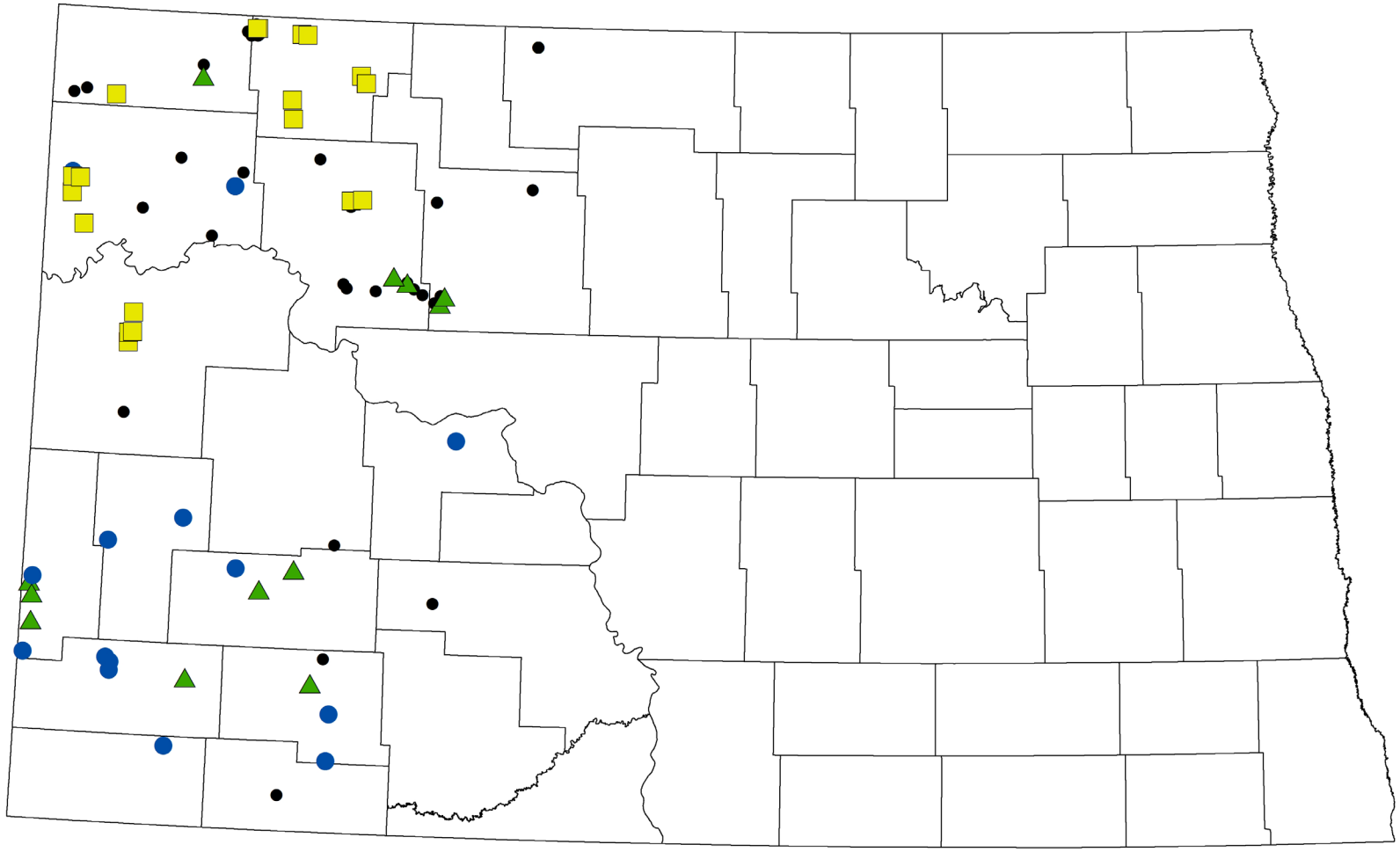
Figure 5: Pea leaf weevil feeding notches on clam leaf (Photo: L. Dosdall).

Figure 9. Larva of pea leaf weevil excised from root nodule. (P. Beauzay, NDSU)

Figure 7. Larva feeding on nitrogen-fixing bacteria within root nodules. (P. Beauzay, NDSU)

Pea Leaf Weevil Distribution in North Dakota, 2017-2019

14 counties positive for pea leaf weevil



Presence of Plant Notching

- Absent
- Present in 2017
- Present in 2018
- Present in 2019

Northern Pulse Growers Association

New Pulse Crop Insect Extension Publications

NDSU Extension Service — EXTENDING KNOWLEDGE » CHANGING LIVES

E1879

Integrated Pest Management of Pea Leaf Weevil in North Dakota

Travis J. Prochaska, Extension Specialist, Crop Protection, North Central Research Extension Center, Minot
Janet J. Knodel, Extension Entomologist, NDSU, Fargo
Patrick B. Beauzay, Research Specialist and State Integrated Pest Management Coordinator, NDSU, Fargo

Pea leaf weevil (PLW) is an invasive insect pest that first was detected in southwestern North Dakota on field peas in Golden Valley County during the fall of 2016. Pea leaf weevil is a significant insect pest of field peas and faba beans, and can reduce yields severely.

Pea leaf weevil. (Photo courtesy of H. Goulet, retired, Agriculture and Agri-Food Canada, Ottawa)

Host Plants

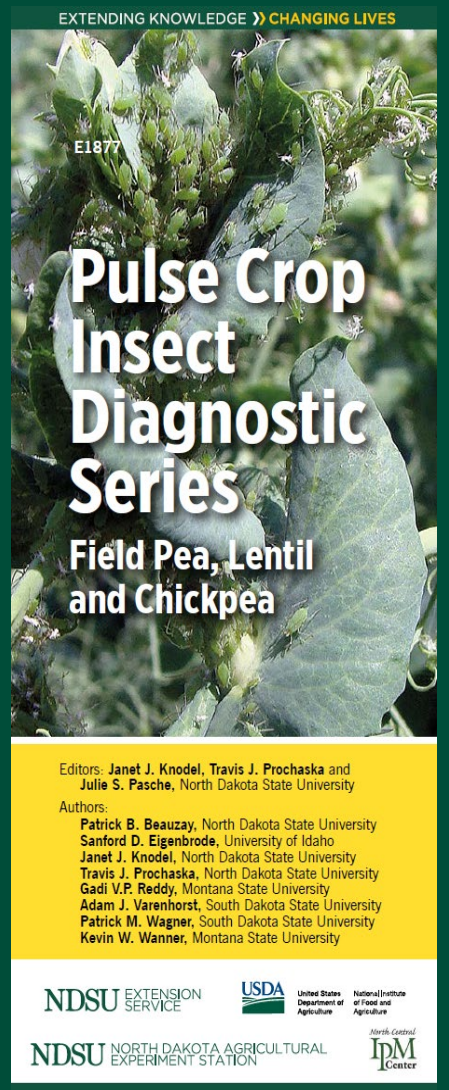
Pea leaf weevil infests cultivated and wild legume species, including field peas, faba beans, alfalfa and dry beans. However, economic damage only occurs on field peas and faba beans. Clover and alfalfa serve as secondary hosts, but larvae do not develop fully on these crops. Pea leaf weevil also feed on foliage of dry bean, lentils, lupins and vetch, but do not cause economic damage. Chickpeas are not known to be a host of PLW.

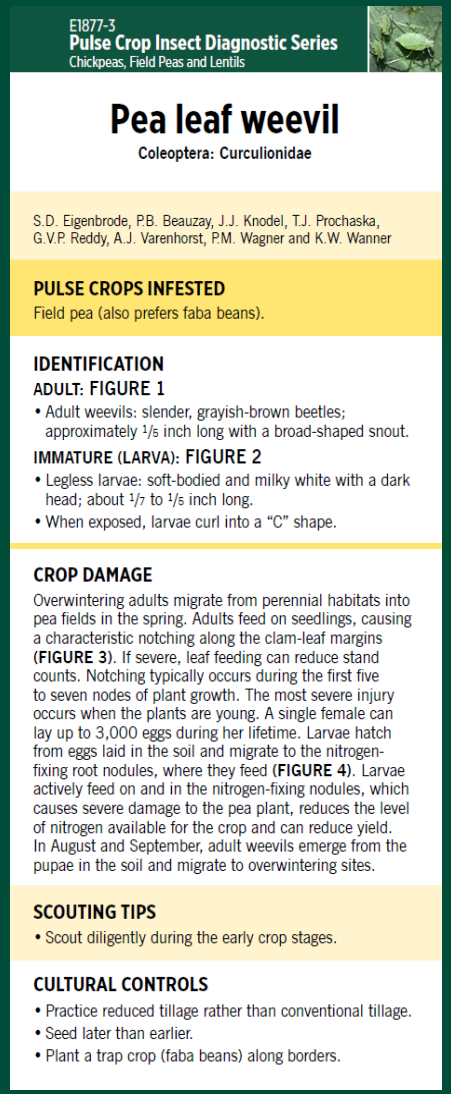
Geographic Range

Pea leaf weevil, a native of Europe and North Africa, first was reported in North America during the 1920s. Since then, it has become an established pest in parts of Florida, Virginia, Texas, the Pacific Northwest (Idaho, Washington), Montana and Canada (British Columbia, Alberta and Saskatchewan).

In the last decade, PLW populations have been moving eastward, affecting increasing field pea acreage. In North Dakota, NDSU Extension entomologists confirmed PLW in 2016 and 2017 in the following areas: southwest (Dunn, Golden Valley and Stark counties), north-central (Mountrail and Ward counties) and northwest (Divide County). If any pulse growers suspect PLW populations, they should report observations to their local Extension agents or NDSU Extension entomology specialists.

NDSU EXTENSION SERVICE
North Dakota State University
April 2018





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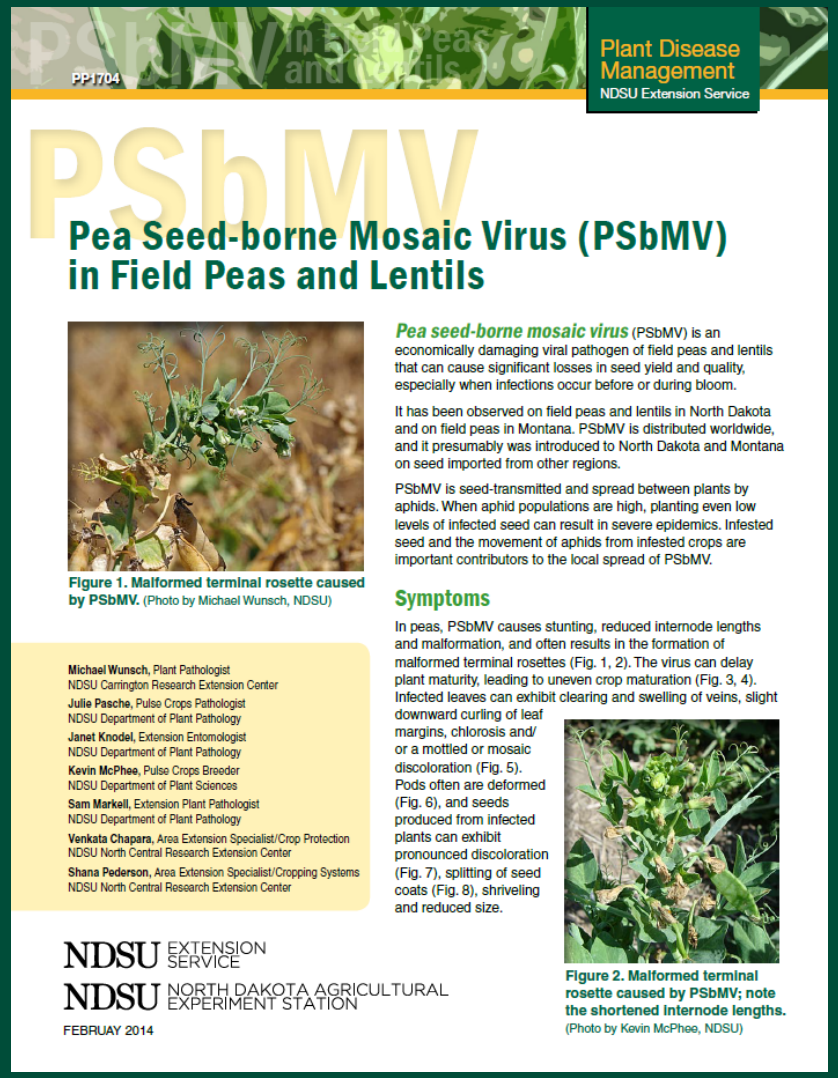
New Pulse Crop Extension Publications



PP1704

Plant Disease Management
NDSU Extension Service

PSbMV

Pea Seed-borne Mosaic Virus (PSbMV) in Field Peas and Lentils

Michael Wunsch, Plant Pathologist
NDSU Carrington Research Extension Center

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NDSU Department of Plant Pathology

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Shana Pederson, Area Extension Specialist/Cropping Systems
NDSU North Central Research Extension Center

Figure 1. Malformed terminal rosette caused by PSbMV. (Photo by Michael Wunsch, NDSU)

Pea seed-borne mosaic virus (PSbMV) is an economically damaging viral pathogen of field peas and lentils that can cause significant losses in seed yield and quality, especially when infections occur before or during bloom.

It has been observed on field peas and lentils in North Dakota and on field peas in Montana. PSbMV is distributed worldwide, and it presumably was introduced to North Dakota and Montana on seed imported from other regions.

PSbMV is seed-transmitted and spread between plants by aphids. When aphid populations are high, planting even low levels of infected seed can result in severe epidemics. Infested seed and the movement of aphids from infested crops are important contributors to the local spread of PSbMV.

Symptoms

In peas, PSbMV causes stunting, reduced internode lengths and malformation, and often results in the formation of malformed terminal rosettes (Fig. 1, 2). The virus can delay plant maturity, leading to uneven crop maturation (Fig. 3, 4). Infected leaves can exhibit clearing and swelling of veins, slight downward curling of leaf margins, chlorosis and/or a mottled or mosaic discoloration (Fig. 5). Pods often are deformed (Fig. 6), and seeds produced from infected plants can exhibit pronounced discoloration (Fig. 7), splitting of seed coats (Fig. 8), shriveling and reduced size.

Figure 2. Malformed terminal rosette caused by PSbMV; note the shortened internode lengths. (Photo by Kevin McPhee, NDSU)

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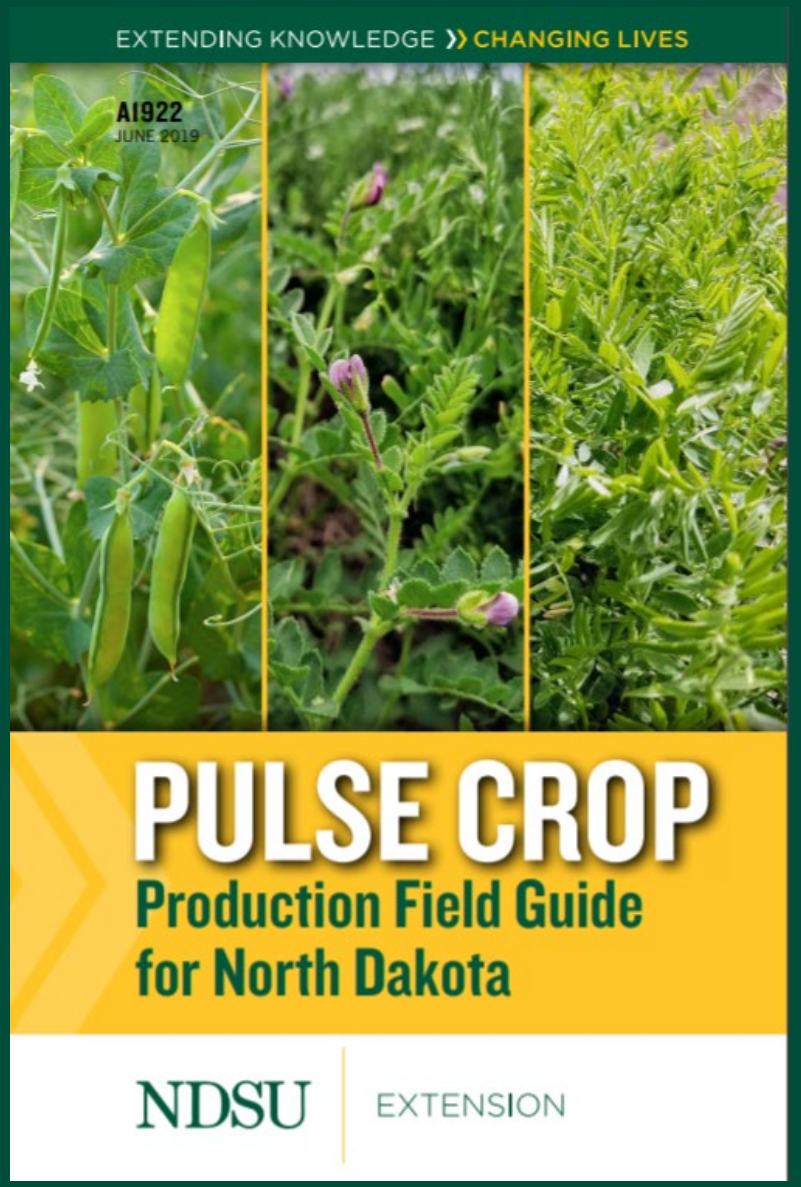
NDSU NORTH DAKOTA AGRICULTURAL EXPERIMENT STATION
FEBRUAY 2014



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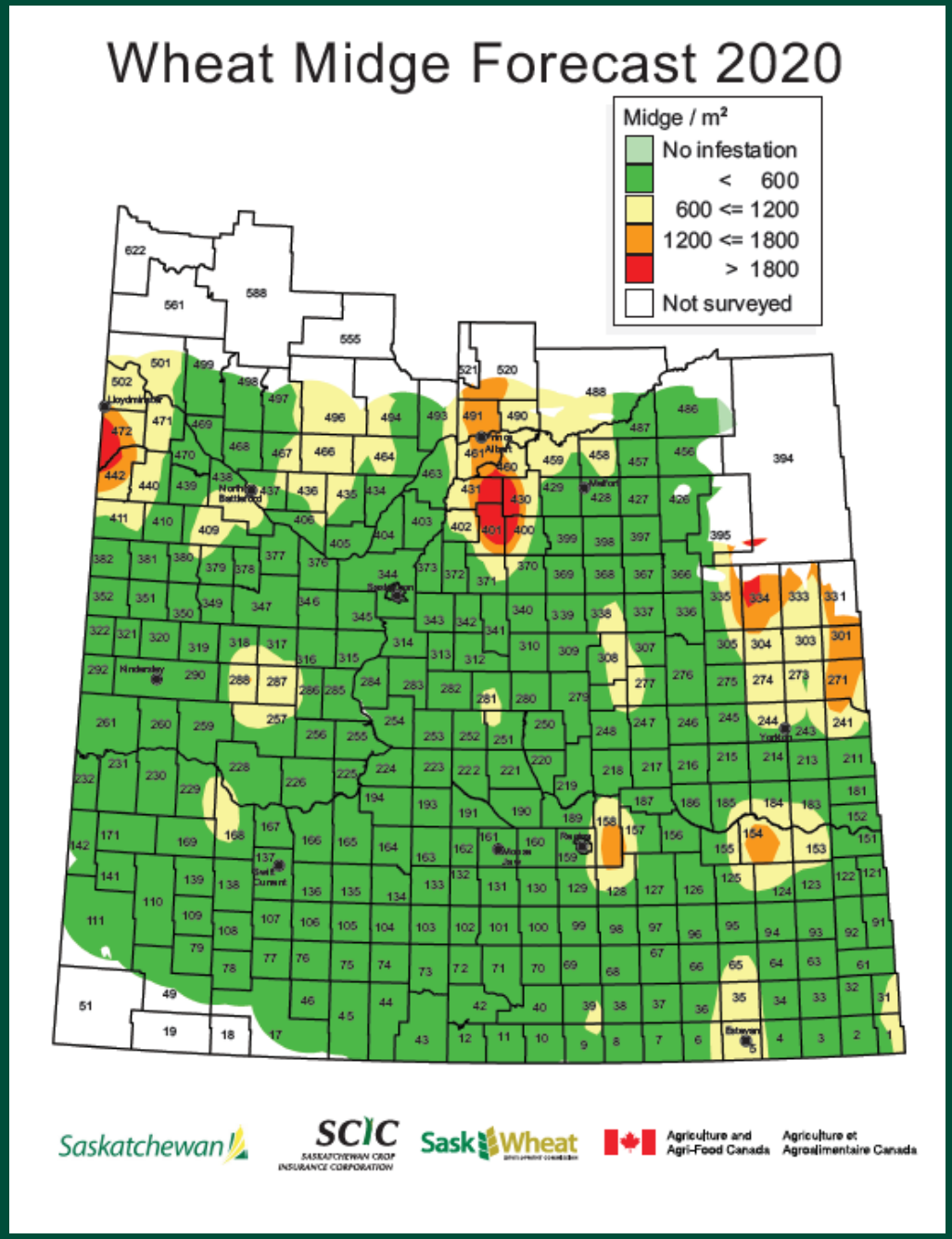
Thank you!

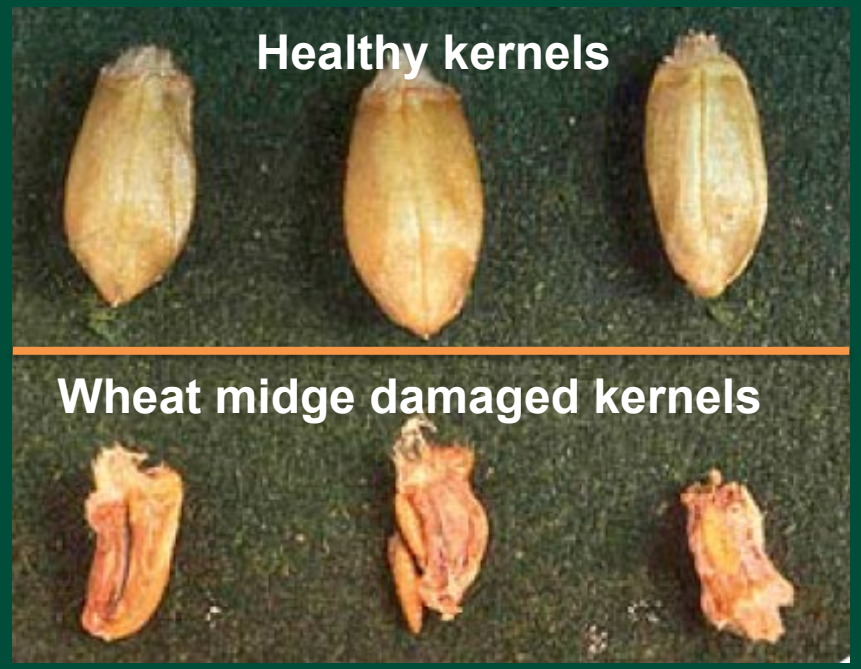
Northern Pulse Growers Association

Wheat Midge


Wheat Midge Forecast 2020
Midge / m²
No infestation
< 600
600 <= 1200
1200 <= 1800
> 1800
Not surveyed
Saskatchewan
SCIC
SASKATCHEWAN CROP INSURANCE CORPORATION
SaskWheat
Agriculture and Agri-Food Canada
Agriculture et Agroalimentaire Canada

Crop Damage from Wheat Midge

- Estimate losses of $3 million per year without IPM



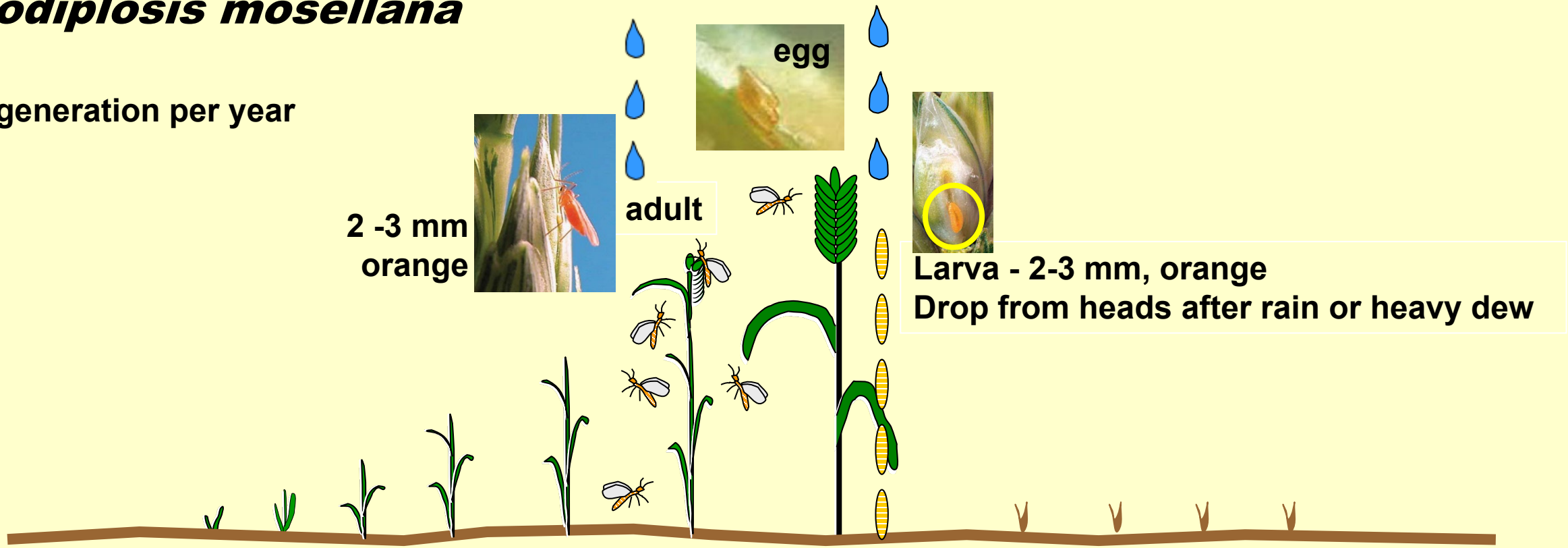
Saskatoon Research Centre, Canada

- Lower yields
- Reduced grain quality
- Vectors *Fusarium* head blight (scab)

Life Cycle of Orange Wheat Blossom Midge

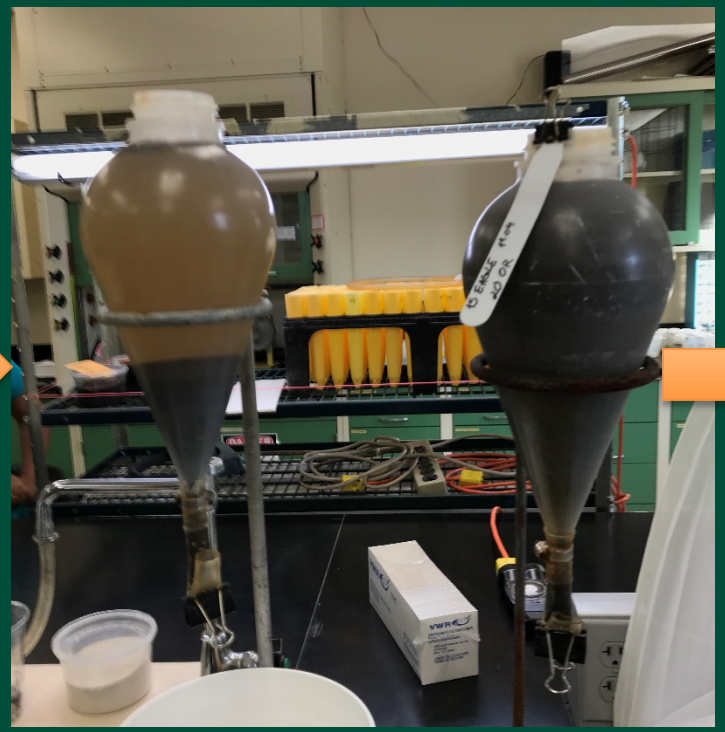
Sitodiplosis mosellana

One generation per year



Extraction of Wheat Midge Larvae in Soil

Washing soil and collecting organic matter in sieves

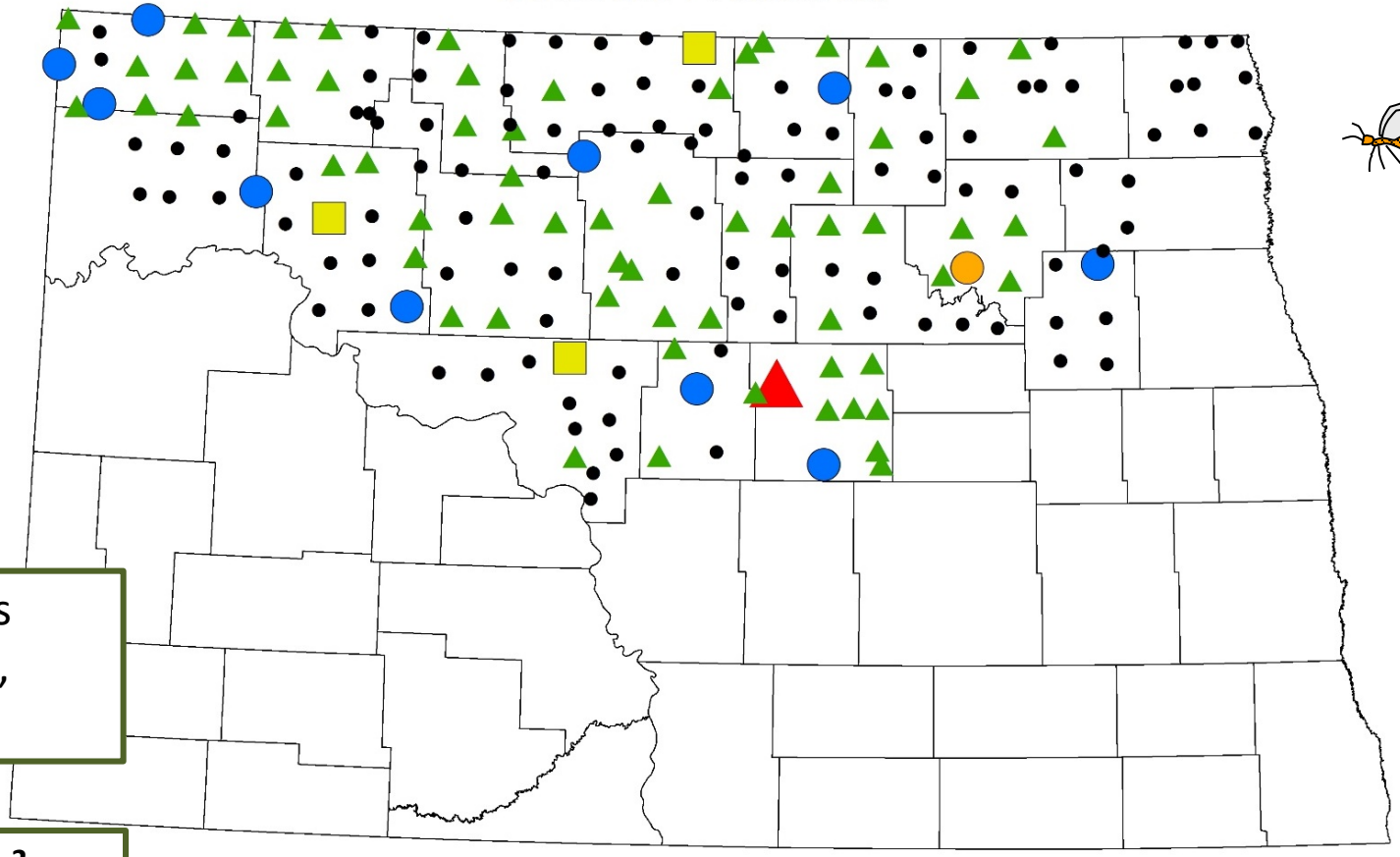


Saline floatation

Examining organic matter for cocoons

2019 Wheat Midge Larval Survey

North Dakota



High Risk: Ramsey & Wells
Moderate Risk: Bottineau, Mountrail & McLean

0 – 1,357 midge larvae / m²
Average = 79 midge larvae / m²
58% of samples were 0!

NORTH DAKOTA WHEAT COMMISSION

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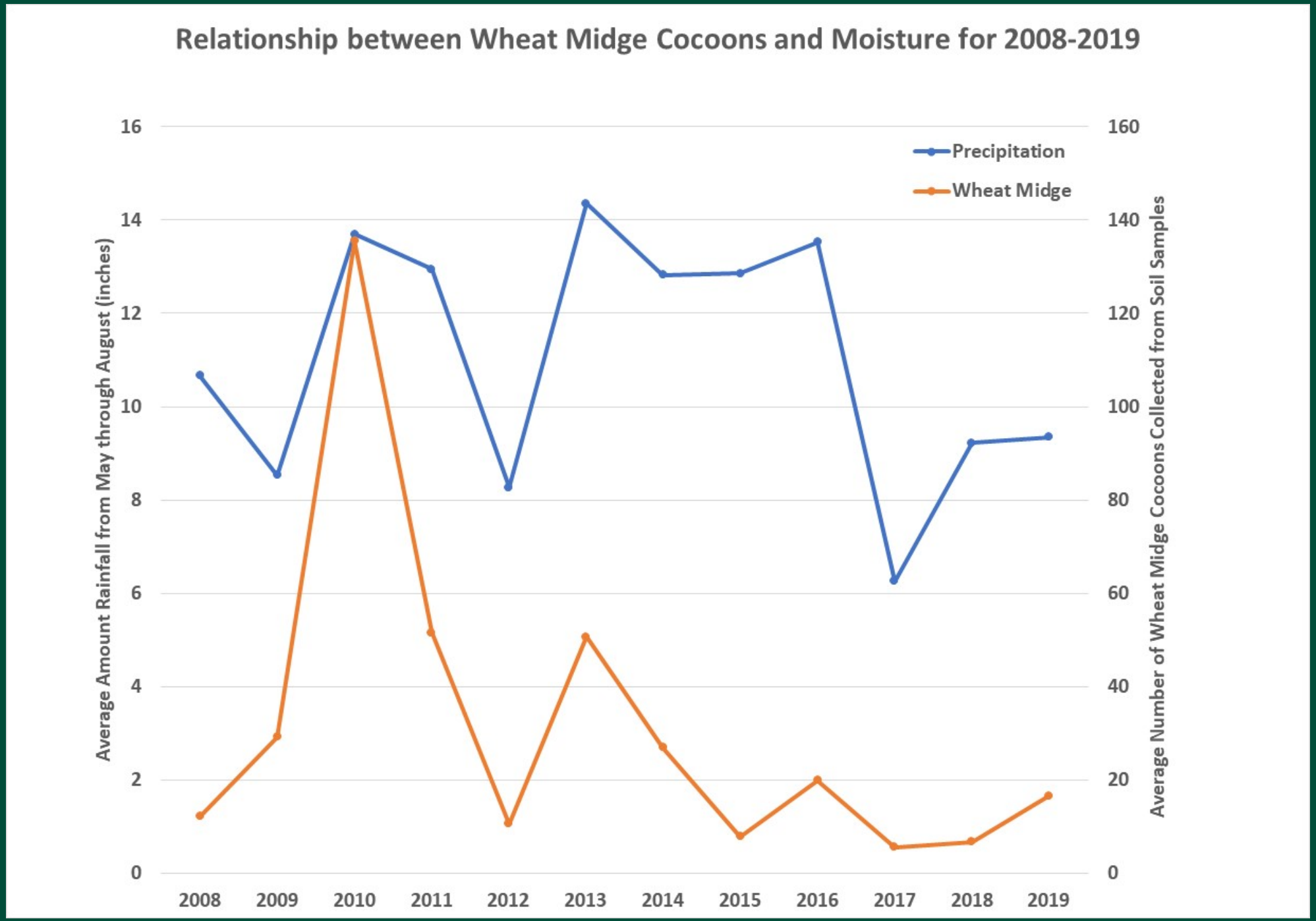
Canada:
25 mm of precipitation prior to the end of May is required for proper development of wheat midge

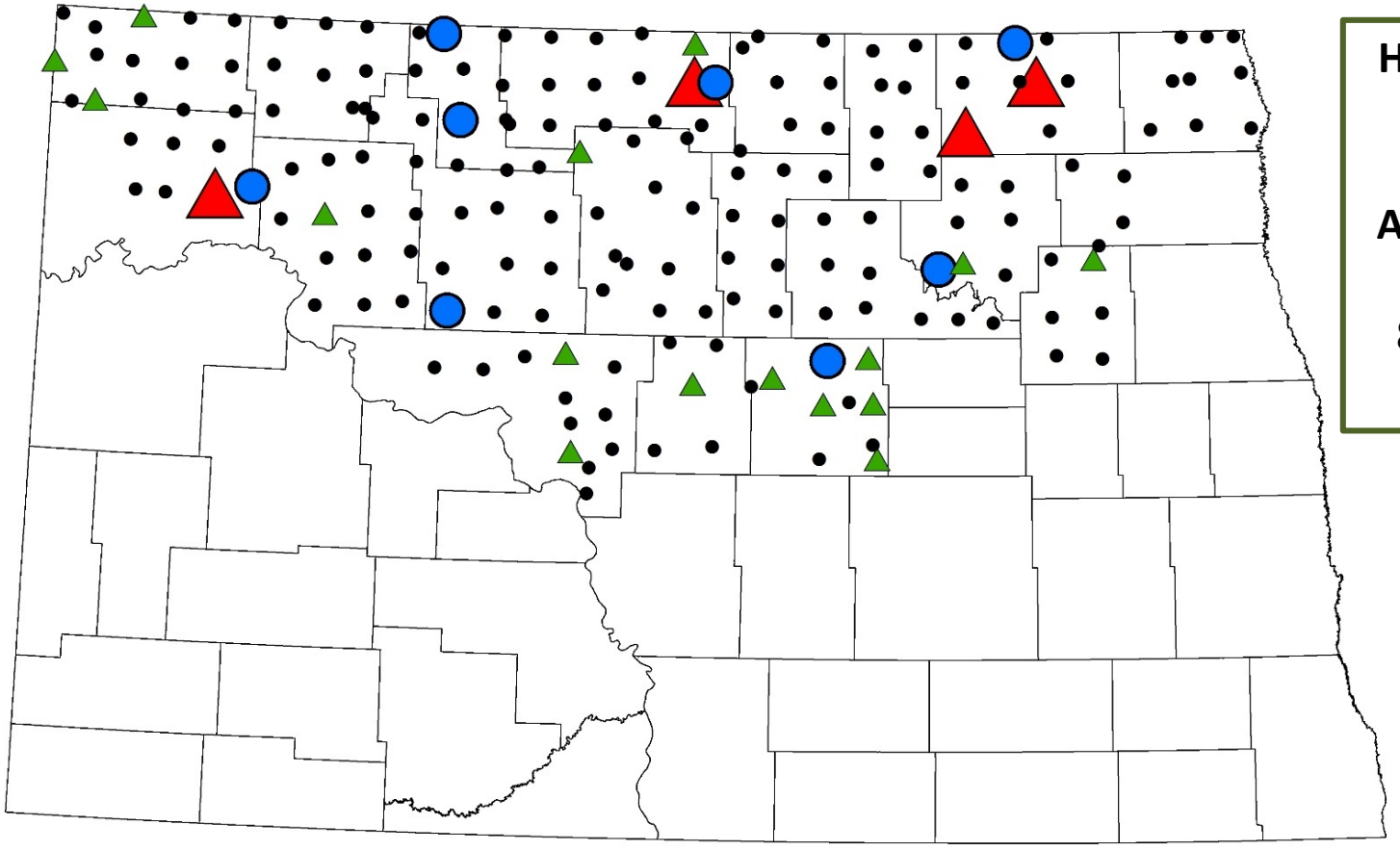
Elliott et al. 2009 Crop Protection 28: 588-594



Macroglenes penetrans
egg-larval parasite
of the Wheat Midge

2019 Wheat Midge Larval Survey

Percent Parasitism
North Dakota



Percent parasitized midge larvae

0 | 1-25 | 26-50 | 51-75 | 76-100

Highest Parasitism rate in Bottineau, Williams, & Cavalier counties
Average = 36% parasitism rate
85% of samples had 0% parasitism

NORTH DAKOTA WHEAT COMMISSION

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Other Areas of Interest

- Soybean aphids – Pyrethroid Resistance
- Soybean gall midge (*Resseliella maxima*) – Invasive insect pest of soybeans (not in ND)
- Corn – Corn rootworm & European corn borer monitoring network, Bt resistance
- Pollinator (bees & syrphids) work in field crops and perennial flowers
- IPM Survey for insect pests & diseases in wheat, barley, soybeans and sunflowers

Bee Count Summary in Soybean 2014 and 2016 Combined

Family	No. of Genera	No. of Species	No. of Individuals	Percent
Andrenidae	4	7	13	0.1
Megachilidae	2	8	19	0.2
Colletidae	2	5	29	0.3
Apidae	11	31	998	9.2
Halictidae	8	57	9,763	90.2
Total	**27**	**108**	**10,822**	**100**

NDSU Extension *Crop & Pest Report*

www.ag.ndsu.edu/cpr/

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