Flea Beetle Insecticide Resistance & Midge Trap Survey in Canola

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Northern Canola Growers Association

15th Annual Canola Research Conference

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Flea Beetles of Canola (*Brassica napus* L.)

- Flea beetles are an early season pest.

- >90% of canola uses an insecticidal seed treatment as the primary control against flea beetles.

Canola

Insecticide Recommendations

Registered Insecticides - 2022

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

Butenolides (Group 4D):

Flupyradifurone – Buteo Start

Always Read and Follow Labels.

Striped flea beetle
Phyllotreta striolata

Crucifer flea beetle
Phyllotreta cruciferae

LIFE CYCLE

Westdal & Romanow 1972

Overwintering Adults

WINTER-JUNE

Adult

MAY-JUNE

Egg

JUNE-JULY

Larva

JULY-AUGUST

Pupa

Summer Adults (new generation)

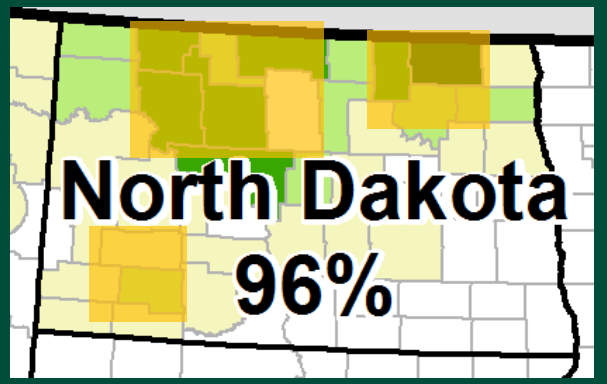
JULY-OCTOBER

Adult

Objectives

- ✔ Determine efficacy of current insecticide seed treatments for control of spring and summer populations of *P. cruciferae* originating from three geographic canola production areas of ND.

- ✔ Compare efficacy of seed treatments between *P. cruciferae* and *P. striolata*.



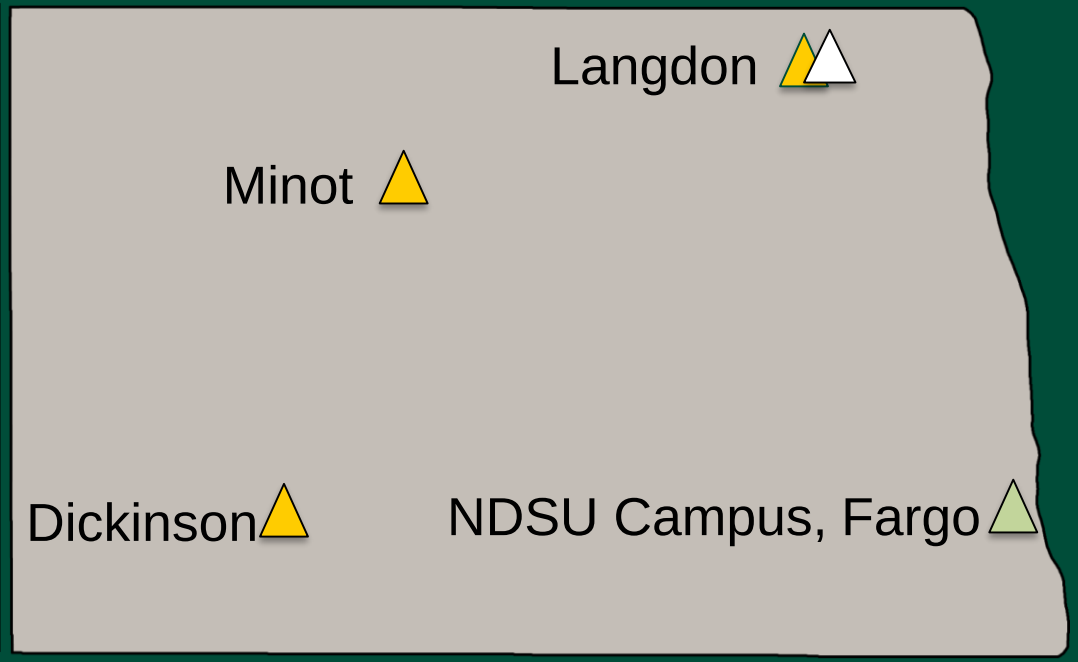
Three geographic canola growing regions (USDA NASS)

Lesley Lubenow's Ph.D. project

MATERIALS AND METHODS

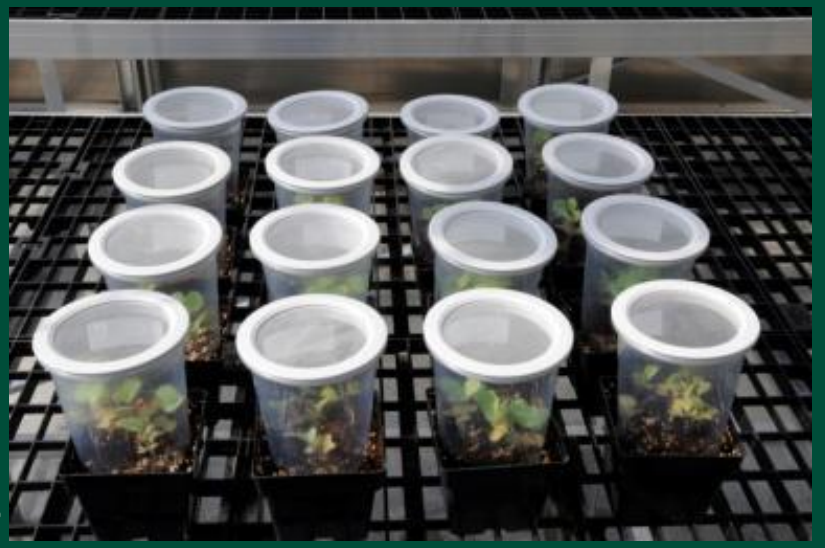
Wild Flea Beetle Collection 2021

▲ *P. cruciferae* (CFB) lured with allyl isothiocyanate



▲ *P. striolata* (SFB) lured with a hydroxyketone aggregation pheromone, racemic 10-hydroxyhimachalan-9-one (USDA-ARS, Beltsville MD)

Experimental Design: Bioassay



RCBD with factorial arrangement

- 6 reps, ran twice
- Days after planting (DAP) infestation timing
  - 7 DAP and 14 DAP

Canola Seed Treatment

- Clothianidin (Prosper FX), 200.8 g ai per 100 kg seed
- Thiamethoxam (Helix XTra), 400 g ai per 100 kg rate
- Cyantraniliprole (Lumiderm), 1000 g ai per 100 kg seed
- Untreated check

Experimental Design: Bioassay

- 10 flea beetles were introduced on 5 plants per cup.
- Conducted live counts and feeding injury ratings at 3, 7 and 10 days after infestation.

Experimental Design: Bioassay

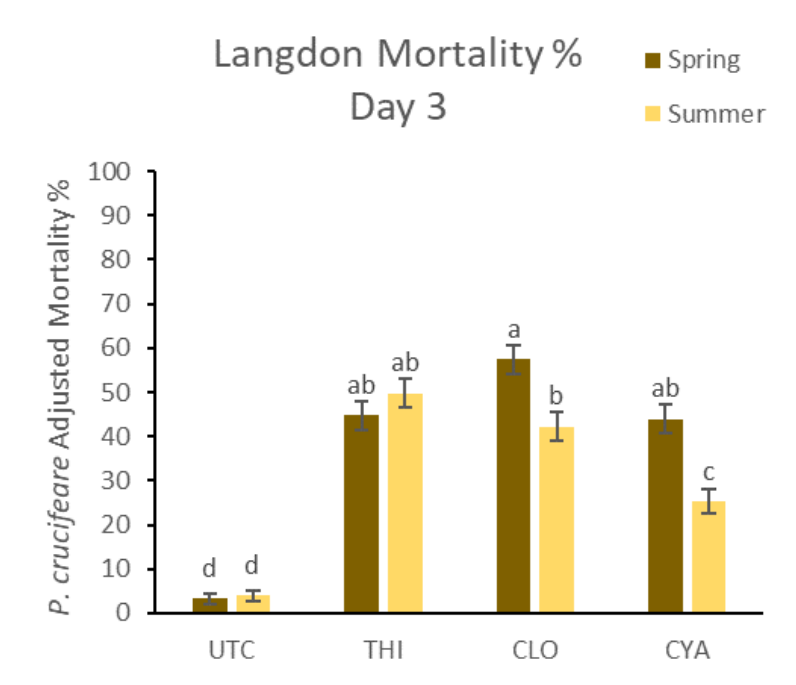
- Feeding injury score was rated on a 0-6 scale based on cotyledon pitting feeding injury (Knodel et al. 2008).

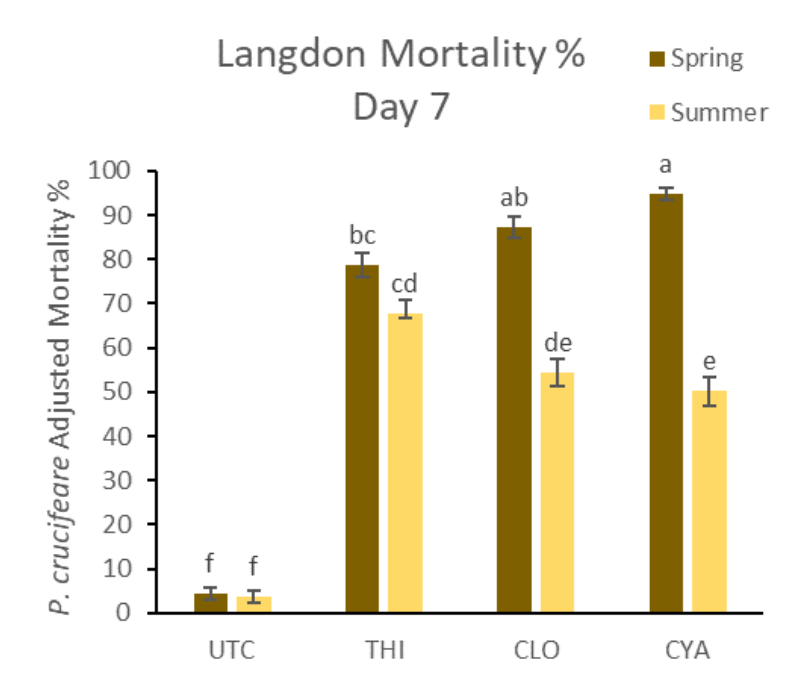
0 = 0 pits
1 = 1-3 pits
2 = 4-9 pits
3 = 10-15 pits
4 = 16-25 pits
5 = >25 pits
6 = Plant death

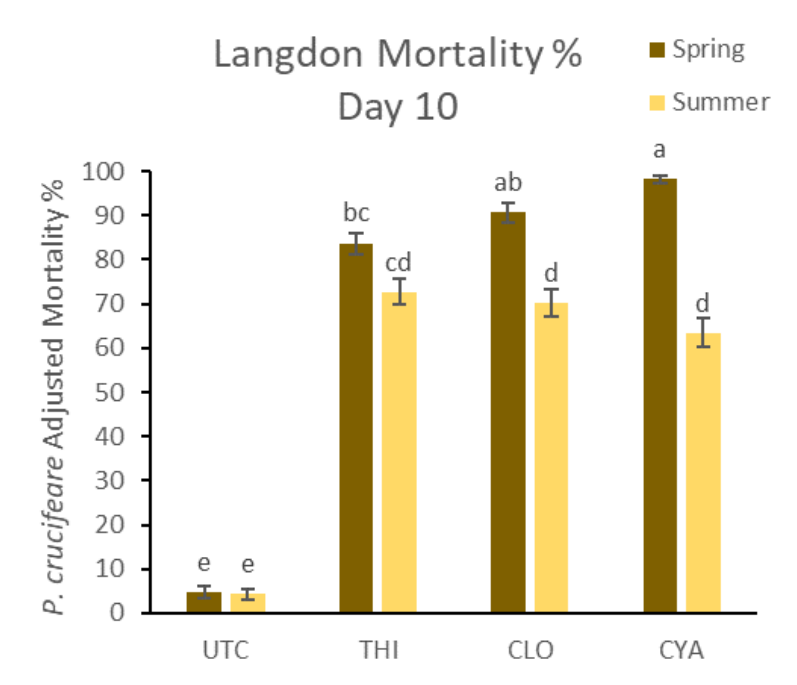
RESULTS

P. cruciferae LOCATION EXPERIMENT

Langdon averaged across DAP







CLO = clothianidin, CYA = cyantraniliprole, THI = thiamethoxam, UTC = untreated control

PROC GLIMMIX, LS MEANS, α = 0.05, df 3, 165, Day 3 P =0.0007, Day 7 & 10 P <0.0001

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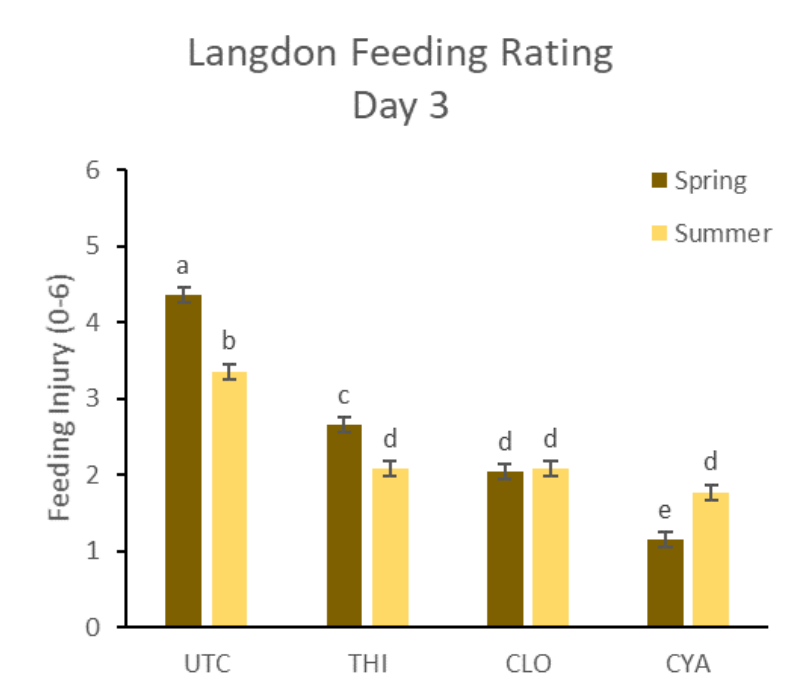
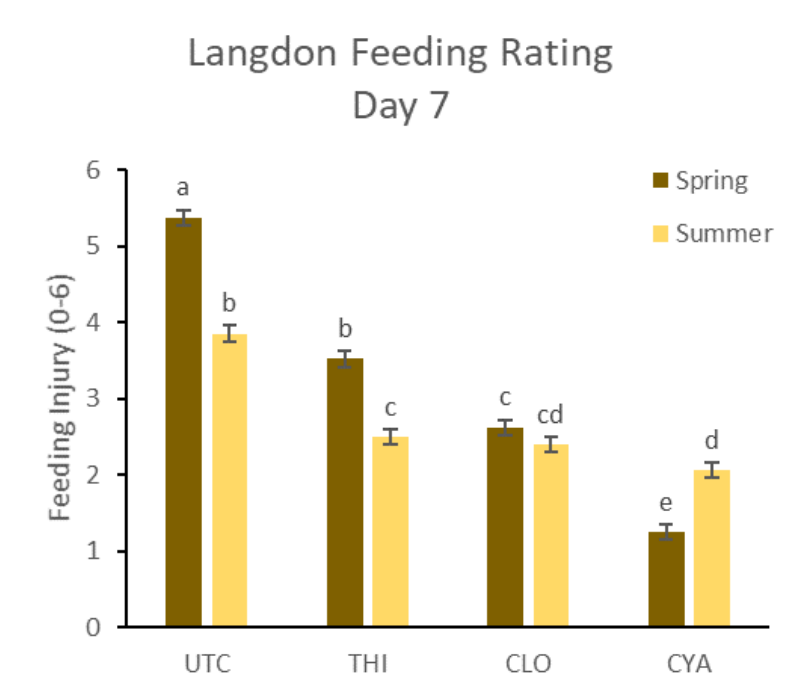
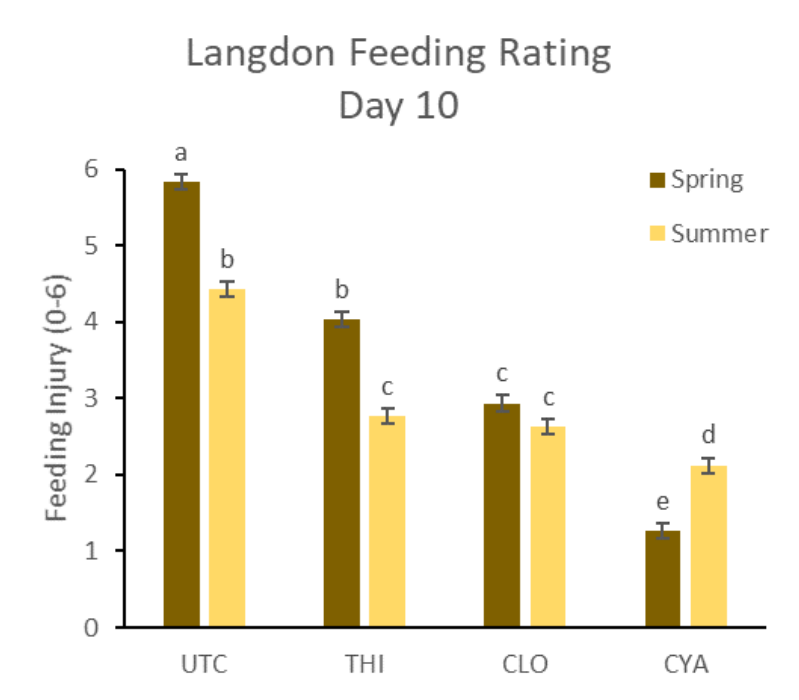
P. cruciferae LOCATION EXPERIMENT

Langdon averaged across DAP







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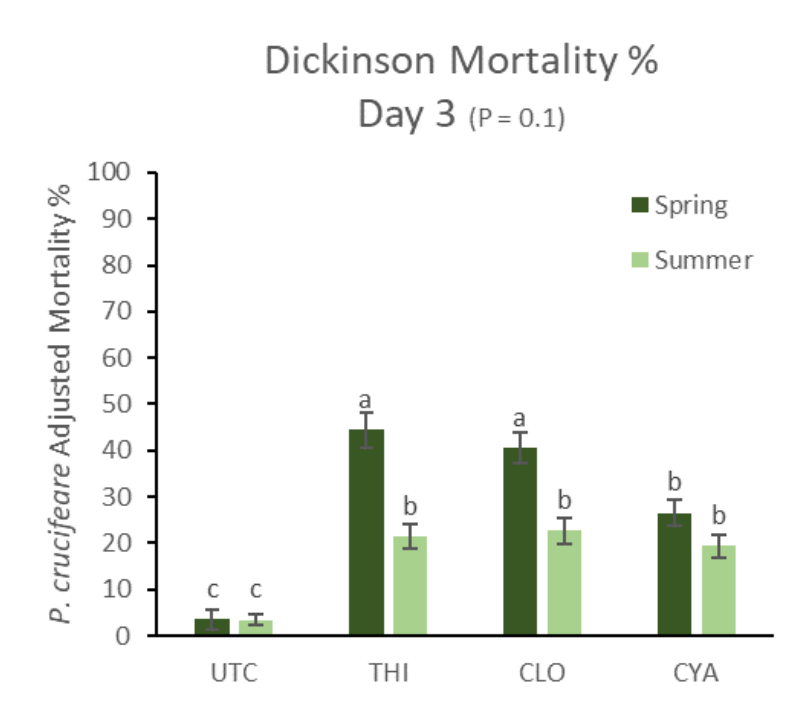
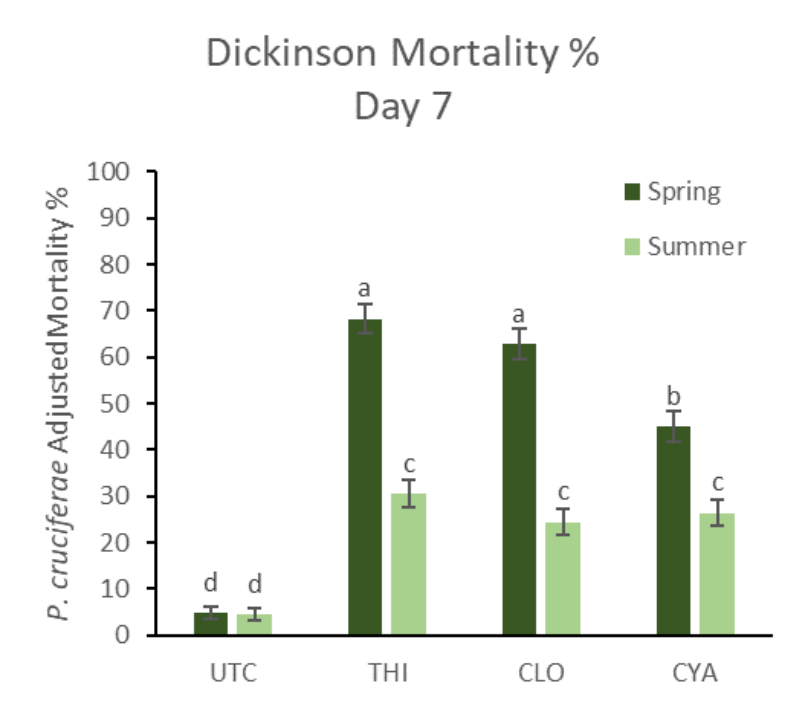
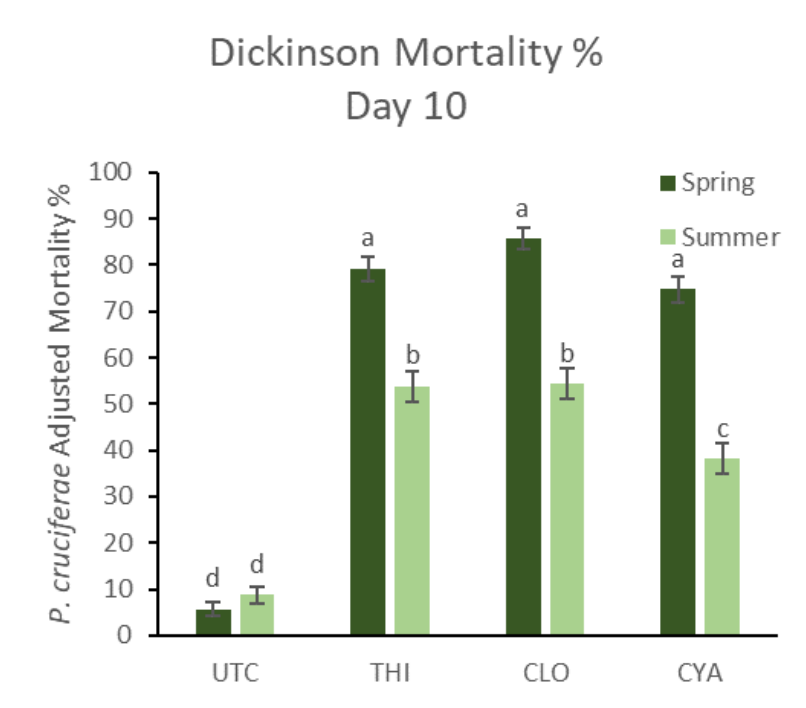
P. cruciferae LOCATION EXPERIMENT

Dickinson averaged across DAP







CLO = clothianidin, CYA = cyantraniliprole, THI = thiamethoxam, UTC = untreated control

PROC GLIMMIX, LS MEANS, α = 0.10, df 3, 165, Day 3 P = 0.0687

PROC GLIMMIX, LS MEANS, α = 0.05, df 3, 165, Day 7 P=0.005, Day 10 P <0.0001

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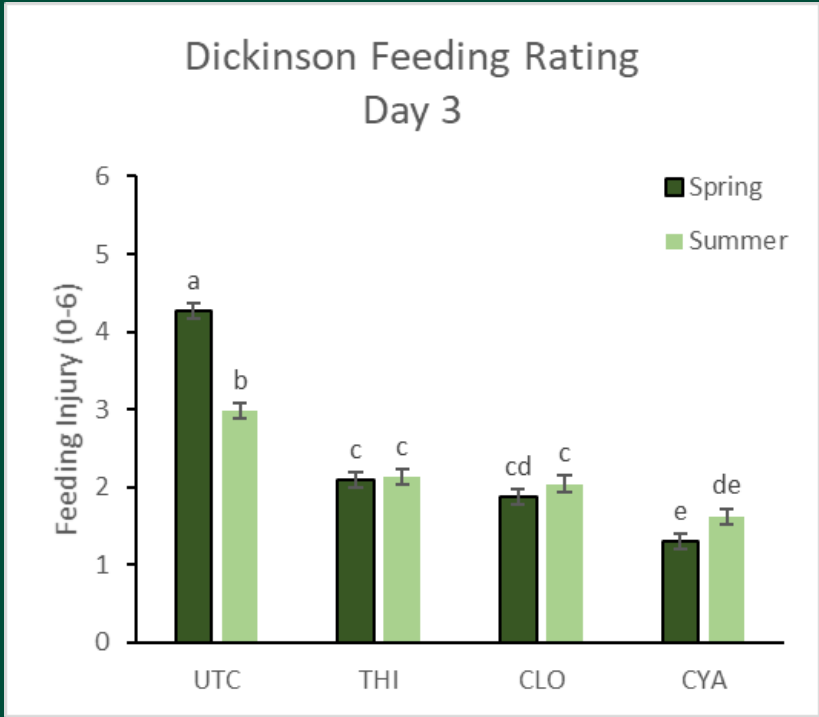
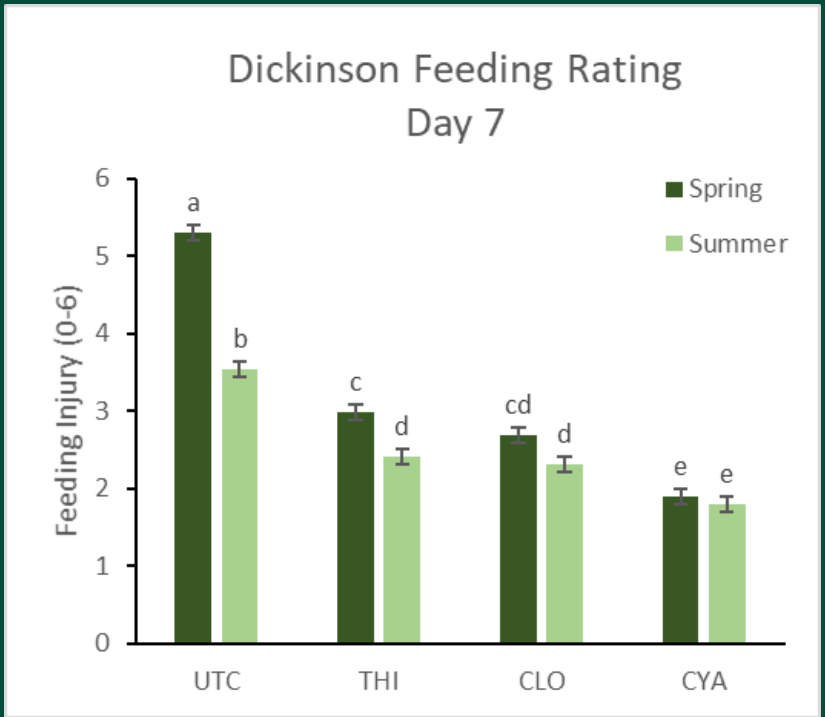
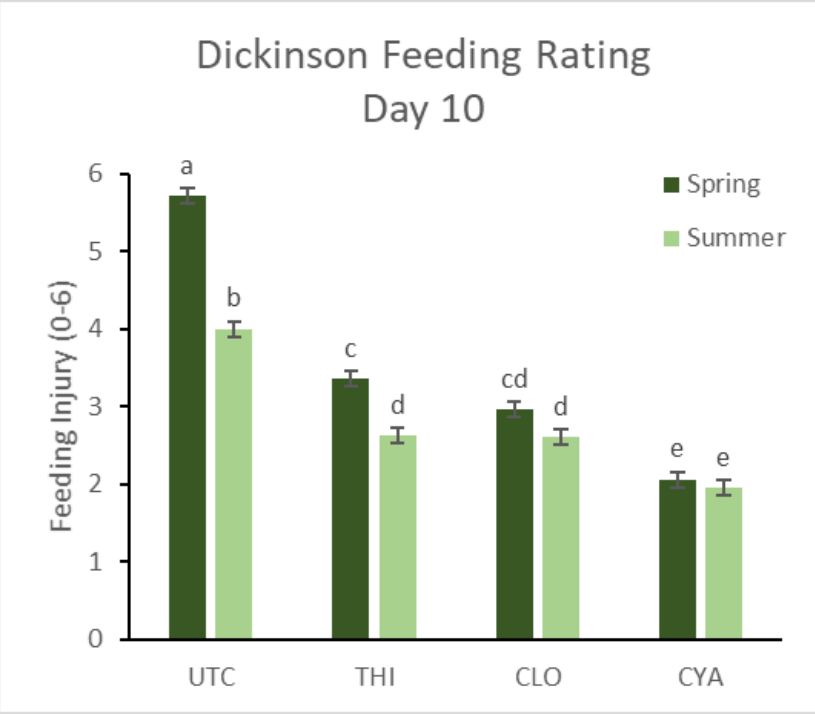
P. cruciferae LOCATION EXPERIMENT

Dickinson averaged across DAP







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PROC GLIMMIX, LS MEANS, α = 0.05, df 3, 165, Day 3, 7 & 10 P <0.0001

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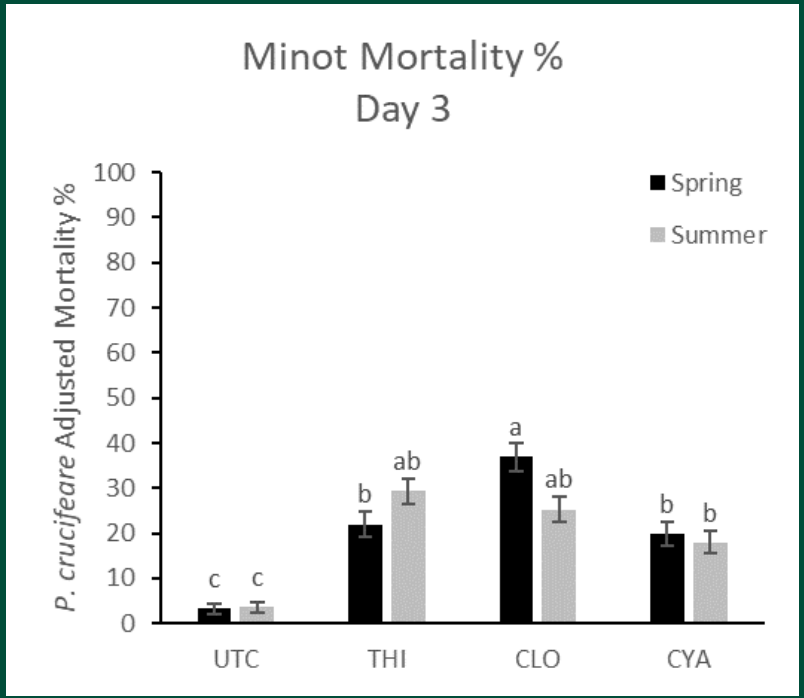
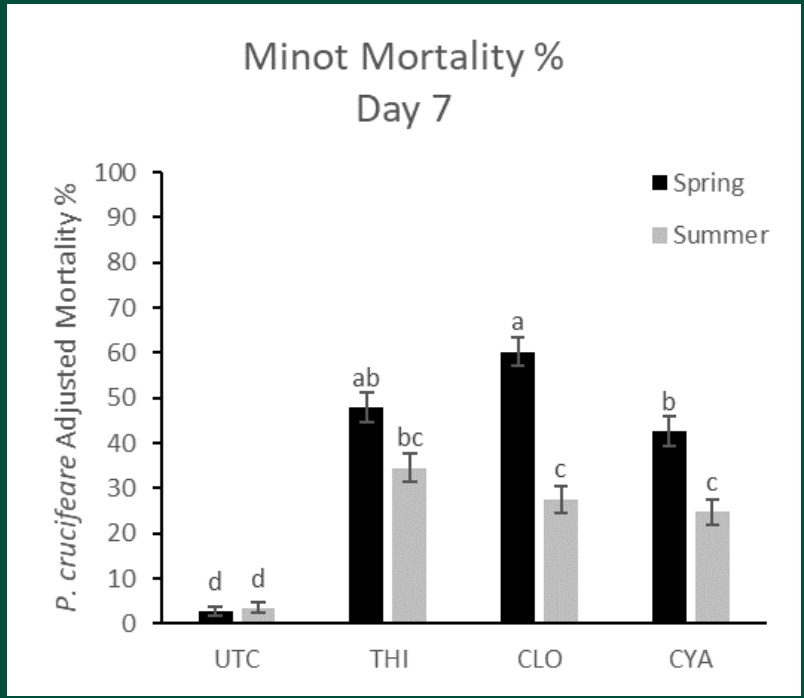
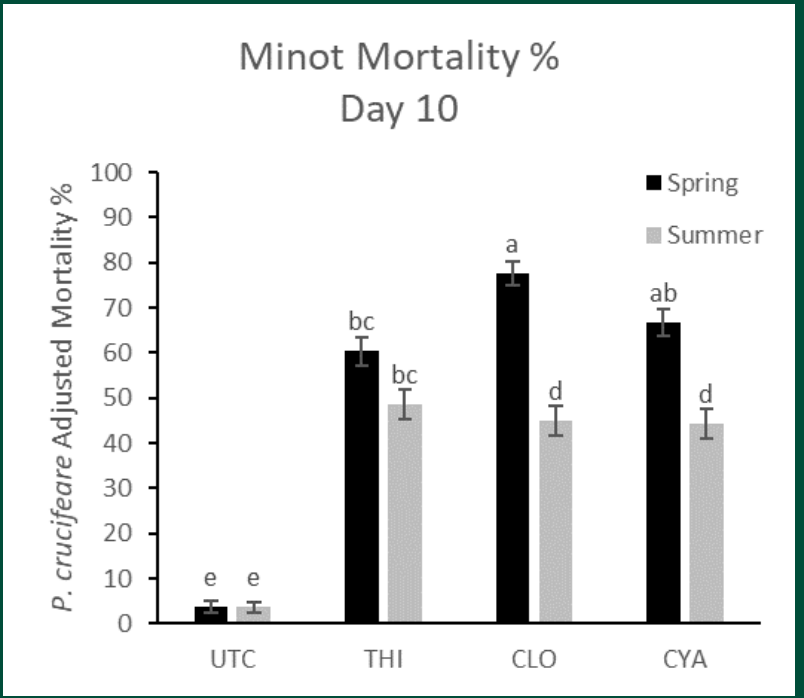
P. cruciferae LOCATION EXPERIMENT

Minot averaged across DAP





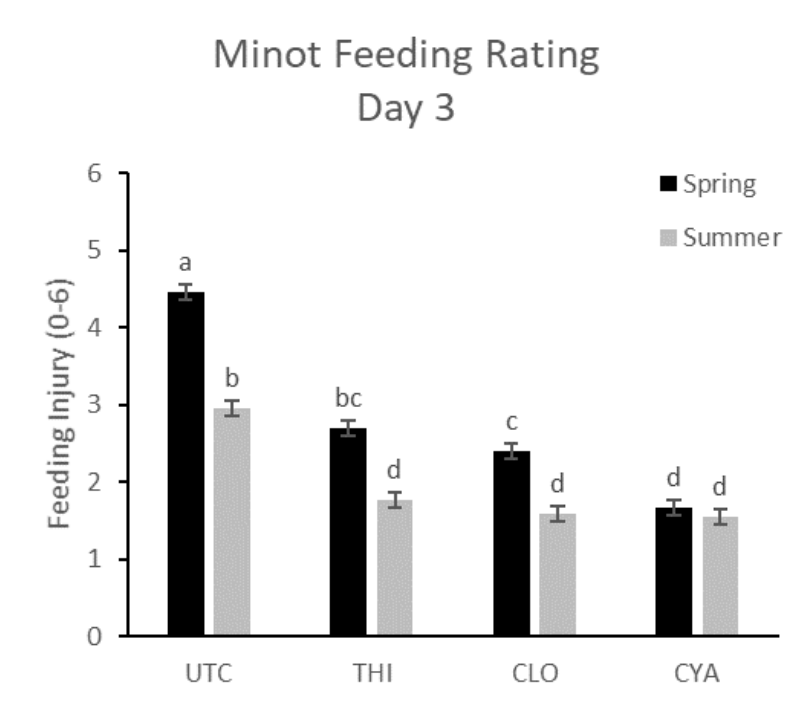


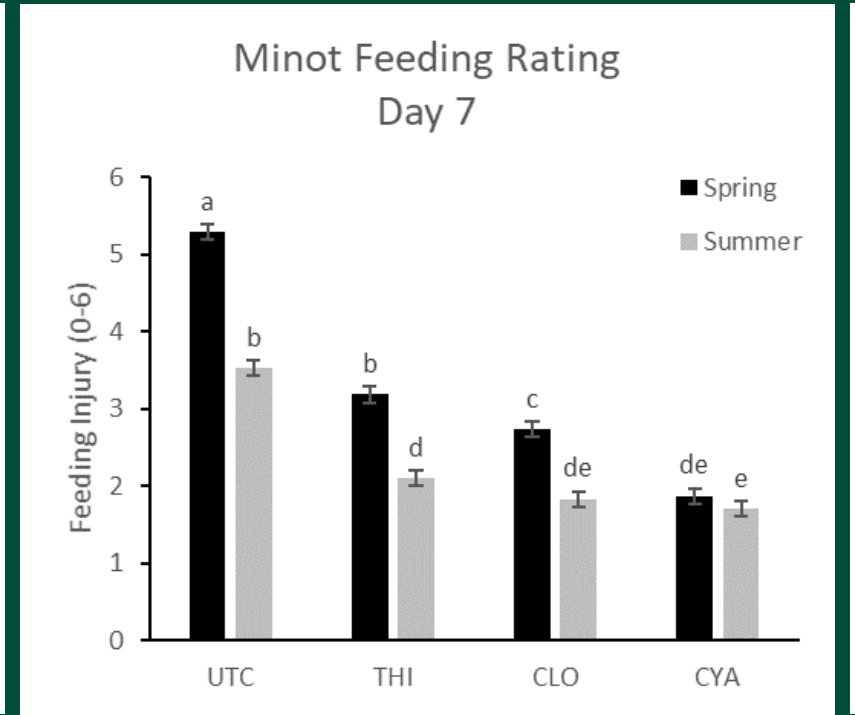
CLO = clothianidin, CYA = cyantraniliprole, THI = thiamethoxam, UTC = untreated control

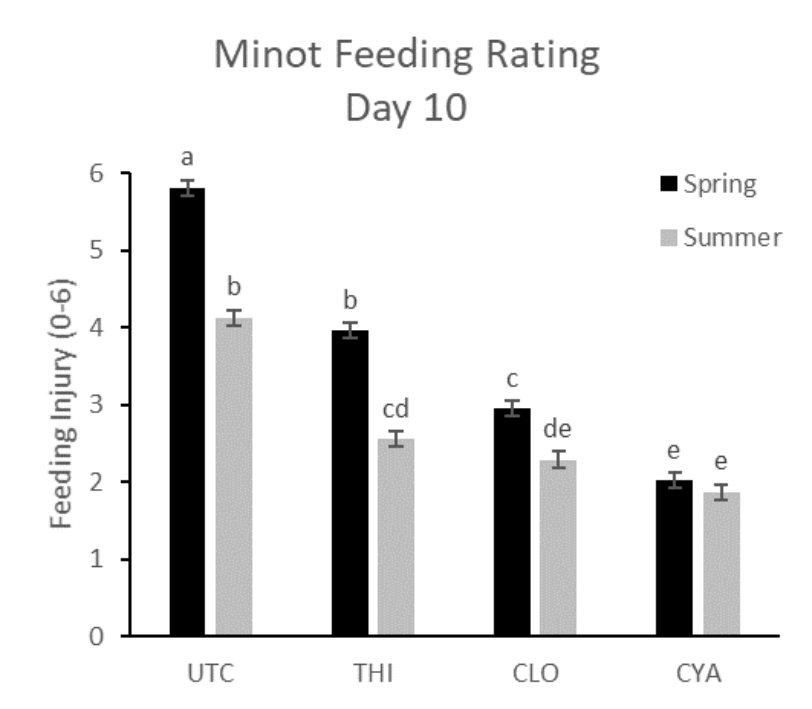
PROC GLIMMIX, LS MEANS, α = 0.05, df 3, 165, Day 3 P =0.0185, Day 7 P =0.0038, Day 10 P =0.0017

P. cruciferae LOCATION EXPERIMENT

Minot averaged across DAP







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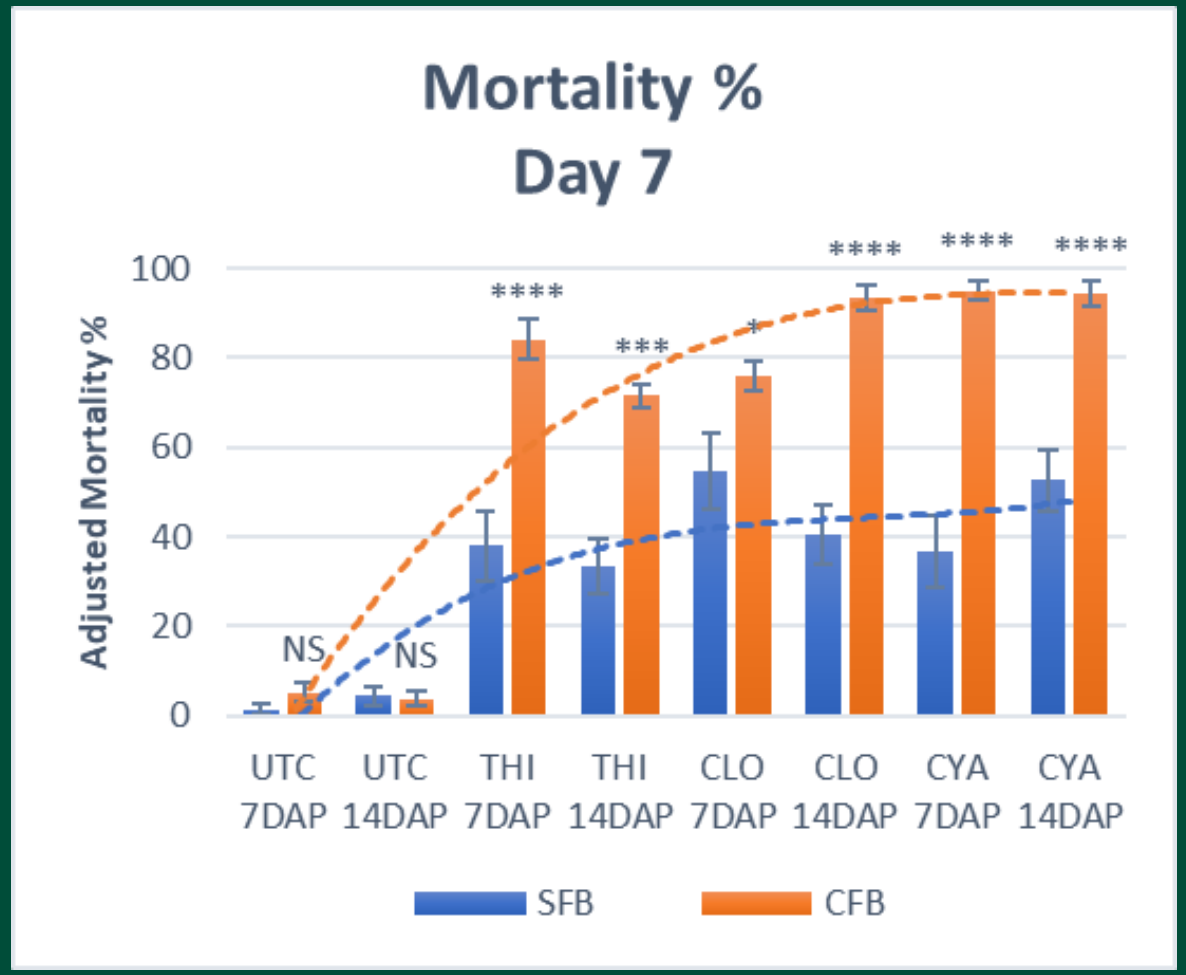
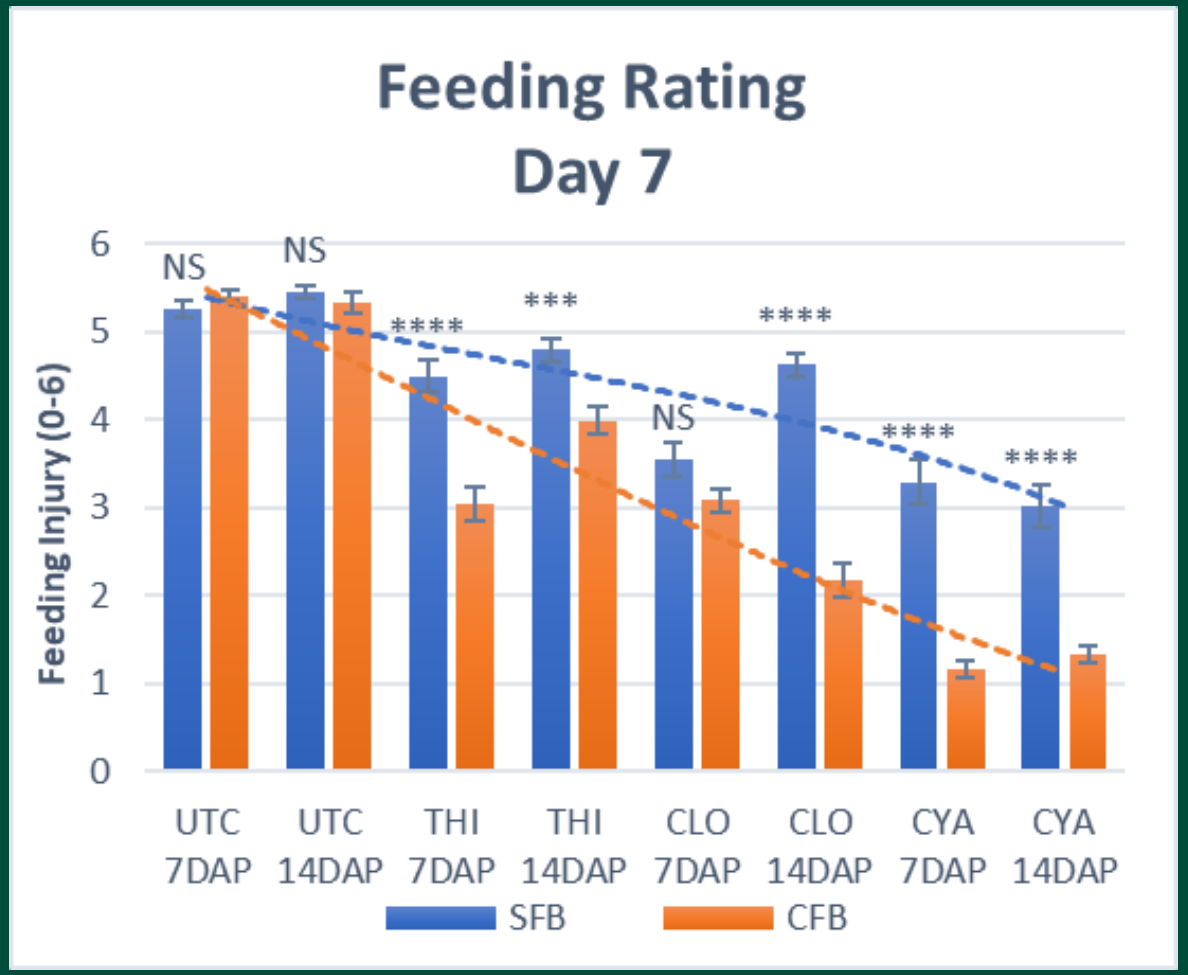
PROC GLIMMIX, LS MEANS, α = 0.05, df 3, 165, Day 3, 7 & 10 P <0.0001

Crucifer FB versus Striped FB – Day 7



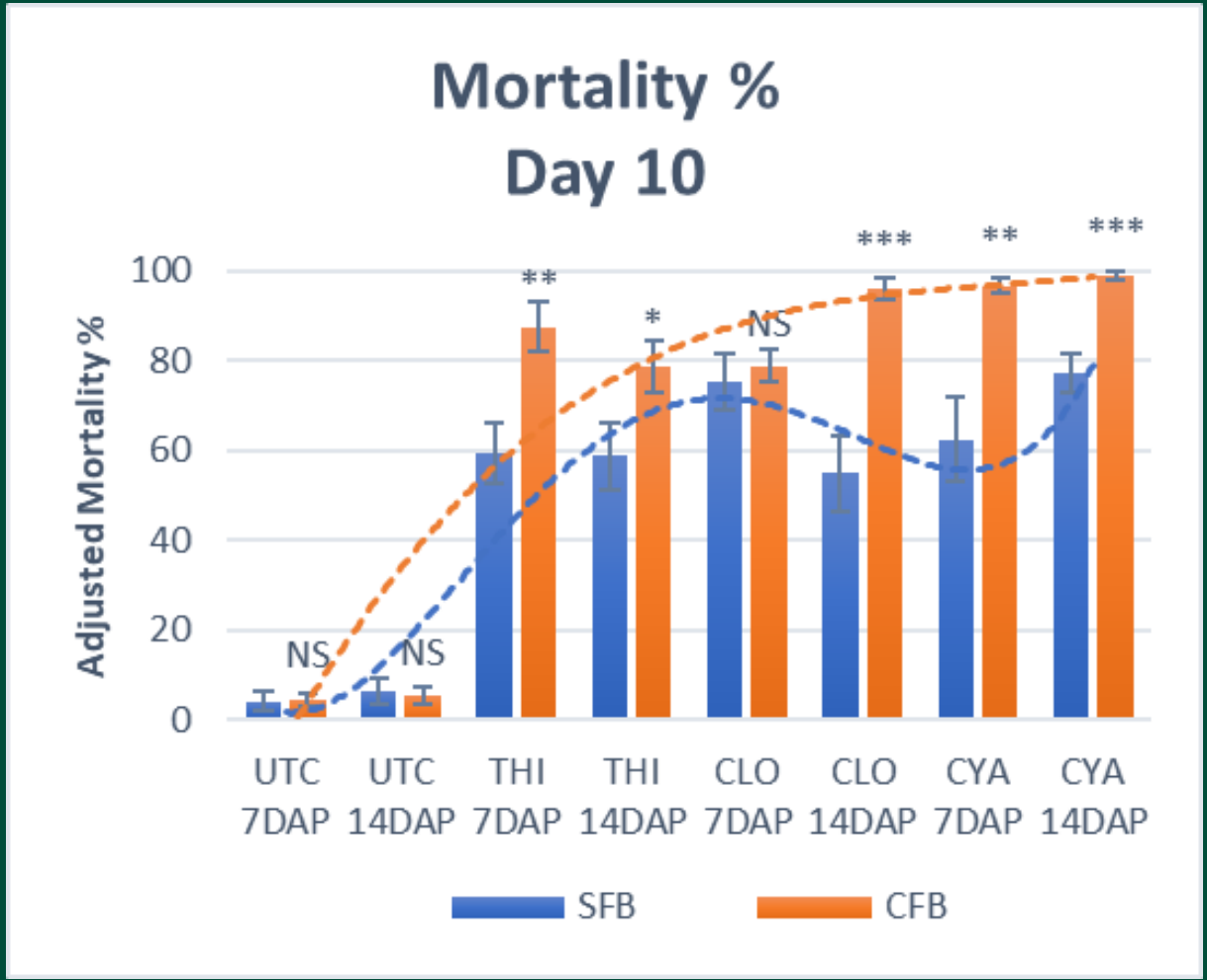


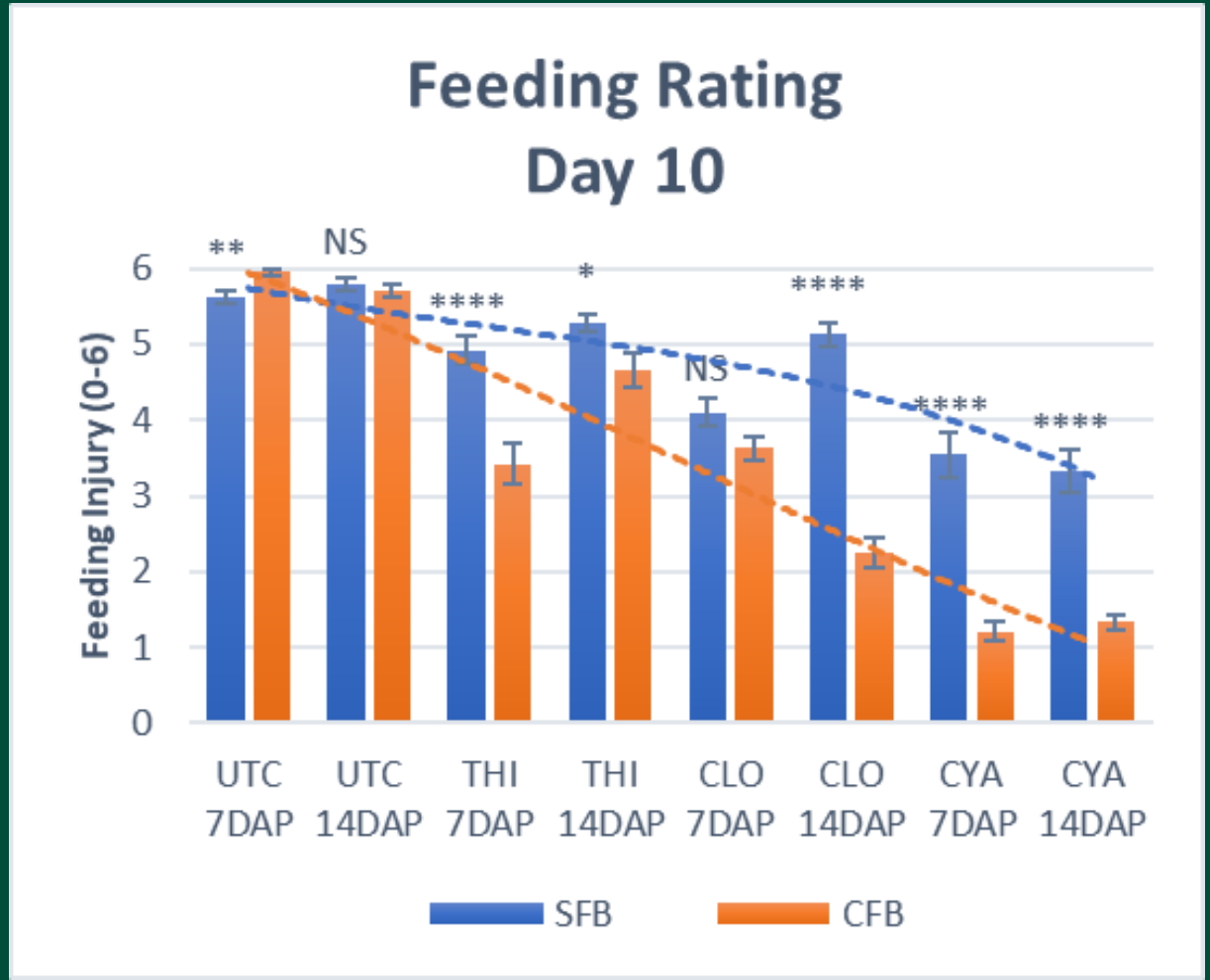
Significance at α=0.05

CLO = clothianidin, CYA = cyantraniliprole, THI = thiamethoxam, UTC = untreated control

Asterisks mean significant differences between paired SFB and CFB plots according to a t-test with equal variances ($P \leq 0.05$) where * is $P \leq 0.05$,** is $P \leq 0.01$, *** is $P \leq 0.001$ and **** is $P \leq 0.0001$.

Crucifer FB versus Striped FB – Day 10





Significance at α=0.05

CLO = clothianidin, CYA = cyantraniliprole, THI = thiamethoxam, UTC = untreated control

Asterisks mean significant differences between paired SFB and CFB plots according to a t-test with equal variances ($P \leq 0.05$) where * is $P \leq 0.05$,** is $P \leq 0.01$, *** is $P \leq 0.001$ and **** is $P \leq 0.0001$.

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Conclusion

- All insecticide seed treatments tested (THI, CLO, CYA) for control of crucifer flea beetle had higher mortality and lower feeding injury ratings than the untreated check.

- Flea beetles responses varied based on location, but trends were the same.

Conclusion

- Newer MOA insecticide (Group 28: Diamide)

  Cyantraniliprole (CYA), was slower to cause mortality, but beetles did not feed after initial ingestion of chemical
- Crucifer flea beetle mortality increased usually on Observation Day 7 or 10
- CYA reduced flea beetle feeding injury
  - Feeding injury ratings for CYA were lower than THI and CLO as well as the untreated check

Conclusion

- **Crucifer flea beetle**
  - Spring population was more susceptible to all insecticide seed treatments than the summer population
  - Higher mortality in spring compared to summer
  - Higher or similar feeding injury ratings in spring compared to summer
  - The exception was CYA, which had comparable values between spring and summer.

Spring population

Summer population

Conclusion

- Striped flea beetle had decreased mortality and increased feeding injury as compared to crucifer flea beetle.
  - Tansey et al. (2008) found similar response for THI and CLO between the two species in Canada

- Mortality on Observation Day 7 (7 DAP)

Spring population

Treatment	Mortality	
	SFB	CFB
THI	38	84
CLO	55	76
CYA	37	95

Take Home Message for Canola Growers

- Control of both crucifer flea beetle and striped flea beetle is important for successful canola production.
- Striped flea beetles are slowly increasing in canola due to tolerance/resistance of standard insecticide seed treatments (Neonicotinoids, Group 4A) used in canola.
- New Modes of Action (Diamides, Group 28) show promise for control of both species of *Phyllotreta* flea beetles and other soil insect pests (cutworms).

Midge Trap Surveys in Canola

- ***PI: Janet J. Knodel***
- **Identifier: *Patrick Beauzay***
- ***2020-2021 Trappers:***
  - ***NE: Lesley Lubenow, Anitha Chirumamilla, Lindy Berg, Jolena Lowery, Traci Murphy***
  - ***NC: T.J. Prochaska, Sara Clemens, LoAyne Voigt, Riley Racine***
  - ***SW: Ryan Buetow, Iris Dukart, Kia Ward***
  - ***EC: Greg Endres, Carrie Nichols, Sean Nichols***
  - ***SE: Patrick Beauzay, Tommy Crompton, Veronica Calles-Torrez, Marc Michaelson***

Midges in Canola

- Family Cecidomyiidae, Order Diptera (flies)
  - Swede midge, *Contarinia nasturtii* (Kieffer)
    - Introduced into Ontario, Canada in 2000
    - United States in 2004 in Niagara County, New York
  - Canola flower midge, *Contarinia brassicola* Sinclair
    - Identified in 2017; it was first discovered in 2012
- Major crop damage by larval stage of midge:

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

Hosts of Midges

Canola flower midge	Swede midge
Canola (*Brassica napus and B. rapa)* Other hosts?	Canola (*Brassica napus, B. rapa*) Broccoli (*B. oleracea* var. *italica*) Cauliflower (*Brassica oleracea* var. *botrytis*) Cabbage (*B. oleracea* var. *capitata*) Radish (*Raphanus sativus*) Other plants in family Brassicaceae

Identification Features of Adult Midges

Canola flower midge	Swede midge
Light brown fly, small <2mm long (see image A)	Brown fly, small 1.5-2mm long
Wings mottled with dense macrotrichia (see image B)	Clear wings

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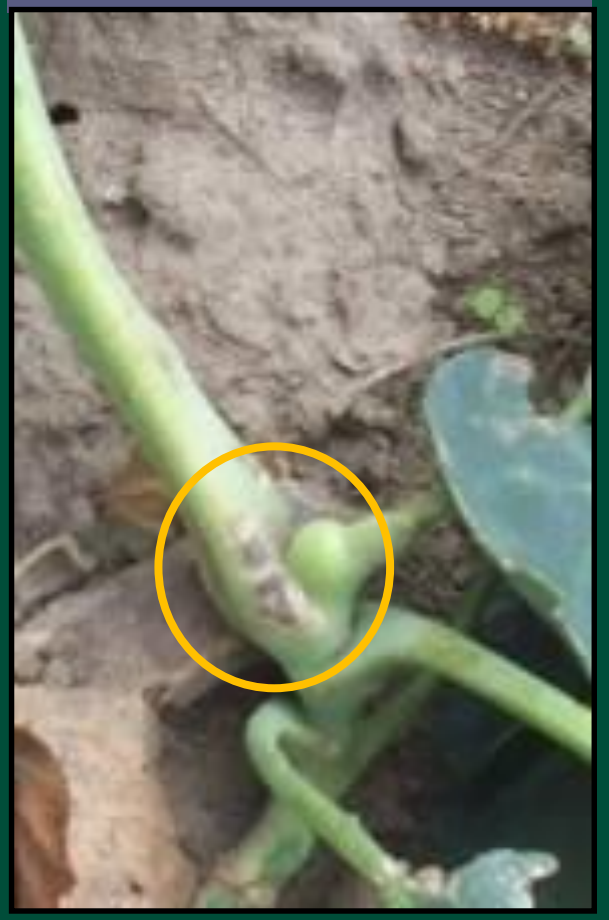
2019 Mori et al. Can. Entomol. 151:131-148

Swede Midge Crop Damage

- Caused by tiny larvae (2mm long)
- Young shoots and leaf stalks may be swollen, distorted and twisted resulting in death of main shoot or secondary shoots
- Leaves crinkled and crumpled
- Destruction of inflorescence called “blindness”
- Flower bud remain closed and swollen



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

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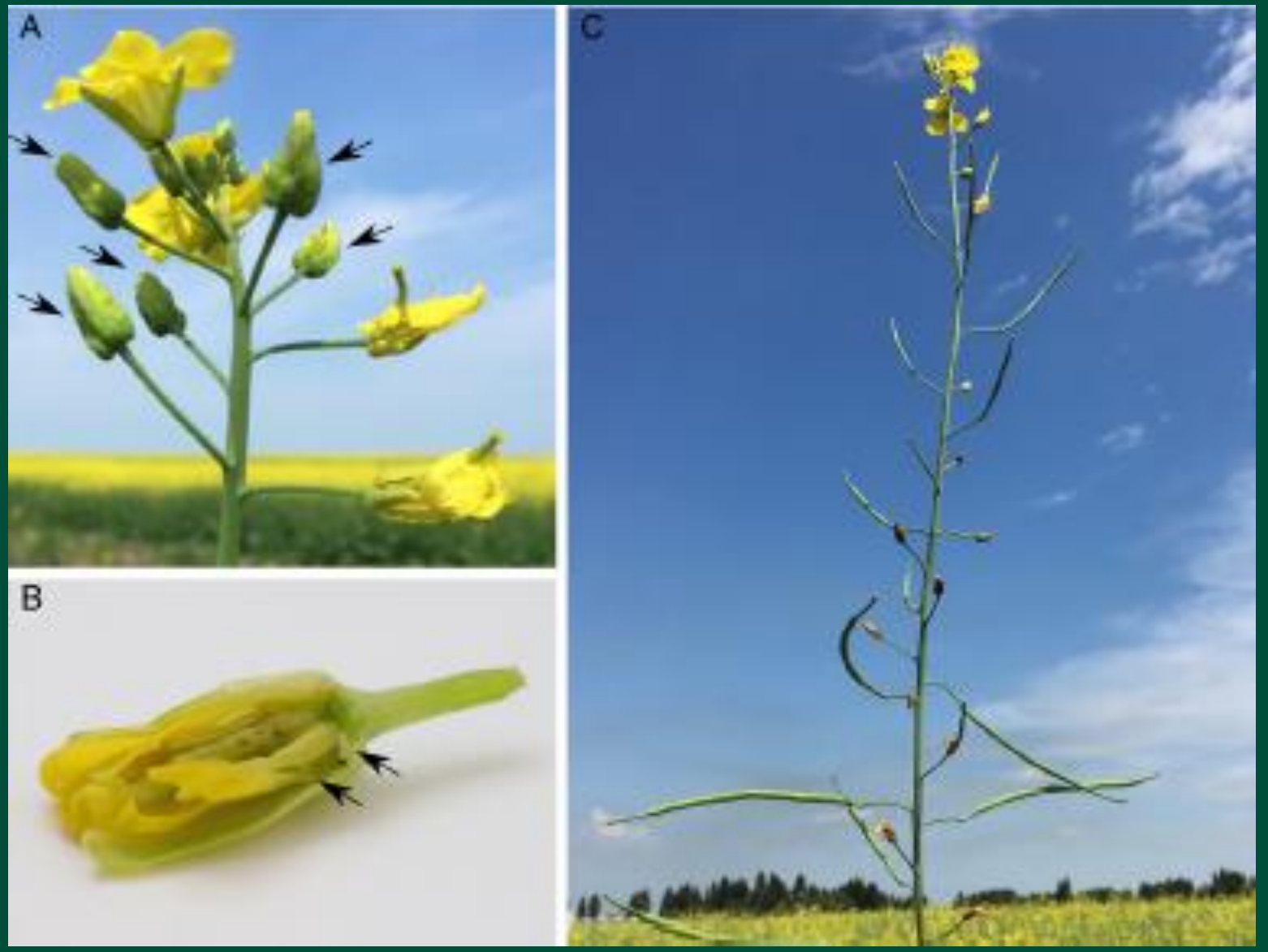
Canola Flower Midge Crop Damage

- Larva injure the flowers by causing a swelling (or gall), that prevents flowers from opening.
- Damaged flowers do not produce pods or seeds.
- 2021 – found larvae inside pods damaged by hail



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

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Canola Flower Pod Damage by Midges

Canola flower midge	Swede midge
No feeding injury on leaves or shoots	Feeding injury on leaves and shoots (scarring of tissue)
Shape of flower gall - elongated, bottle-shaped, closed flower galls (see image A)	Shape of flower gall - caper shaped, closed flower galls (see image B)

A. Canola flower midge

B. Swede midge

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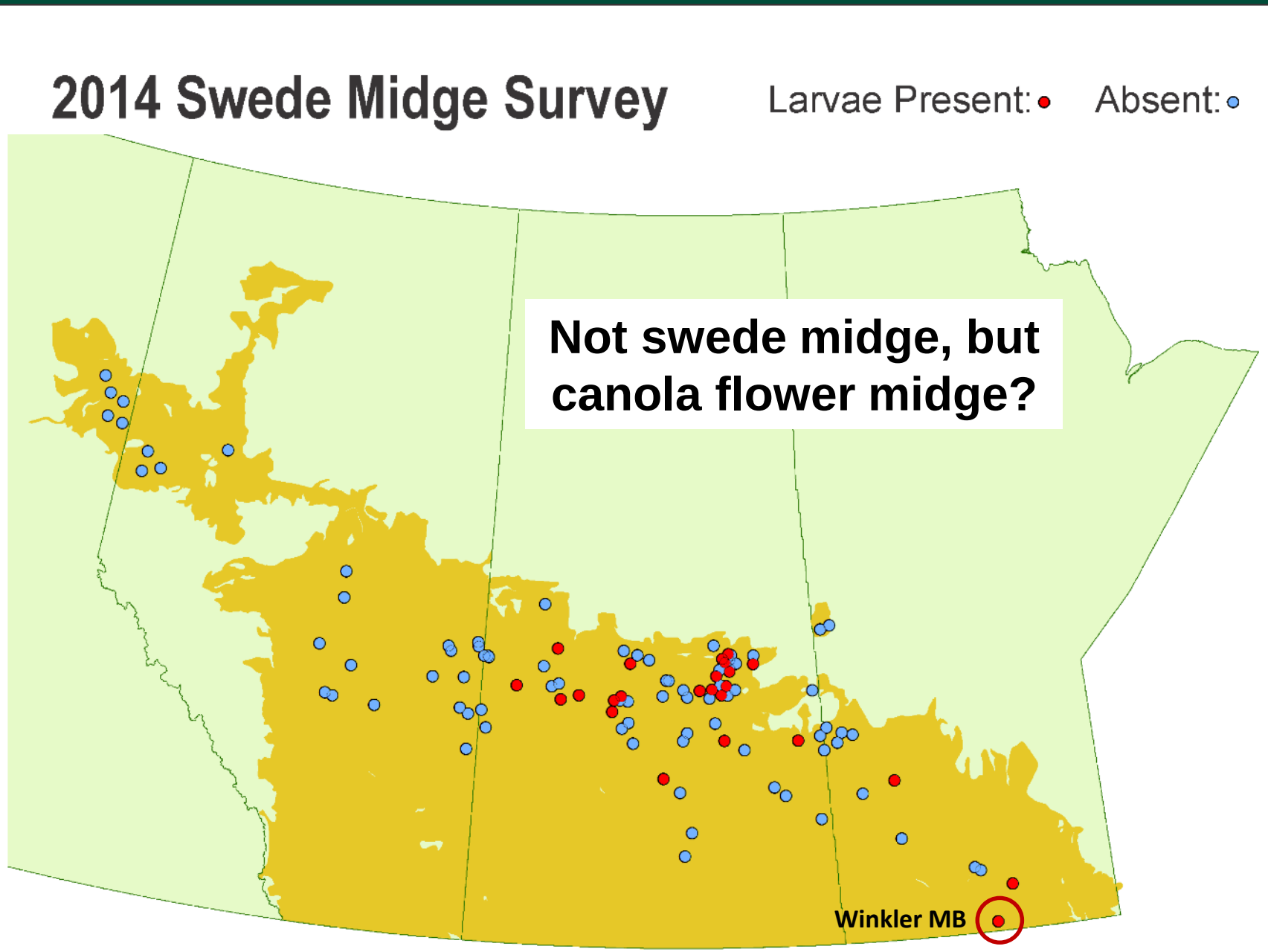
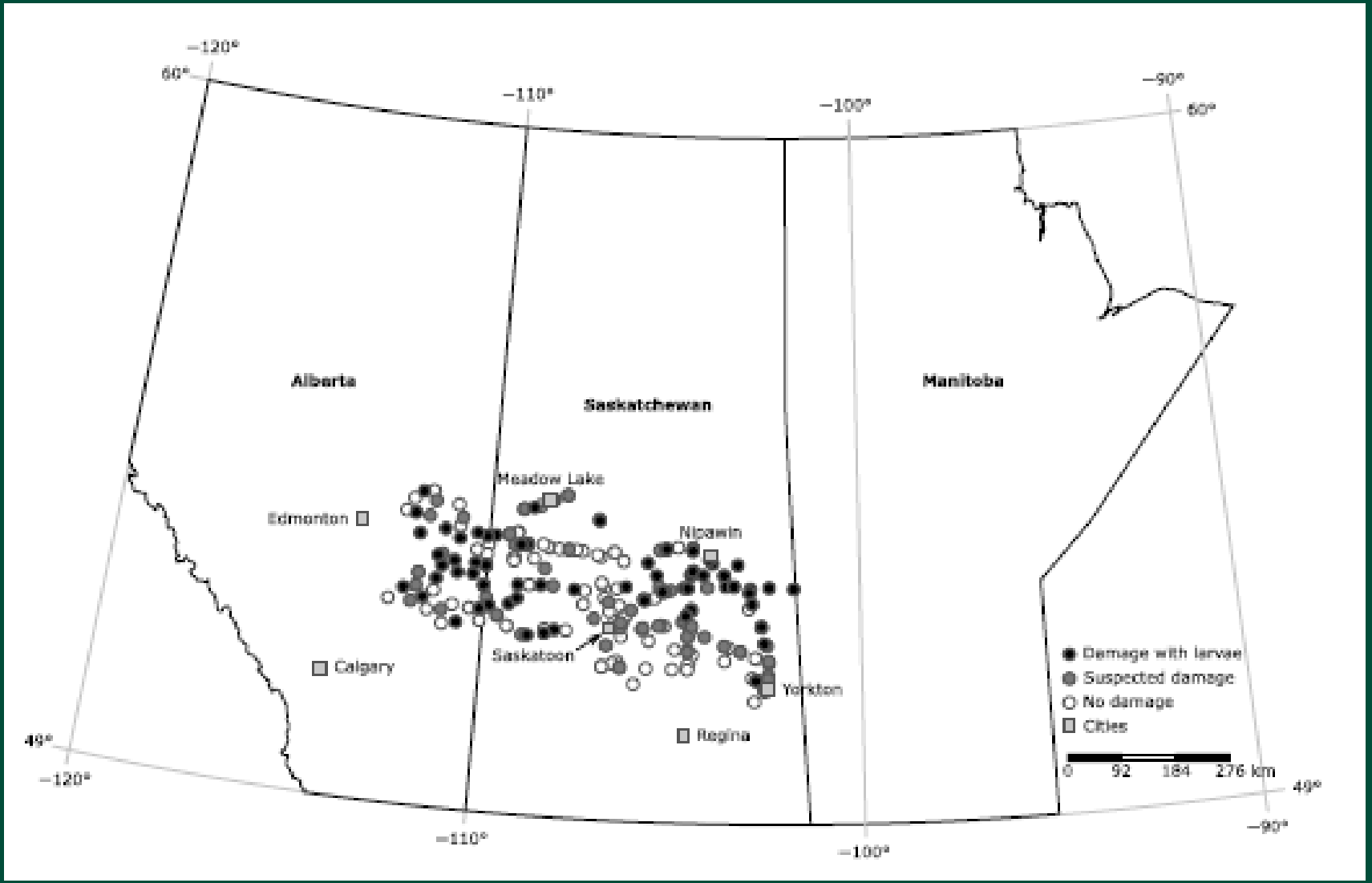
2019 Mori et al. Can. Entomol. 151:131-148


2014 Swede Midge Survey
Larvae Present:
Absent:
Not swede midge, but canola flower midge?
Winkler MB

Distribution of Canola Flower Midge from Canadian Surveys 2014-2016



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

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Midge Trap Survey

- Sites: canola or vegetable gardens
- Used commercially available pheromone lure & delta trap
- Monitored from mid-June (rosette) through mid-August (ripening crop stage)
- Traps checked weekly (sticky trap bottoms replaced)
- Trap bottoms stored in freezer

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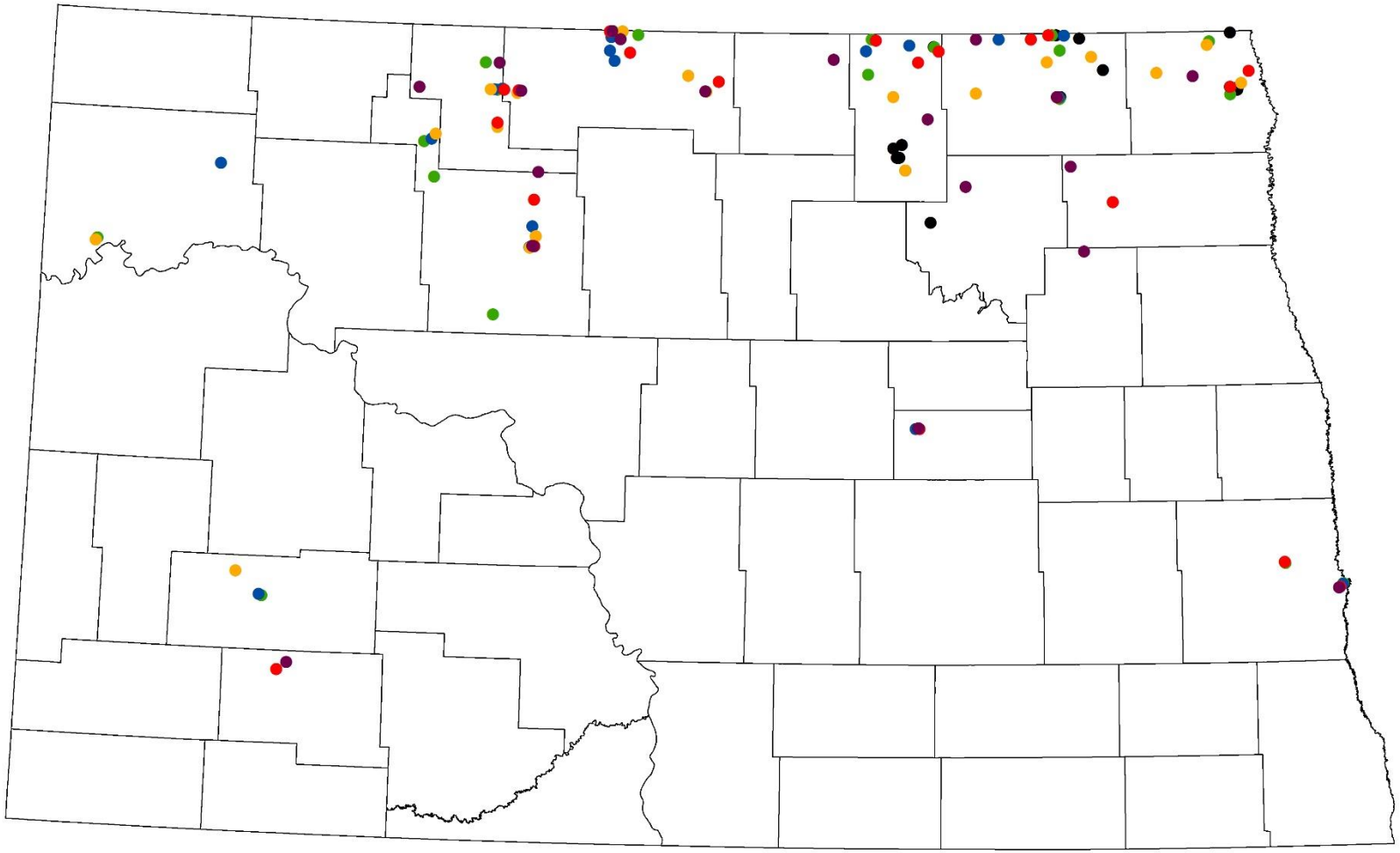
Swede Midge (*Contarinia nasturtii*) Trap Surveys in Canola, ND - 2015 and 2017-2021



A total of 117 trap sites in 15 counties

All negative data

Year trapped (all negative results)

2015 2017 2018 2019 2020 2021

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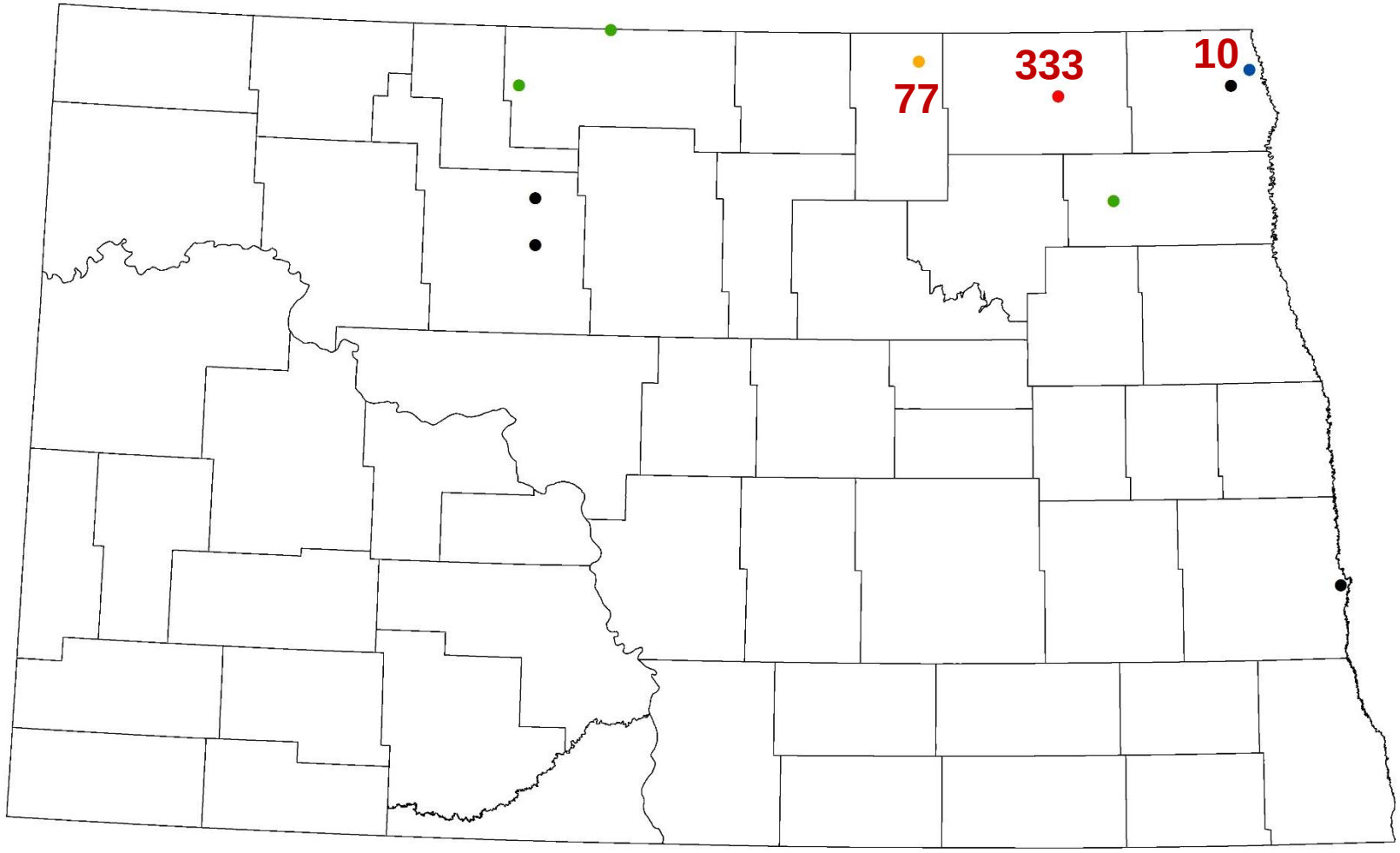
2020 Canola Flower Midge (*Contarinia brassicola*) Trap Survey in Canola, North Dakota

July 15 to August 12, 2020



A total of 10 trap sites in 8 counties

6 of 10 trap sites were positive in 5 counties

Total of 426 canola flower midge captured

Total Number of Canola Flower Midge Captured in Trapping Season

- 0
- 0.1-5
- 5.1-10
- 10.1-100
- > 100

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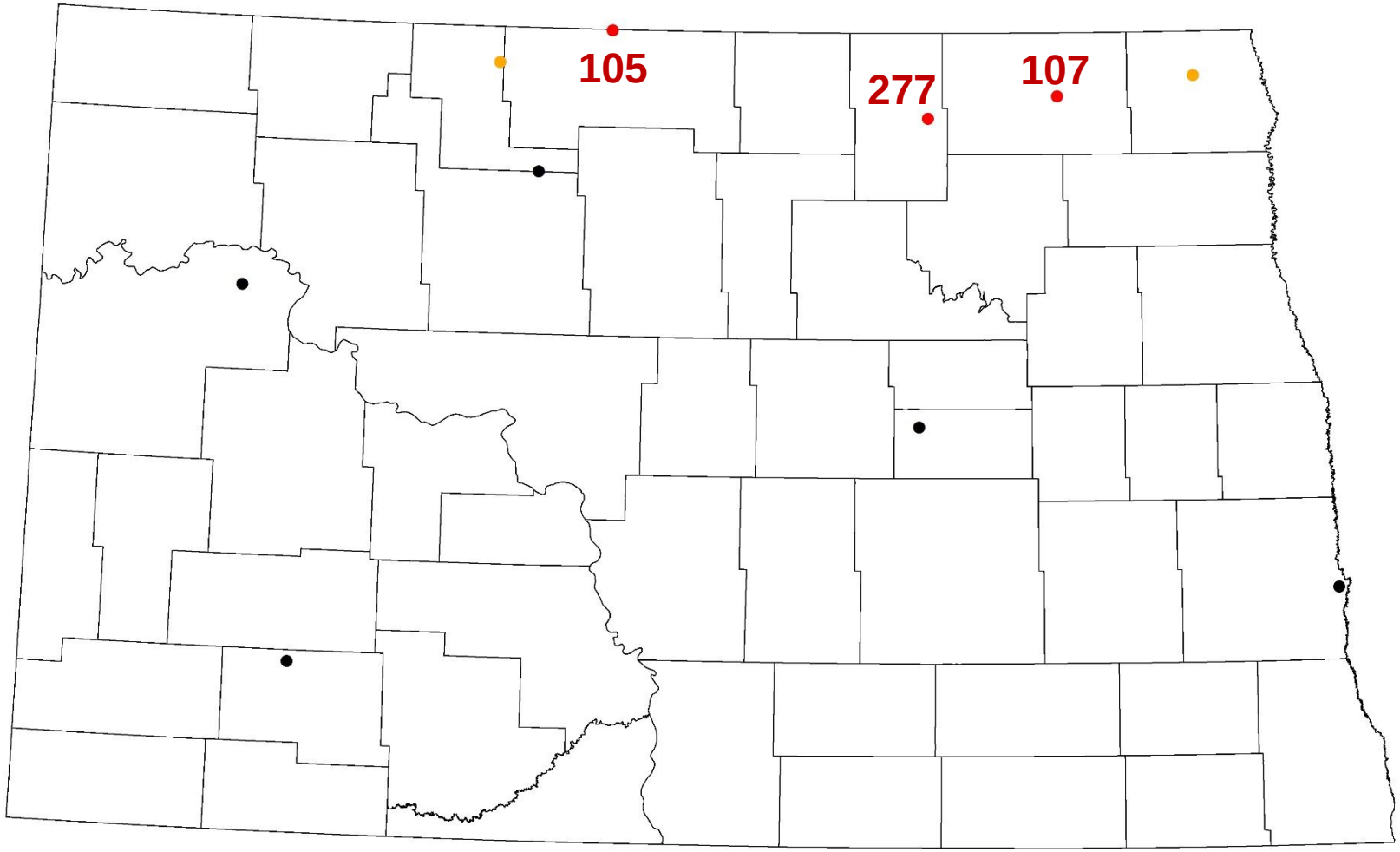
2021 Canola Flower Midge (*Contarinia brassicola*) Trap Survey in Canola, ND



A total of 10 trap sites in 10 counties

5 of 10 trap sites were positive in 5 counties

Total of 541 canola flower midge captured

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Trap Bottom of Canola Flower Midge from Langdon REC

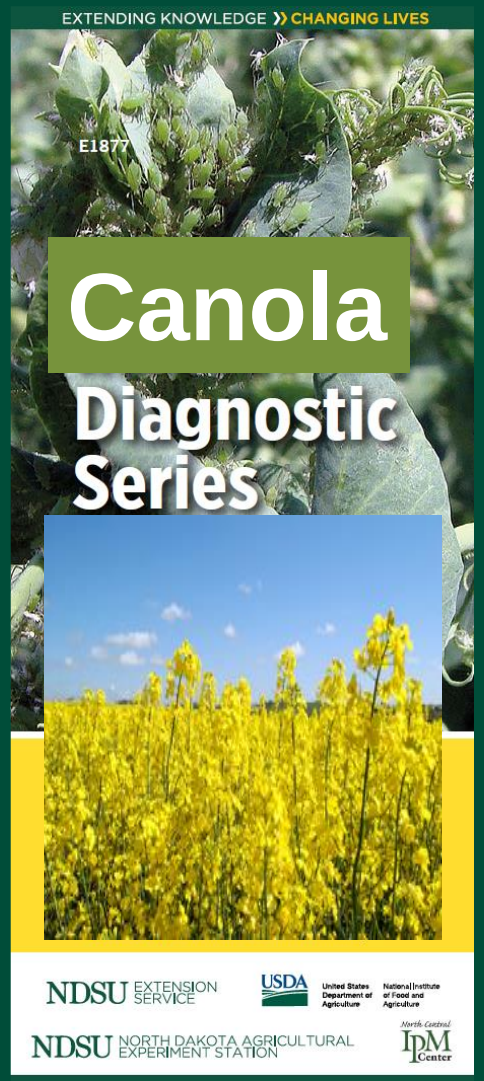
IPM - Canola Flower Midge

- Monitoring: Pheromone trapping for adults
- Planting Date
  - Early-planted canola (mid May) had more midge damaged pods compared to late-planted canola (early June)
  - Early-planted canola had the highest yield due to other more important agronomic factors
- Insecticide seed treatments
  - Little or no negative effect on midge injury to pods
- Yield loss studies are underway in Canada
- Biological Control - average wasp parasitism rate about 10% (range of 0 to 62%).

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

2019 Soroka et al. Can. Entomol. 151: 219-235

Canola Insect & Disease Diagnostic Series



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Introduction

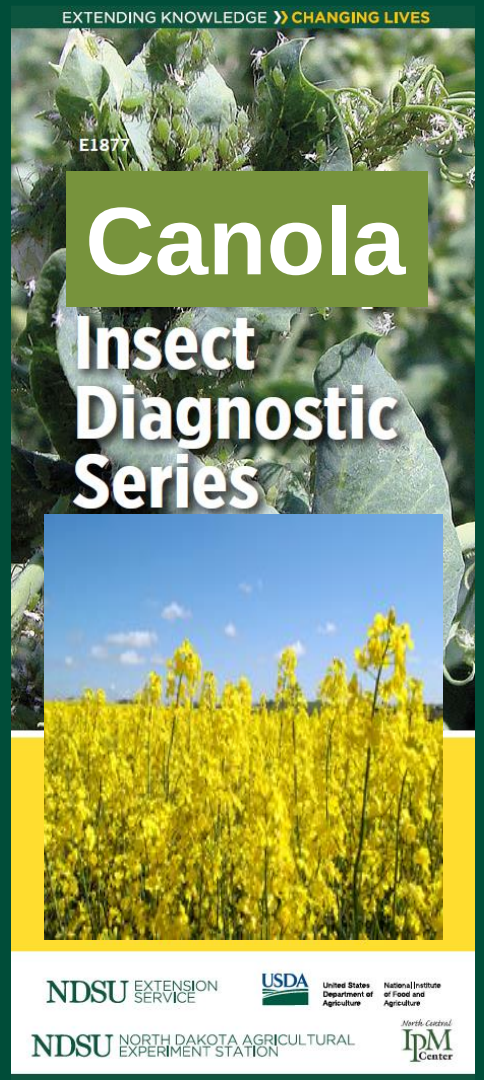
General Scouting & Calendar

Root and Surface Feeders

- Wireworms
- Cabbage root maggots
- Cutworms

Foliage and Seed feeders

- Flea beetles
- Grasshoppers
- Aster leafhoppers
- Bertha armyworms
- Lygus bugs
- Cabbage seed pod weevils



Sap Feeders

- Turnip aphids, cabbage aphids and other aphid species

New Insect Pests of Canola

- Canola flower midge
- Invasive Swede midge

Biological Control – Natural Enemies

- Predators
  - Lady beetles
  - Lacewings,
  - Orius bug and other true bugs
  - Syrphid fly larva
  - Ground beetles (Carabidae)
- Parasitoids
  - Parasitic wasps
  - Tachinid flies
- Beneficial entomopathogens (fungi ,bacteria, viruses)

Pollinators

NDSU | EXTENSION

ACKNOWLEDGEMENTS

- Dr. Knodel's lab members: Miro Herrera Grant, Joslin Forness, Stephanie Crompton and Imelda Miller
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- Langdon REC: Tucker Regner, Amanda Arens
- Northern Canola Growers Association for funding

Send any questions to:
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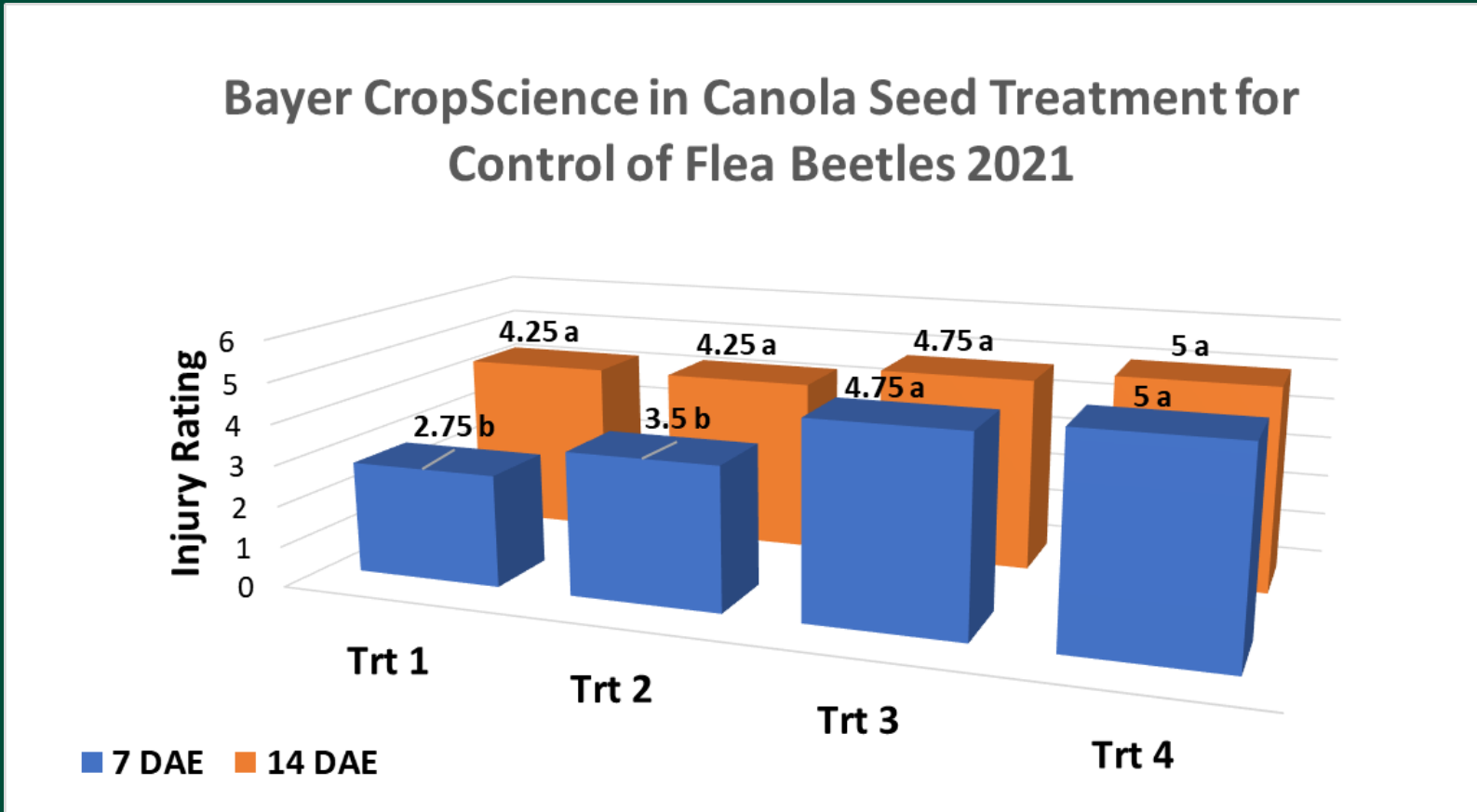
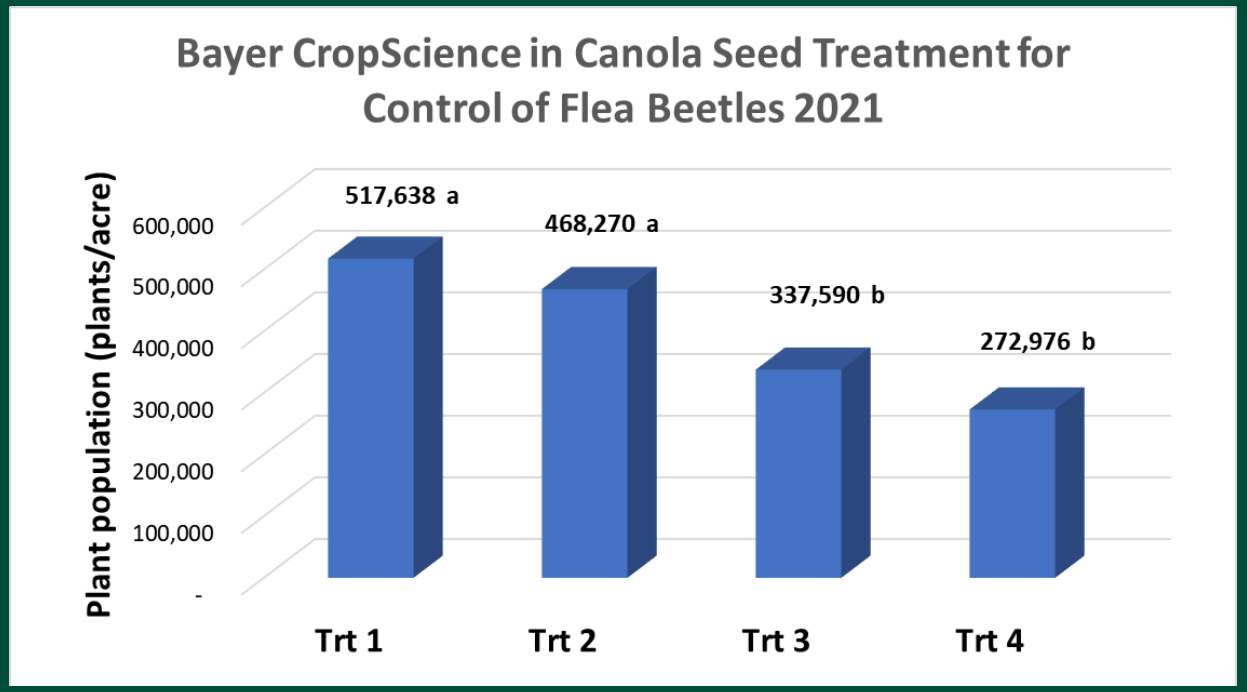
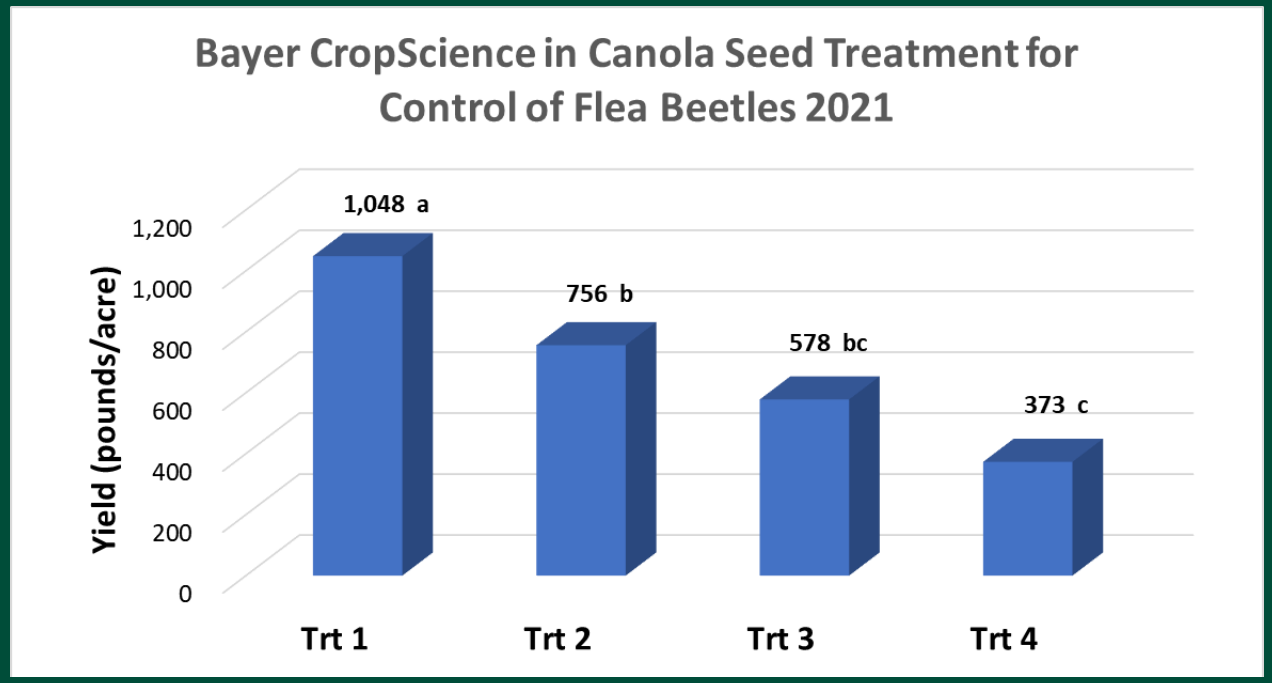
Field - Buteo Start Seed Treatment 2021



Trt 1 = Prosper Evergol @ 21.5 fl oz/cwt + Buteo Start @ 16 fl oz/cwt
Trt 2 = Prosper Evergol @ 21.5 fl oz/cwt + Buteo Start @ 9.6 fl oz/cwt
Trt 3 = Prosper Evergol @ 21.5 fl oz/cwt
Trt 4 = Untreated Check

Field - Buteo Start Seed Treatment 2021





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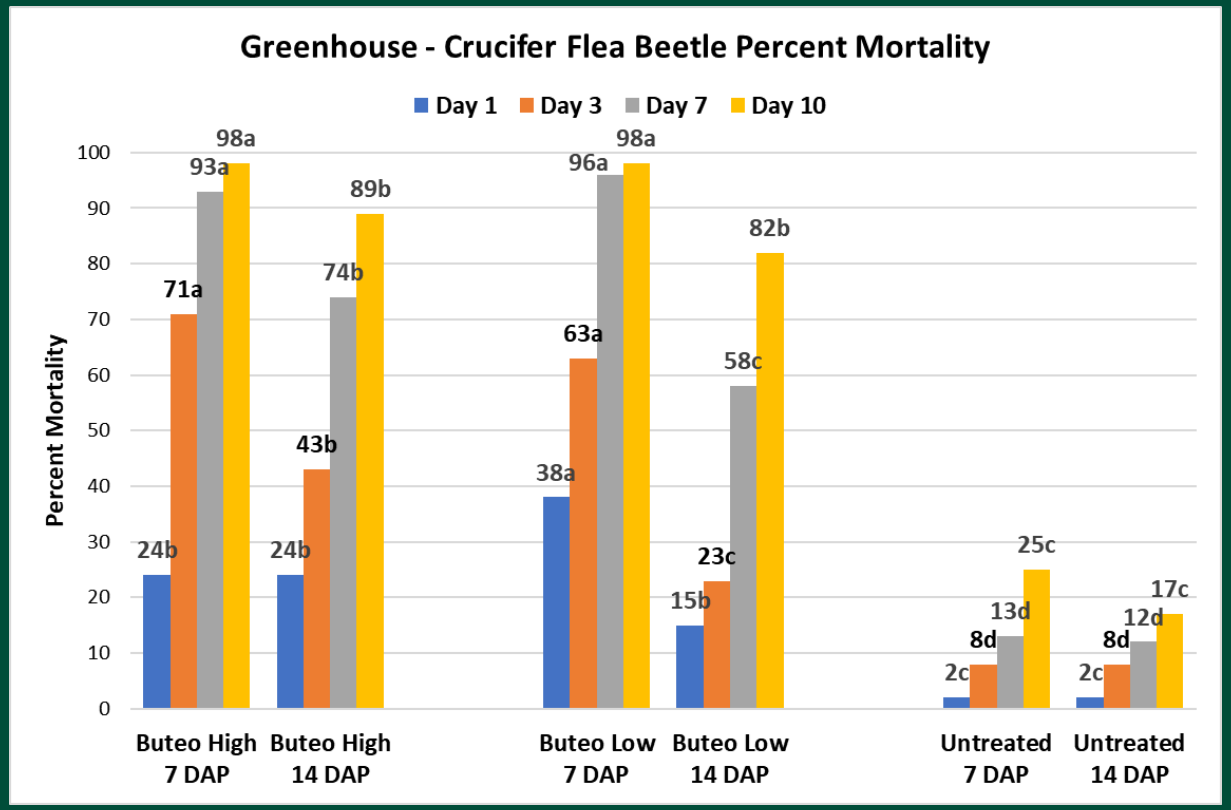
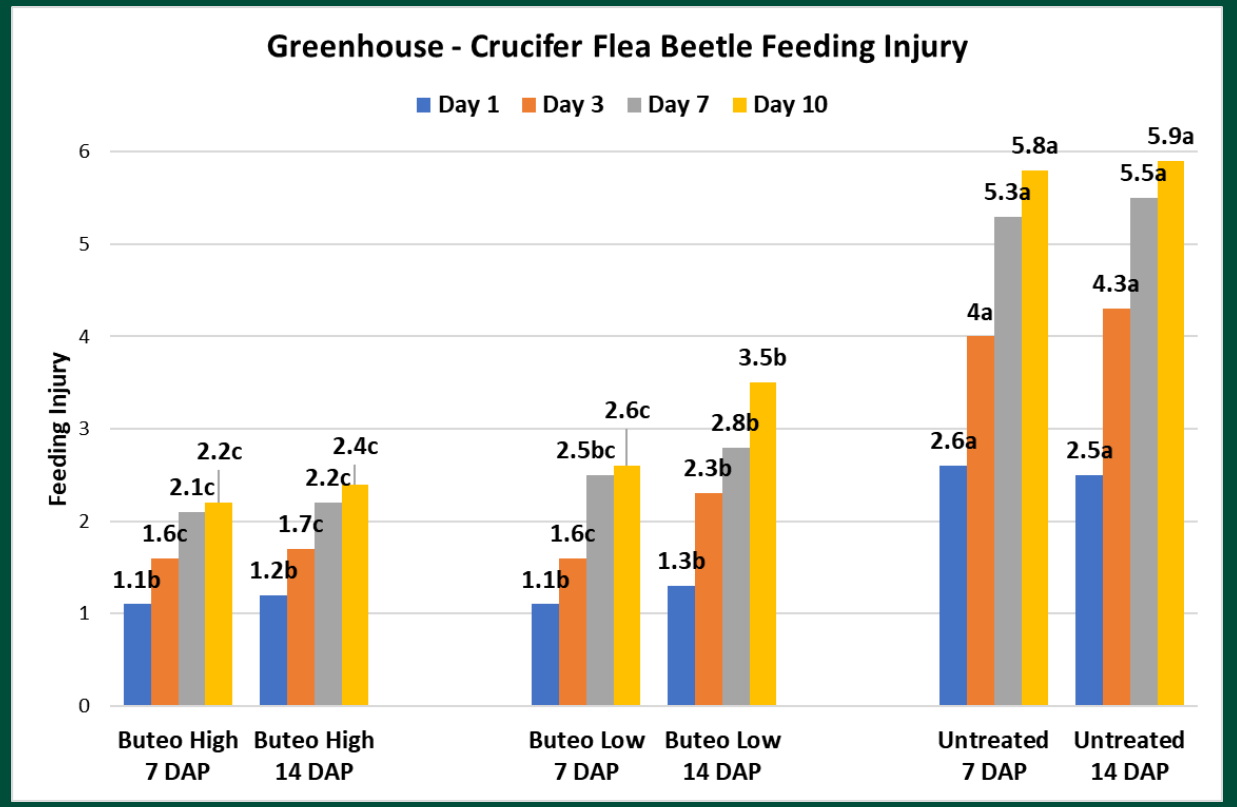
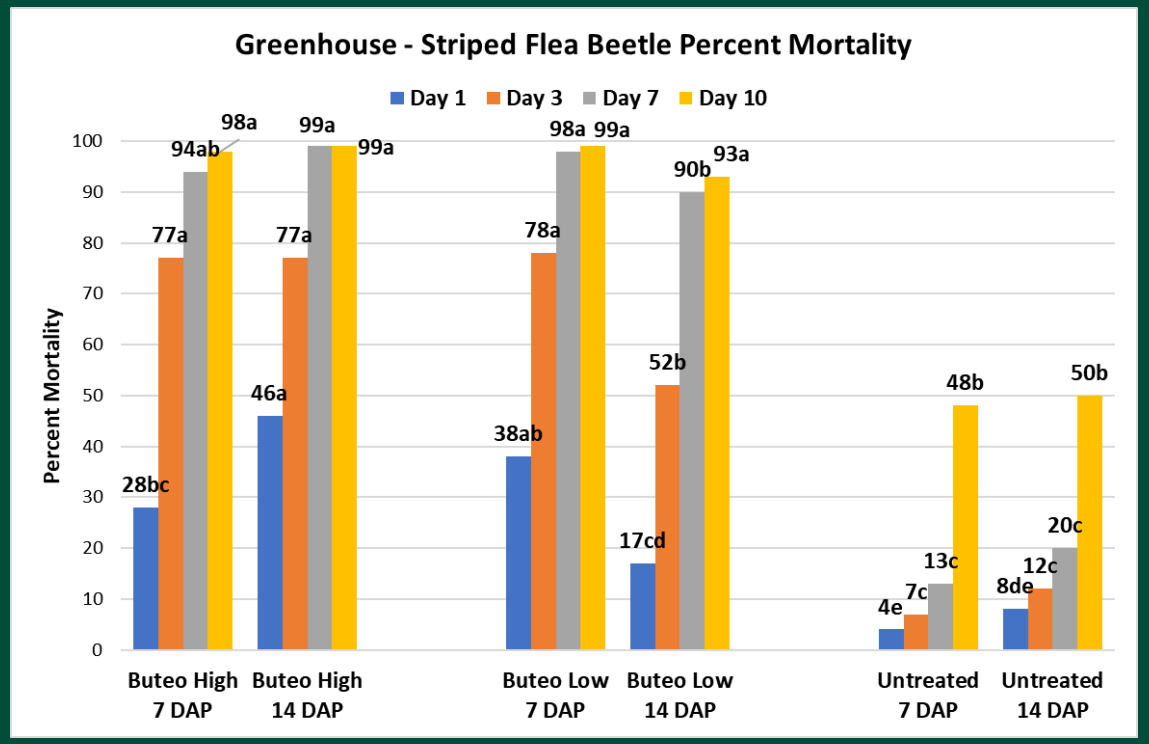
Greenhouse - Buteo Start Seed Treatment 2021

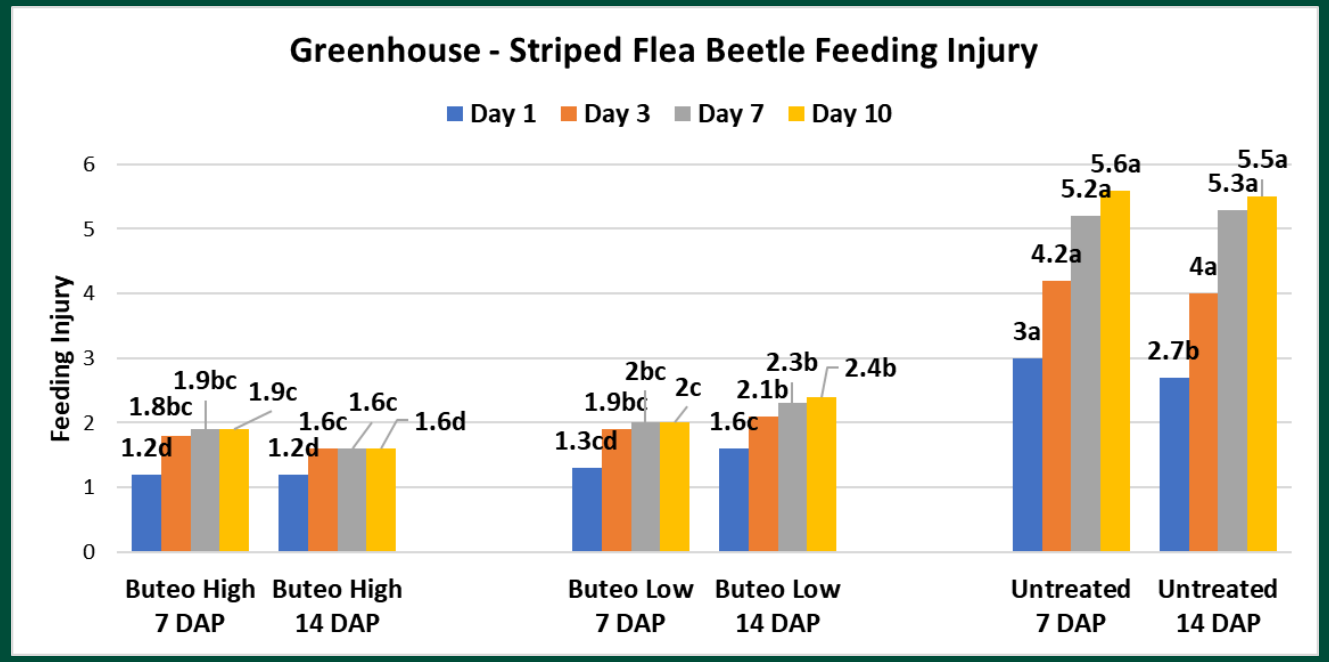




Treatment	Rate
Buteo Start (low rate)	9.6 fl oz/acre
Buteo Start (high rate)	16 fl oz/acre

Greenhouse - Buteo Start Seed Treatment 2021





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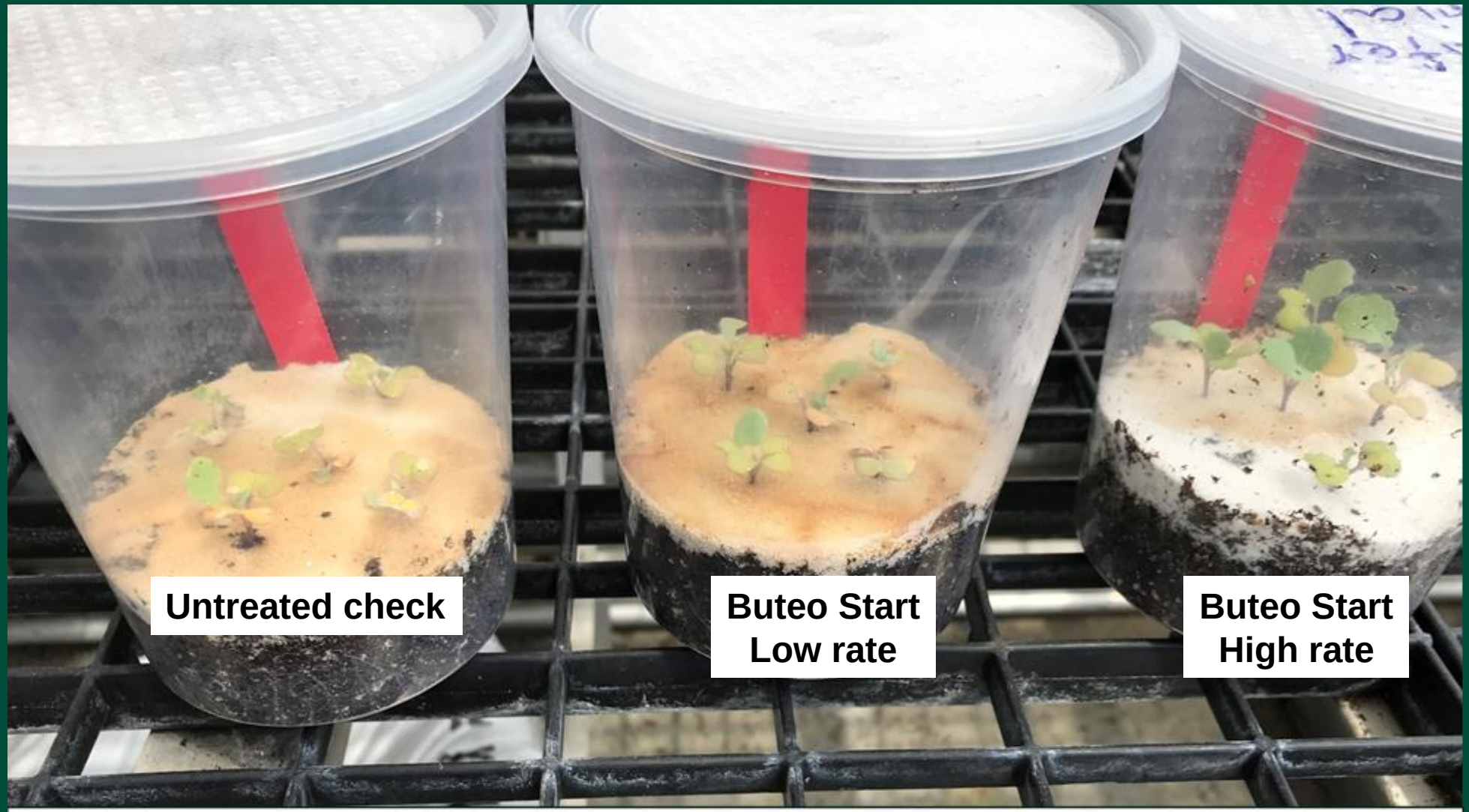
Greenhouse - Buteo Start Seed Treatment 2021



From left to right: Untreated check, Buteo Start low rate and Buteo Start high rate assessed at day 10 (7 DAP).