Agriculture and Agri-Food Canada
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“An Ag world without neonics” or “Beyond Thunderdome, with flea beetles”

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Canada

https://european-seed.com/2017/12/impact-ban-neonicotinoids/

Europe pub. December 7th, 2017 by Marcel Bruins

- 2012 European Food Safety Authority (EFSA) reviewed studies re. “impact of neonicotinoids on bees”
- Dec 1 2013: European Commission implements **moratorium** on 3 neonics for seed treatment, soil application and foliar treatment Regulation (EU) No 485/2013
- January 2017: HFFA Research GmbH study calculates the economic and environmental impacts of the EU ban Oilseed Rape
- May 2017 LMC International studies impact in sugar beets

Findings?

- Yield depression: a negative yield impact of **four per cent** (weighted average) in oilseed rape production in the EU;
- Quality losses: on average 6.3 per cent of the realized harvest saw quality losses at a cost of **€ 36.50 per ton** affected;
- More foliar applications: additional **0.73 applications per hectare** (weighted average), mainly pyrethroids.

Total cost to oilseed rape industry? € 900 million

- Almost **€ 350 million** market revenue losses
- More than **€ 50 million** revenue losses due to lower quality
- Close to **€ 120 million** additional production costs
- **€ 360 million** in upstream and downstream industries.

Environmental cost ?

- **80.2 million tons of CO_2** emissions, 1,300 million m^3 additional water consumption, and biodiversity losses equalling the slashing and burning of 333,000 hectares of Indonesian rainforest.
- Additional foliar insecticide applications add Greenhouse Gas (GHG) emissions of estimated **0.03 million tons CO_2** equivalents and **1.4 million m^3** of additional water use annually
- an estimated 5-fold increase in pyrethroid usage = high chance of resistance

Perspective

SCI

Received: 7 December 2016 Accepted article published: 26 December 2016 Published online in Wiley Online Library: 22 February 2017

(wileyonlinelibrary.com) DOI 10.1002/ps.4511

The adverse impact of the neonicotinoid seed treatment ban on crop protection in oilseed rape in the United Kingdom†

Alan M Dewar*

Abstract

This paper describes the consequences of the ban on neonicotinoid seed treatments on pest management in oilseed rape. Since the ban was implemented in December 2013, there have been serious crop losses in 2014, 2015 and 2016 owing to cabbage stem flea beetles, *Psylliodes chrysocephala*, and aphids, *Myzus persicae*, which have developed resistance to the alternative pyrethroid sprays that were employed to control them. This has resulted in increased crop losses, decreased yields and a substantial decrease in the area grown, leading to fewer flowering crops available in the spring, especially in the eastern region of the United Kingdom. This is likely to have an adverse effect on bees locally.

Keywords: cabbage stem flea beetles; neonicotinoids; resistance to insecticides; aphids

Canada: It's about the aquatic midges

ELSEVIER

Chemosphere

Volume 226, July 2019, Pages 945-955

Neonicotinoids and other agricultural stressors collectively modify aquatic insect communities

Michael C. Cavallaro [a,1], Anson R. Main [a,2], Karsten Liber [a,b], Iain D. Phillips [c], John V. Headley [d], Kerry M. Peru [d], Christy A. Morrissey [a,e]

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ELSEVIER

Environment International

Volume 74, January 2015, Pages 291-303

Review

Neonicotinoid contamination of global surface waters and associated risk to aquatic invertebrates: A review

Christy A. Morrissey [a,b], Pierre Mineau [c], James H. Devries [d], Francisco Sanchez-Bayo [e], Matthias Liess [f], Michael C. Cavallaro [b], Karsten Liber [b,g]

Show more

https://doi.org/10.1016/j.envint.2014.10.024

Highlights

- Neonicotinoids in surface waters often exceed existing regulatory guidelines.
- Environmental persistence indicates regulatory thresholds using acute toxicity tests may underestimate toxic potential.
- *Daphnia magna*, industry standard, is at least 1000 times less

ELSEVIER

Ecotoxicology and Environm

Volume 175, 15 July 2019, Pages 215-223

Acute and chronic toxicity of neonicotinoid and butenolide insecticides to the freshwater amphipod, *Hyalella azteca*

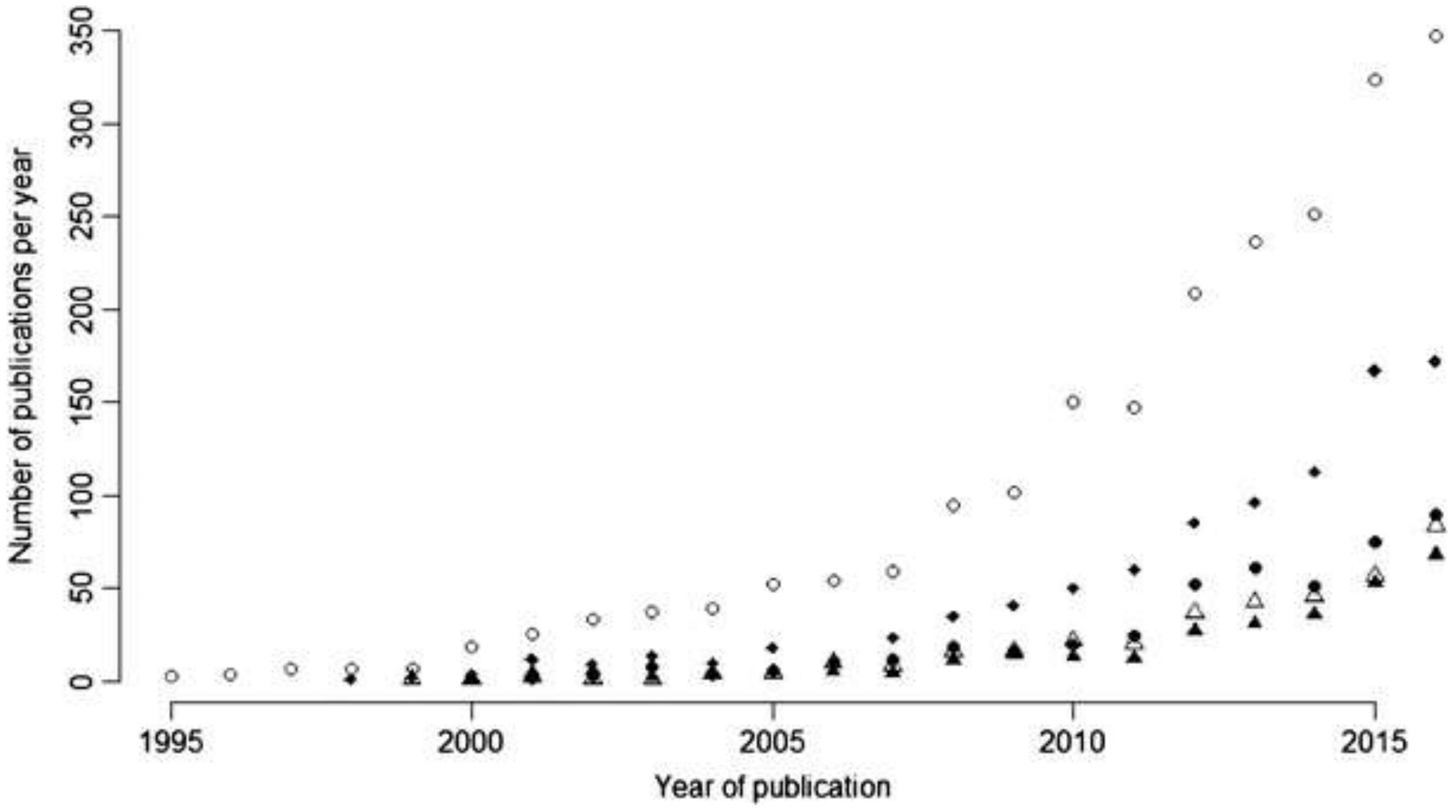

Fig. 2

Number of studies published in scientific journals on neonicotinoids in each year. *Open circles*, “neonicotinoid*”; *filled diamonds*, “neonicotinoid* + bee*”; *filled circle*, “neonicotinoid* + residue”; *open triangle*, “neonicotinoid* + water”; *filled triangle*, “neonicotinoid* + soil”. Data from Web of Science

Wood, T.J. & Goulson, D. Environ Sci Pollut Res (2017) 24: 17285.
https://doi.org/10.1007/s11356-017-9240-x

The PMRA

Proposed Special Review Decisions: Clothianidin and Thiamethoxam:

On August 15, 2018 the PMRA proposed banning all outdoor uses of these seed treatments, also known as Prosper and Poncho; Helix and Cruiser Maxx.

The proposed ban is due to the unacceptable risk to aquatic invertebrates, as modelled by the PMRA.

If the PMRA moves forward with a phase-out, they would not be available after 2024.

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The PMRA

Proposed Special Review Decisions: Clothianidin and Thiamethoxam:

Chronic Endpoint (present for 21 days or more):

Clothianidin: 20ng/L (ppt)

Thiamethoxam: 300ng/L (ppt)

Acute Endpoint (one-time event):

Clothianidin: 1,500ng/L (ppt)

Thiamethoxam: 9,000ng/L (ppt)

CANADIAN CANOLA GROWERS ASSOCIATION

Program Overview

Sampling Detections

- 157 samples taken.
- 18 detections of Clothianidin.
- 10 detections of Thiamethoxam.
- 125 samples analyzed detected no neonics.
- No samples met criteria for chronic or acute event.

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Summer 2019 Water Monitoring Program

Conclusions

- No samples met criteria for chronic or acute event.

- Summer 2019 data demonstrates:
  - No unacceptable risk to aquatic invertebrates

- This research does not support need for regulated mitigation measures.

- This research does not support phasing out these products, due to impacts on aquatic invertebrates.

CANADIAN CANOLA GROWERS ASSOCIATION

AAFC Field Guide

3rd edition out now.

Available as a pdf for your tablet

Publications.gc.ca (website)

Hard copy sometimes available

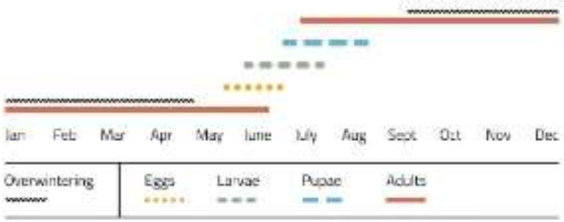
Prairie Pest Monitoring Network Blog

Striped fleabeetle – adult, damage
Mike Dolinski, MikeDolinski@hotmail.com

Flea beetles

crucifer flea beetle
Phyllotreta cruciferae (Goeze)

striped flea beetle
Phyllotreta striolata (Fabricius)



Crucifer fleabeetle – adult, damage
AAFC

Fleabeetle – damage
Mike Dolinski, MikeDolinski@hotmail.com

Hosts
Canola, mustard, and related cruciferous plants and weeds.

Identification
ADULTS: 2–3 mm long, oval; crucifer flea beetle is shiny bluish black; striped flea beetle is black with two wavy yellow lines along back. Jumps like a flea when disturbed .

MATURE LARVAE: Up to 6 mm long with whitish, slender body, brown head and anal plate, and 3 pair thoracic legs.

Life Cycle
Overwinter as adults under plant material along field margins. Females lay eggs in the soil near host plants in batches of about 25. Larvae feed for 3–4 weeks then pupate in earthen cells. New adults feed on host plants until seeking overwintering sites in September.

Feeding Damage
ADULTS: Feed on cotyledons and first true leaves in spring creating a shot-hole appearance; also feed on seedling stems under windy, damp conditions causing breakage or wilting. Feed on bark of maturing pods in late summer; premature ripening under high populations.

LARVAE: Feed on roots of host plants with minimal impact on plants.

Similar Species
Many other species of flea beetles that are not pests of cruciferous crops are present in western Canada; some species have been introduced for biological control of weeds.

Monitoring/Scouting
Starting from field margins, examine emerging plants in spring for shot-hole feeding damage to cotyledons. Cease monitoring after second true leaves appear or adult activity ceases.

Economic Threshold
Consider foliar treatments when 25% cotyledon leaf damage and adults are present. Use a lower threshold under hot, dry conditions which slow seedling development and prolong exposure of plants to attack.

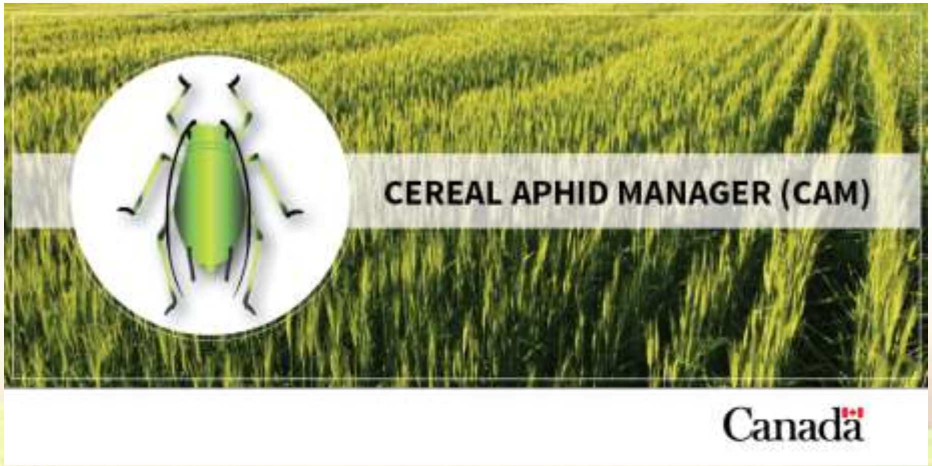
Management Options
BIOLOGICAL: Specific natural enemies are not known that can regulate pest populations.

CULTURAL: Eliminate volunteer host plants (including cruciferous weed hosts) in the spring where possible. Use good quality seed and plant seed to optimize germination and vigorous seedling development to lessen impact of flea beetle feeding. Consider adjusting seeding rates to reduce risk of damage (conventional tillage—10 g seed/ha and 25 cm row width; zero till, 8 kg seed/ha). Damage is less with zero tillage than conventional tillage.

CHEMICAL: Apply foliar treatments if seed treatments fail to protect young plants, especially when plant development is delayed.

Cereal Aphid Manager App

- March 2018 launch date
- Apple and Android operating systems
- FREE download from the Apple store and Google Play



Harmful insects

Flea beetle (Striped and crucifer)

- Chewing feeder

Flea Beetle Species Commonly Found in Canola on the Prairies

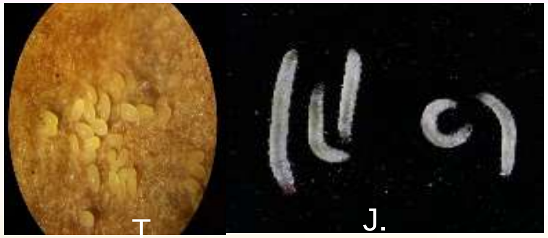
crucifer flea beetle, *Phyllotreta cruciferae*

striped flea beetle, *Phyllotreta striolata*

hop flea beetle, *Psylliodes punctulata*

Photo credit: A. Nemecz, AAFC Beaverlodge, AB

Flea beetle Life Cycle



https://www.gov.mb.ca/agriculture/crops/insects/flea-beetles-canola-mustard.html

Flea beetle damage at the most susceptible stage

Start scouting at the cotyledon stage
Stop scouting at the four leaf stage.

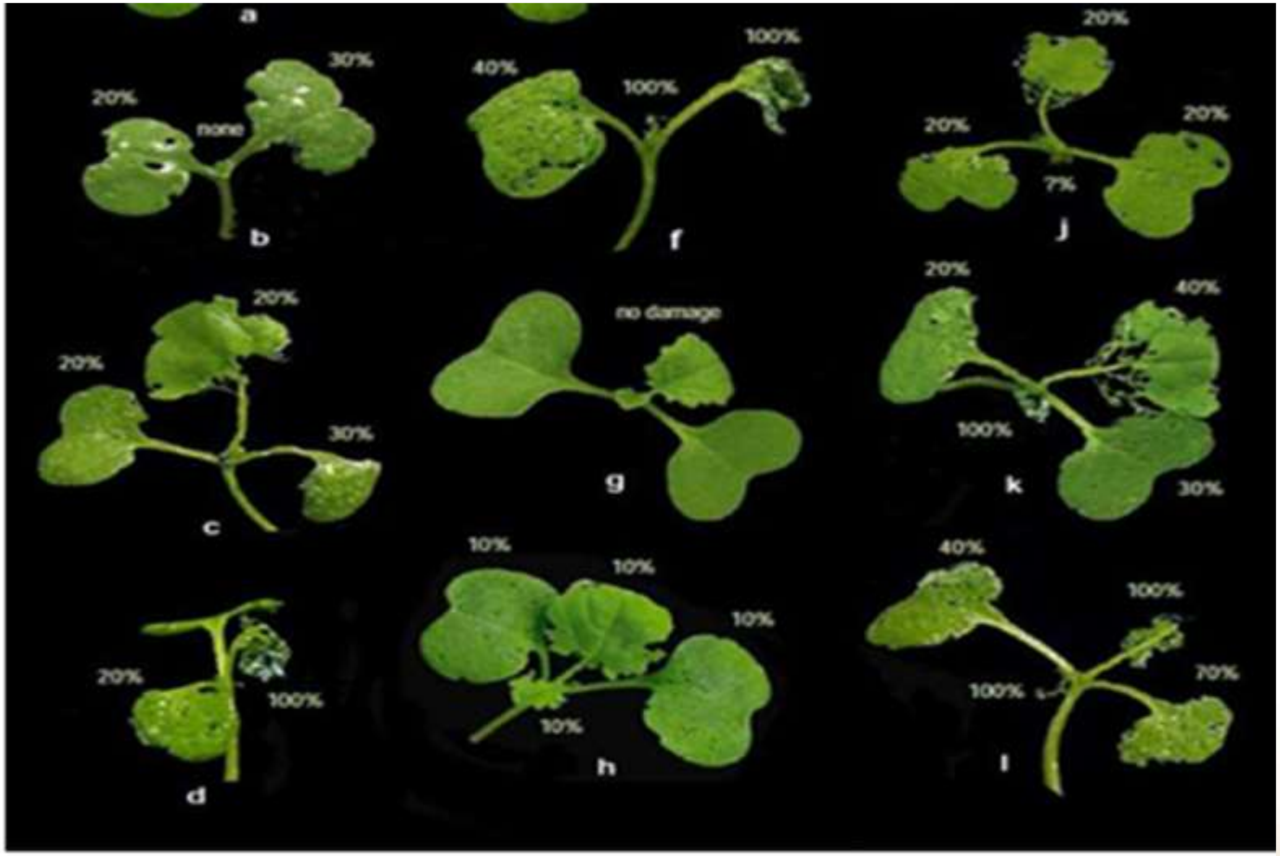


Figure 3. Canola seedlings with varying levels of flea beetle dama
Figures 3a to 3f - first leaf stage; Figures 3g to 3l - two leaf stage

Flea beetle damage at the most susceptible stage

Nominal Action Threshold: 25% damage to the seedling
<u>And</u> Flea beetles are still present

50% damage = yield decreases

Scout 10 plants per area.

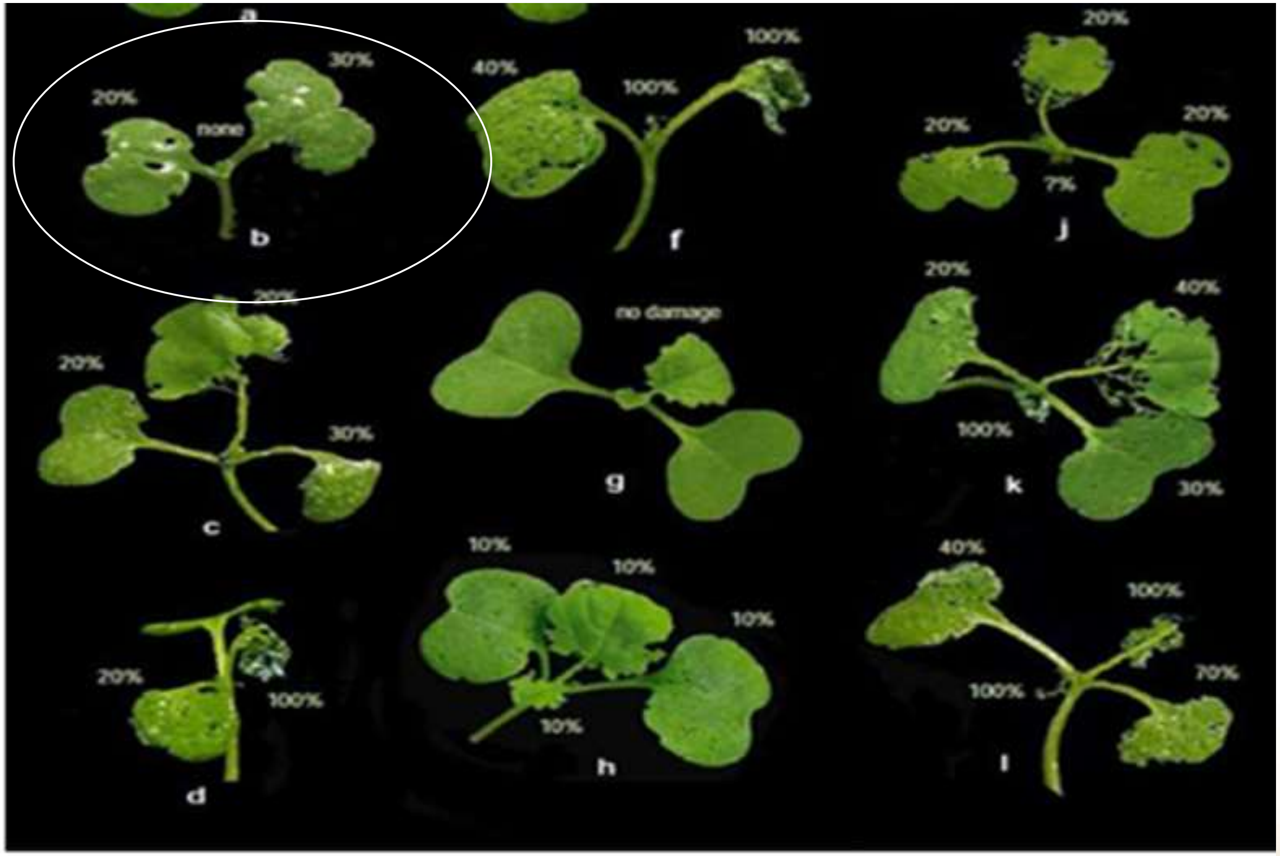


Figure 3. Canola seedlings with varying levels of flea beetle dama
Figures 3a to 3f - first leaf stage; Figures 3g to 3l - two leaf stage

Even with seed treatments

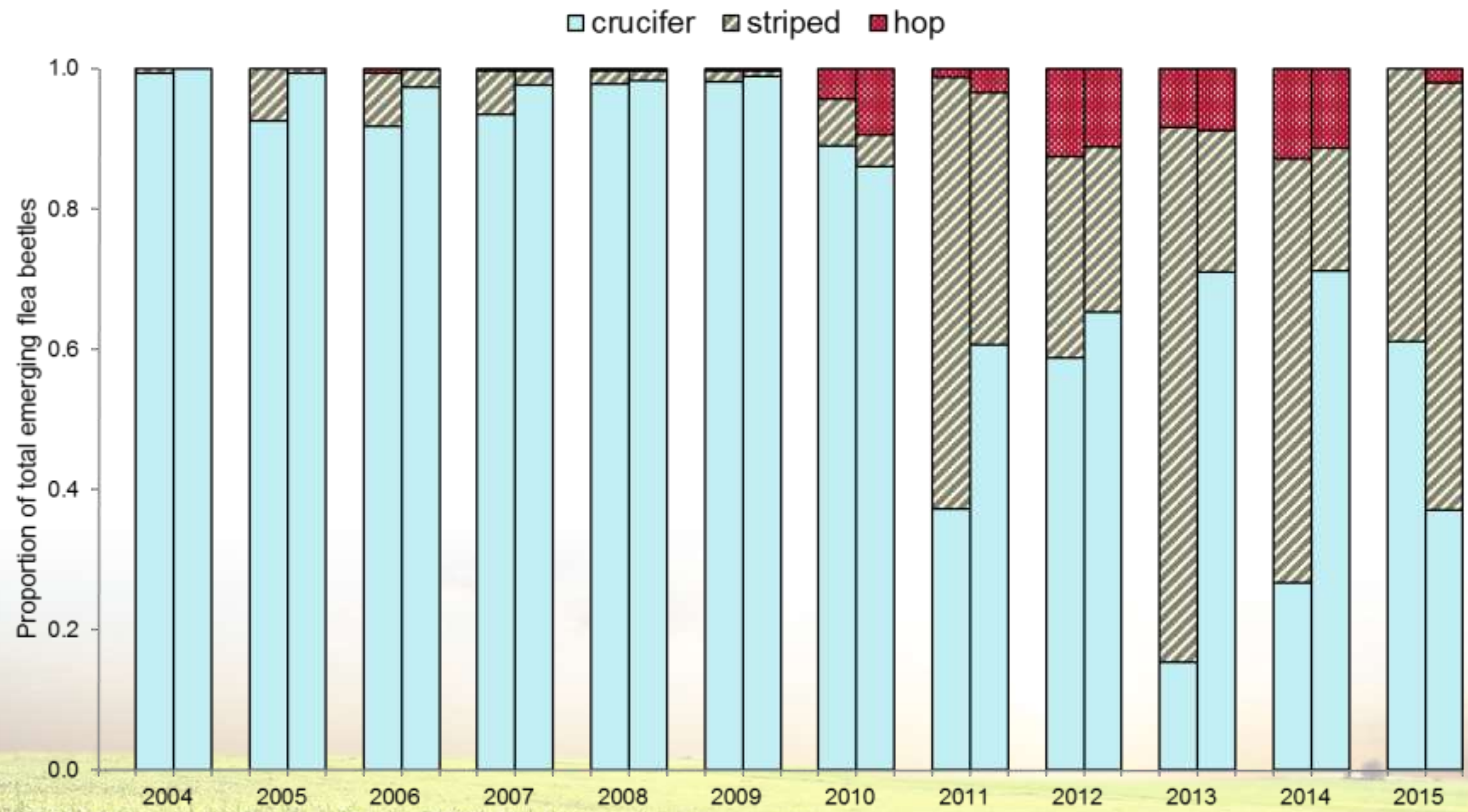
Flea beetles

Flea beetles

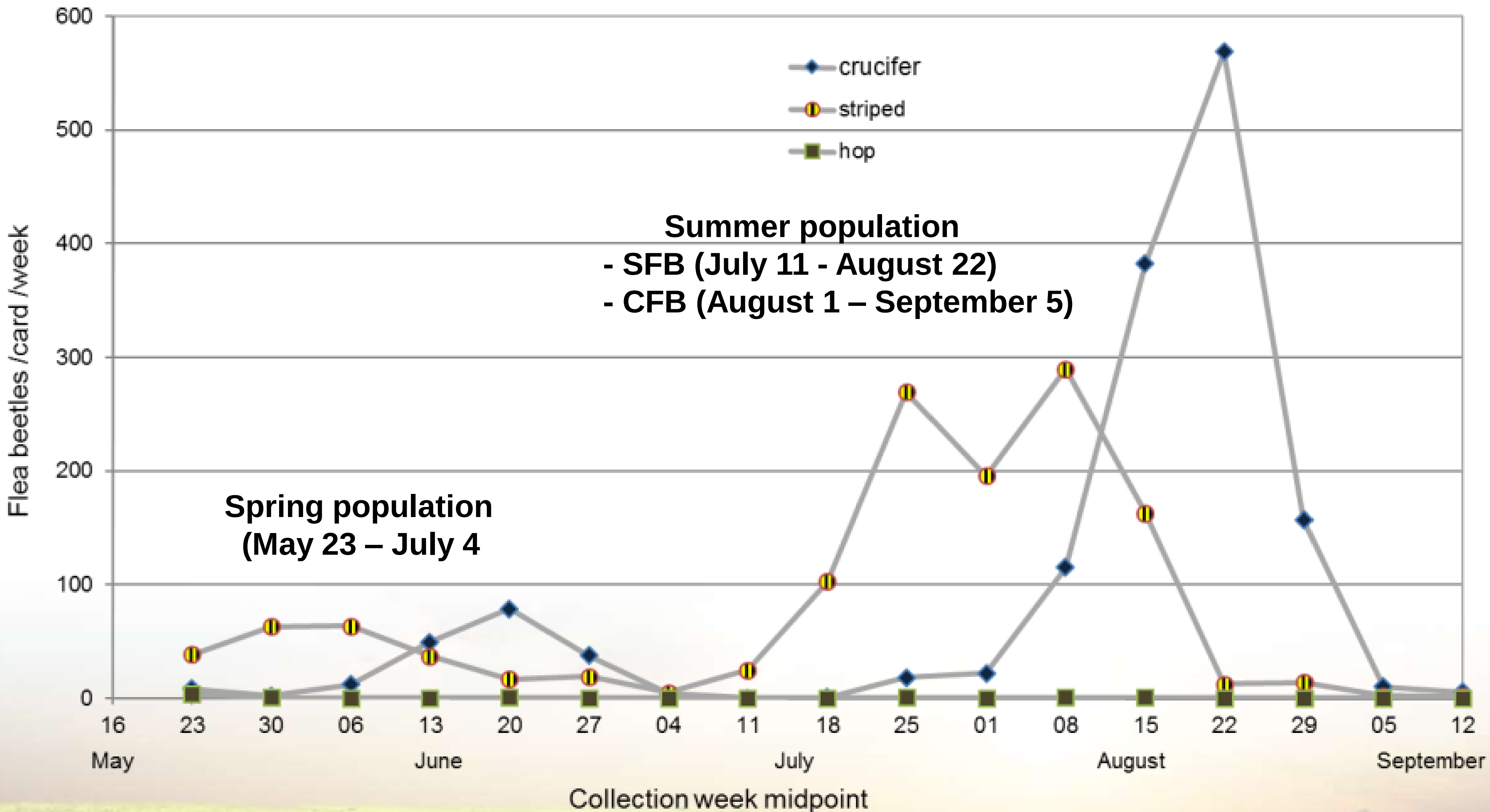
Flea beetles and yellow sticky cards

- To track species composition and population numbers

Relative abundance of crucifer, striped and hop flea beetles emerging from early-seeded (left) and late-seeded (right) canola at AAFC-Saskatoon in 2004-2015



Flea beetle counts on sticky cards in CL canola (2015)



2nd gen Crucifer flea beetle

2nd generation flea beetles

Flea beetle “debarked” pod

Flea beetle parasitoid

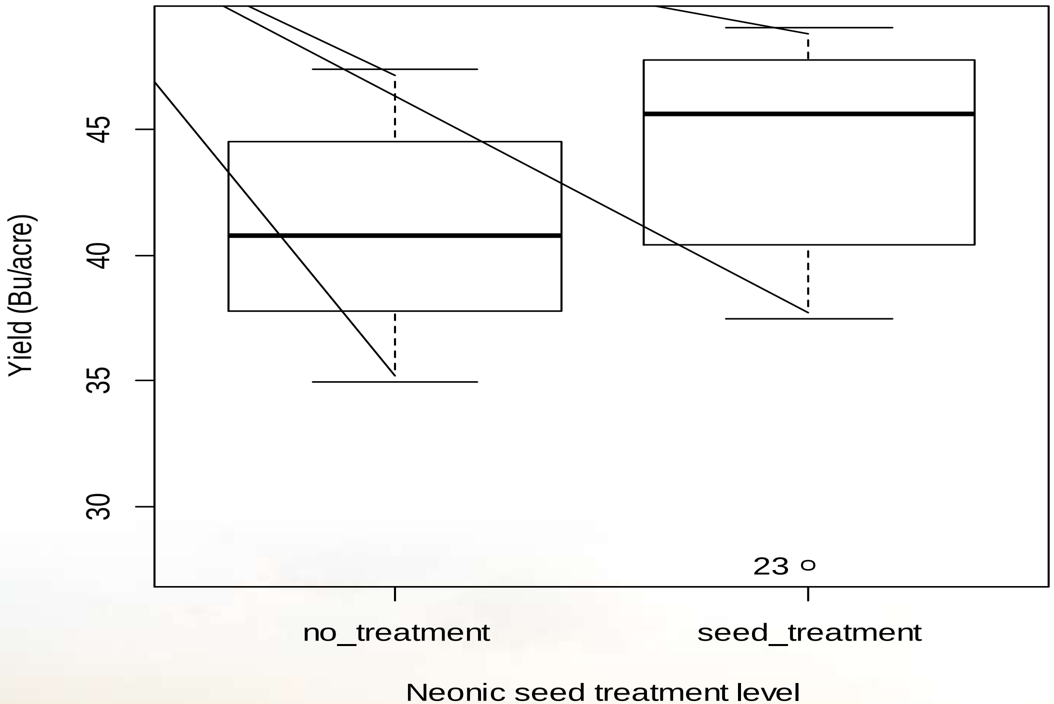
Microctonus vittatae (?)

Flea beetle parasitoid

@FieldHeroes

Neonic treated canola seed vs untreated canola seed

Damage ~70% in 3 days



N=16

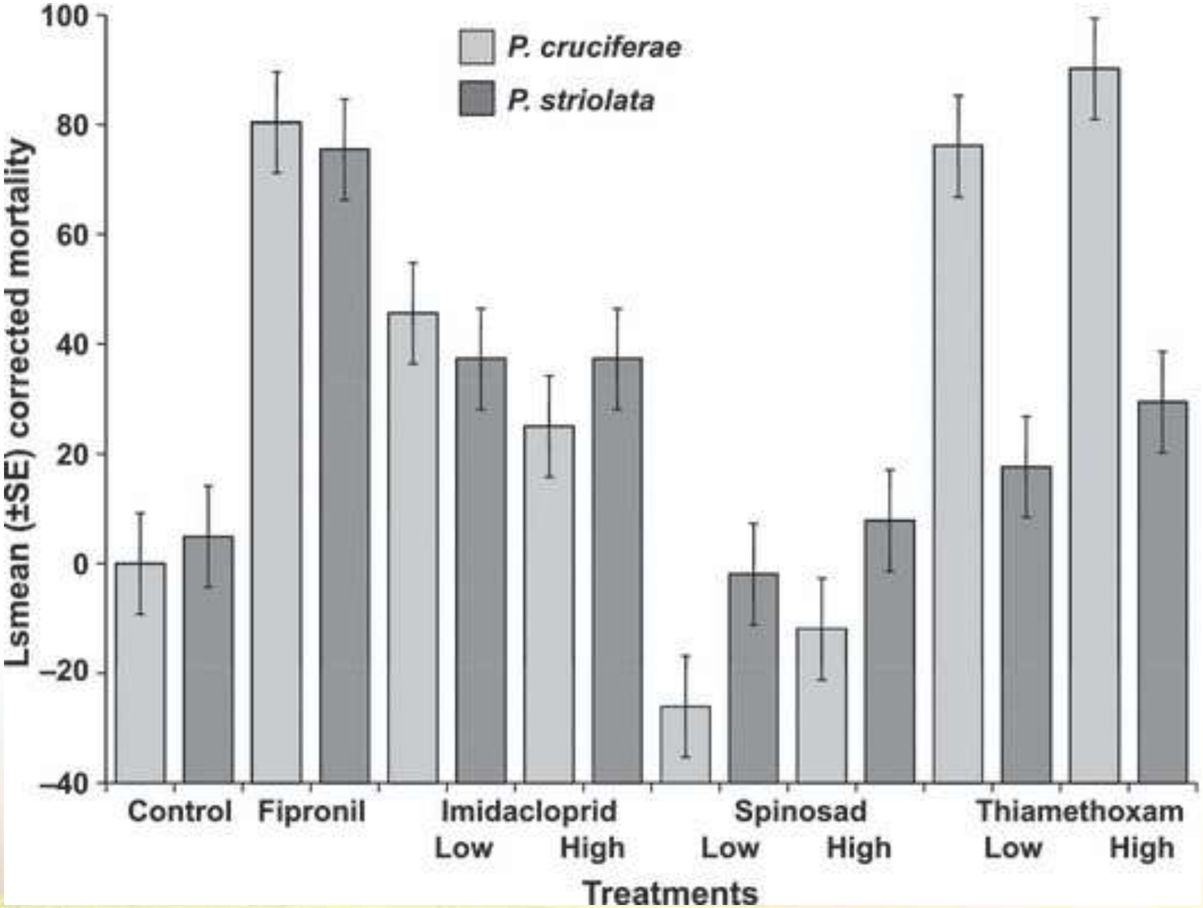
N=12

X^2 = 0.1817
GLM binomial,
Blocked by Range

~ six-bushel per acre yield loss

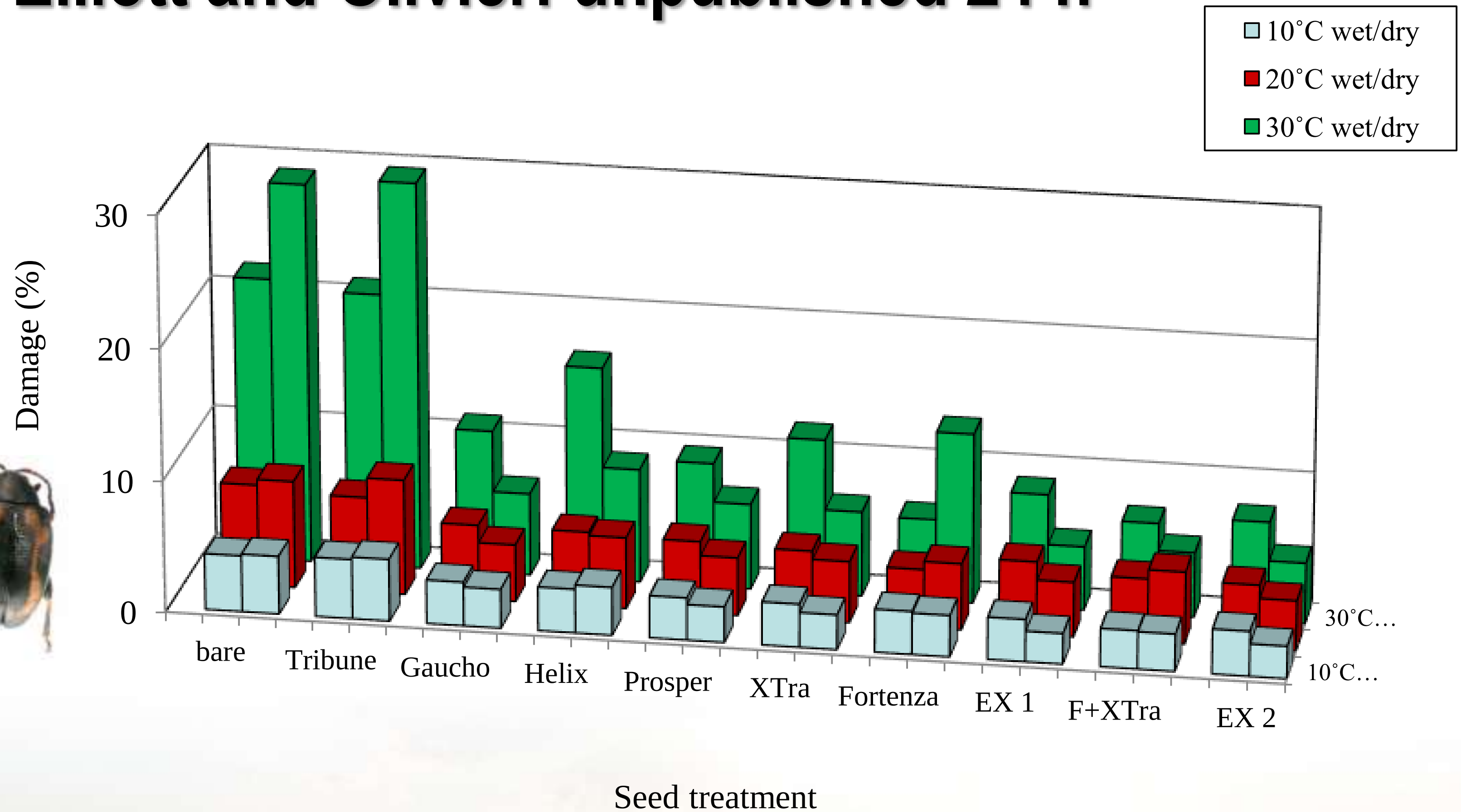
Thiamethoxam
Clothianidin

P. striolata survives neonicotinoids better than *P. cruciferae*



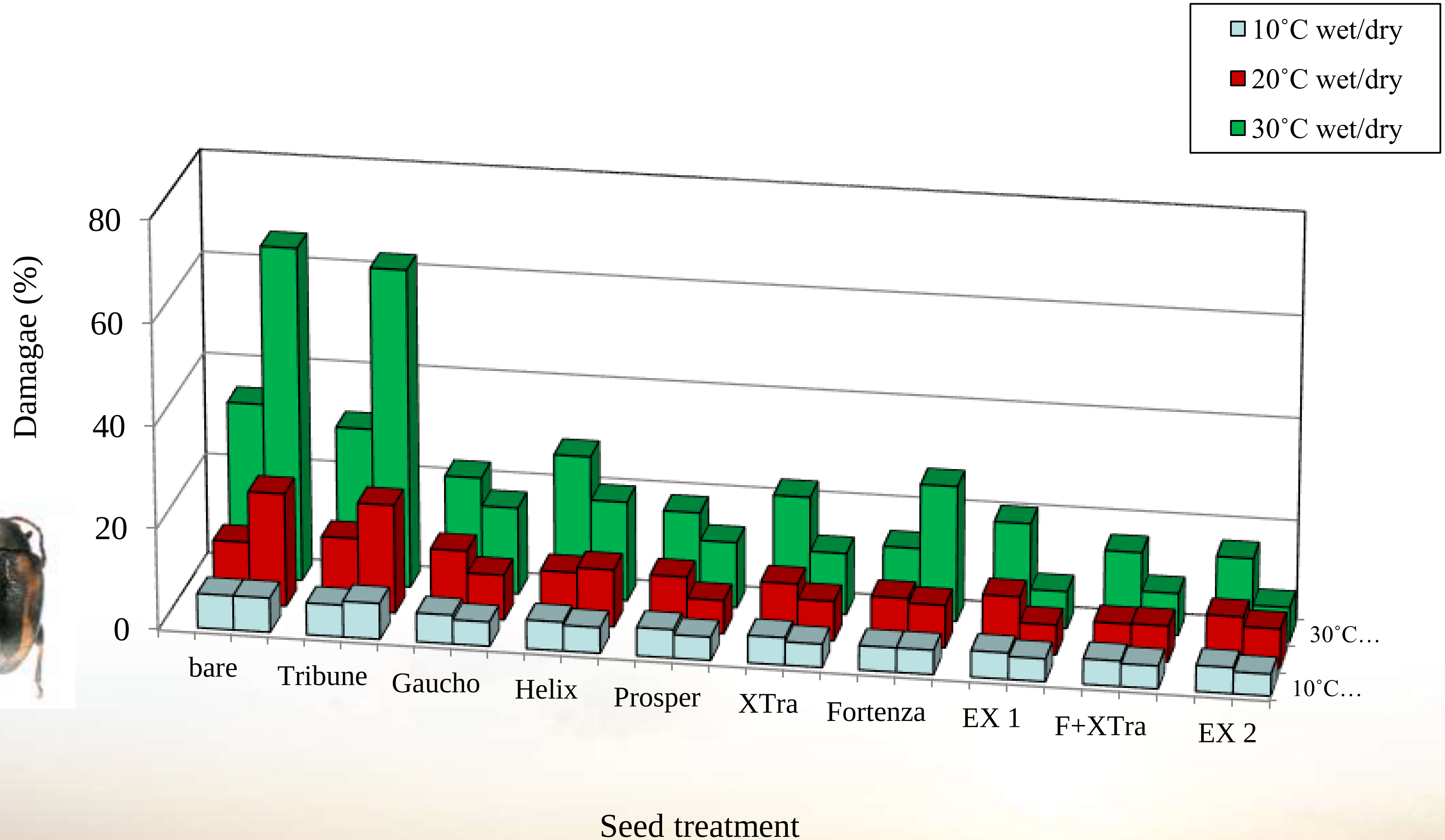
Tansey, Dosdall, Keddie *et al.* 2009

Elliott and Olivier: unpublished 24 h



Feeding damage to canola seedlings grown with different seed treatments and exposed to striped flea beetles for 24 h in wet and dry soil at 10, 20 and 30˚ C in 2012

Elliott and Olivier: unpublished 72hrs



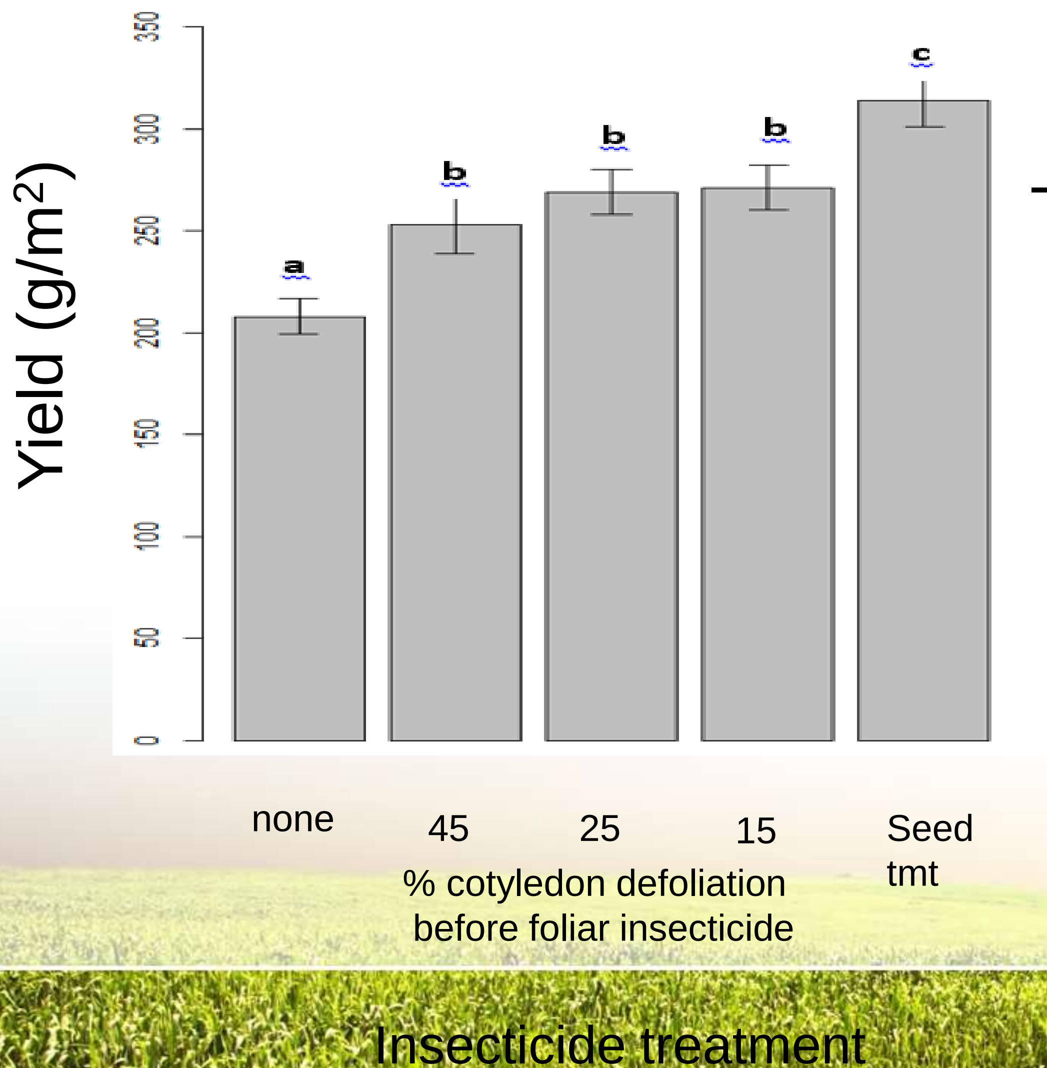
2015-2017 ET/defoliation study

- Small plots
- 3 years: 2015 -2017

Foliar insecticide sprayed at 15%, **<u>25%</u>**, 45% cotyledon defoliation

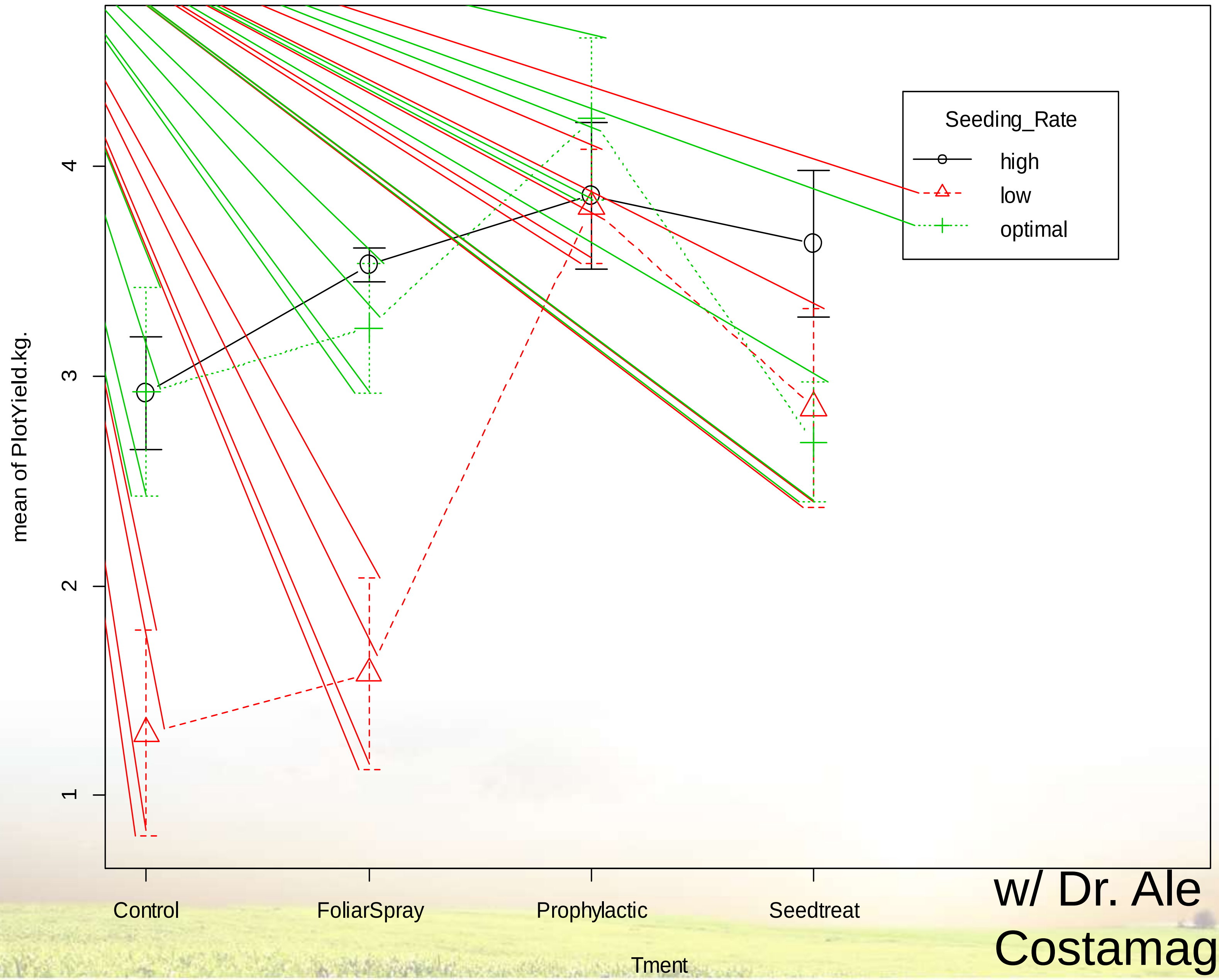
- In 2017 all plots without neonics had over 40% defoliation soon after emergence!
- -short window of control if spraying

Foliar insecticide threshold validation study



- Yield losses incurred e.g. Lethbridge - Fairfield 2016

Seed treatment and planting density



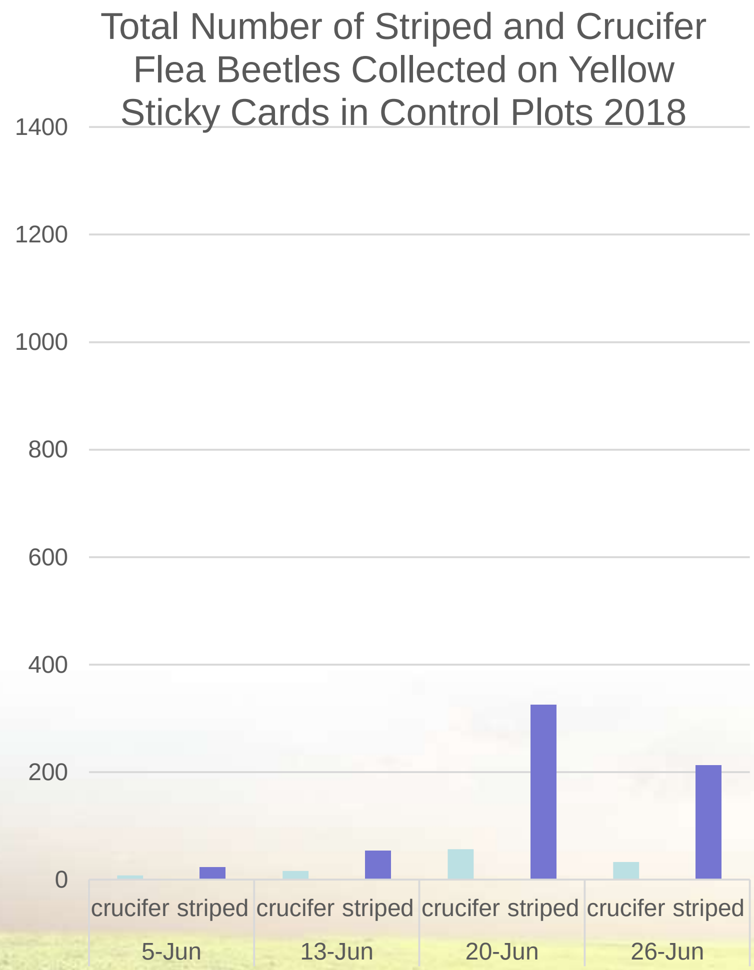
w/ Dr. Ale Costamagna UManitoba

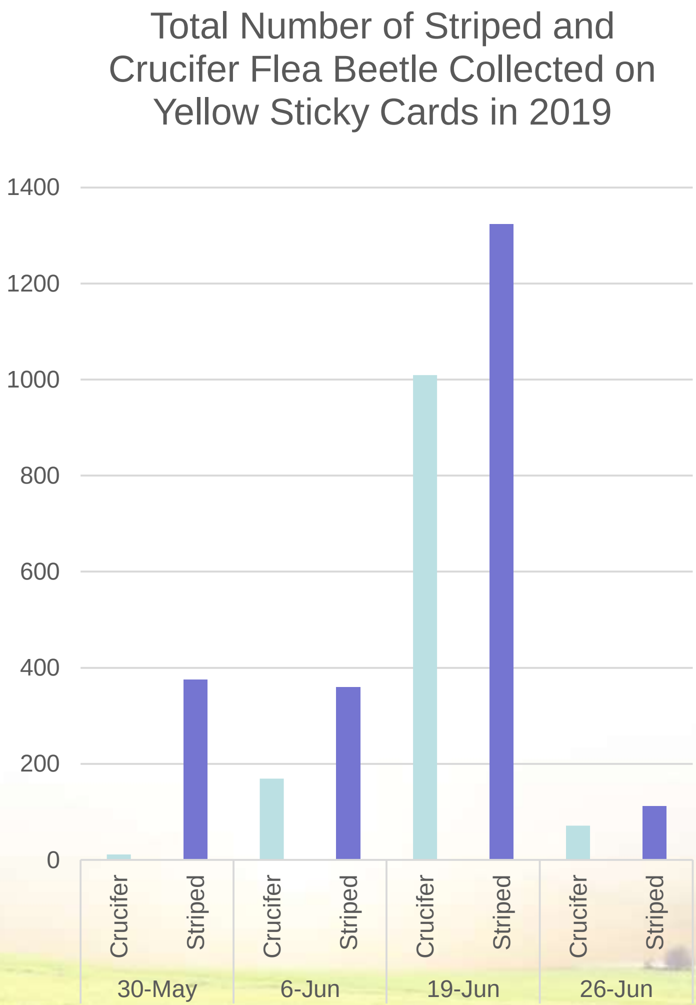
Flea beetle damage - seedling mortality

B. napus seeded May 12, 2003 – B. Elliott, Saskatoon Research Centre

Flea beetle increase

From AAFC SRDC farm: yellow sticky cards





Reduced rate seed treatment

w/ Dr. James Tansey

Reduced rate seed treatment

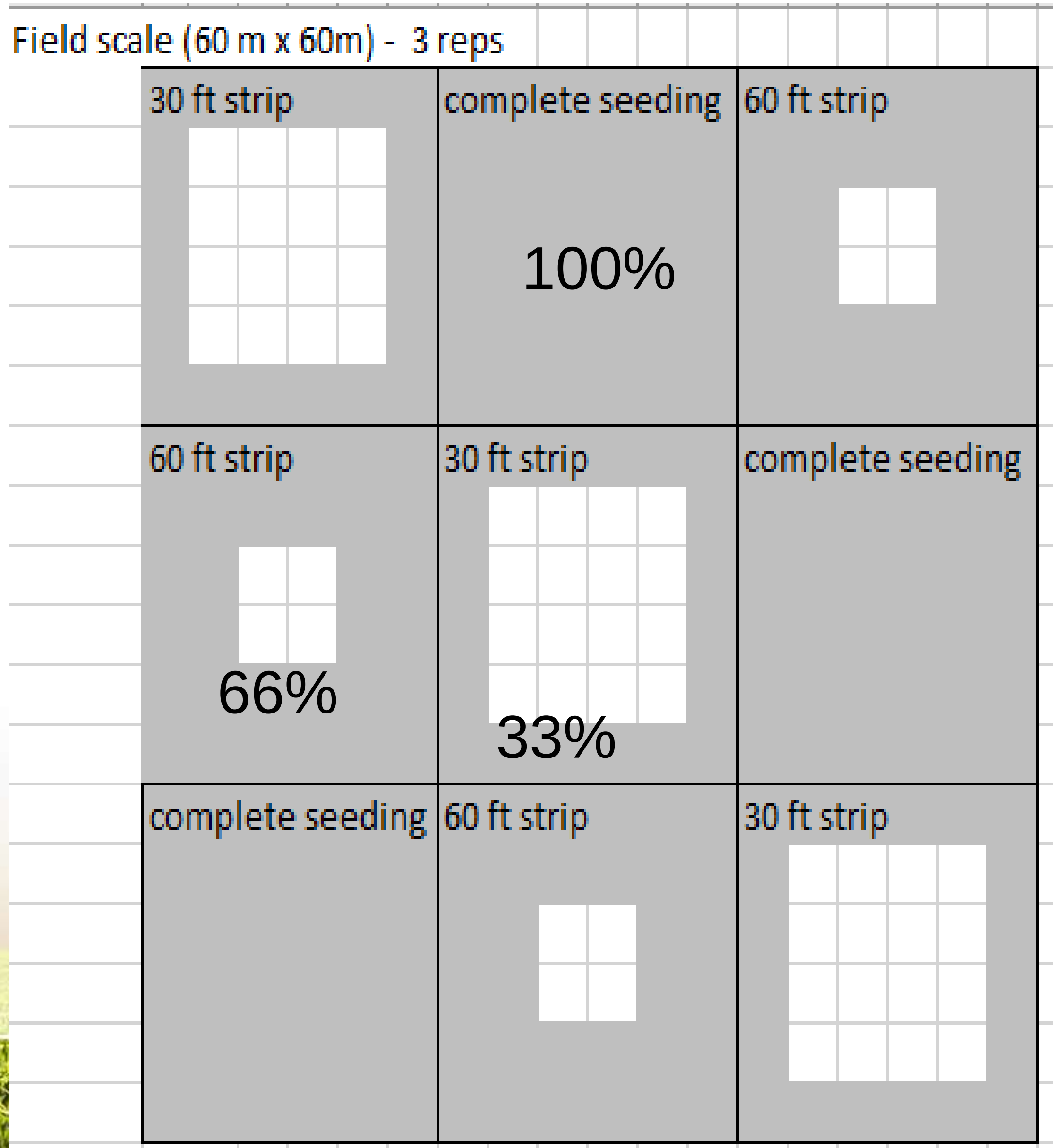


Table 2. Like-lettered treatments are not significantly different according to Tukey's Honestly Significant Difference (HSD) test ($\alpha = 0.05$)

Differences in mean flea beetle feeding damage among treatments at the AAFC Saskatoon site.

Treatment	Mean feeding damage rating (% defoliation)	Tukey HSD designation
30-ft strip (Helix)	13.90	A
60-ft strip (Helix)	10.82	AB
Complete use of seed treatment (Helix)	9.24	B

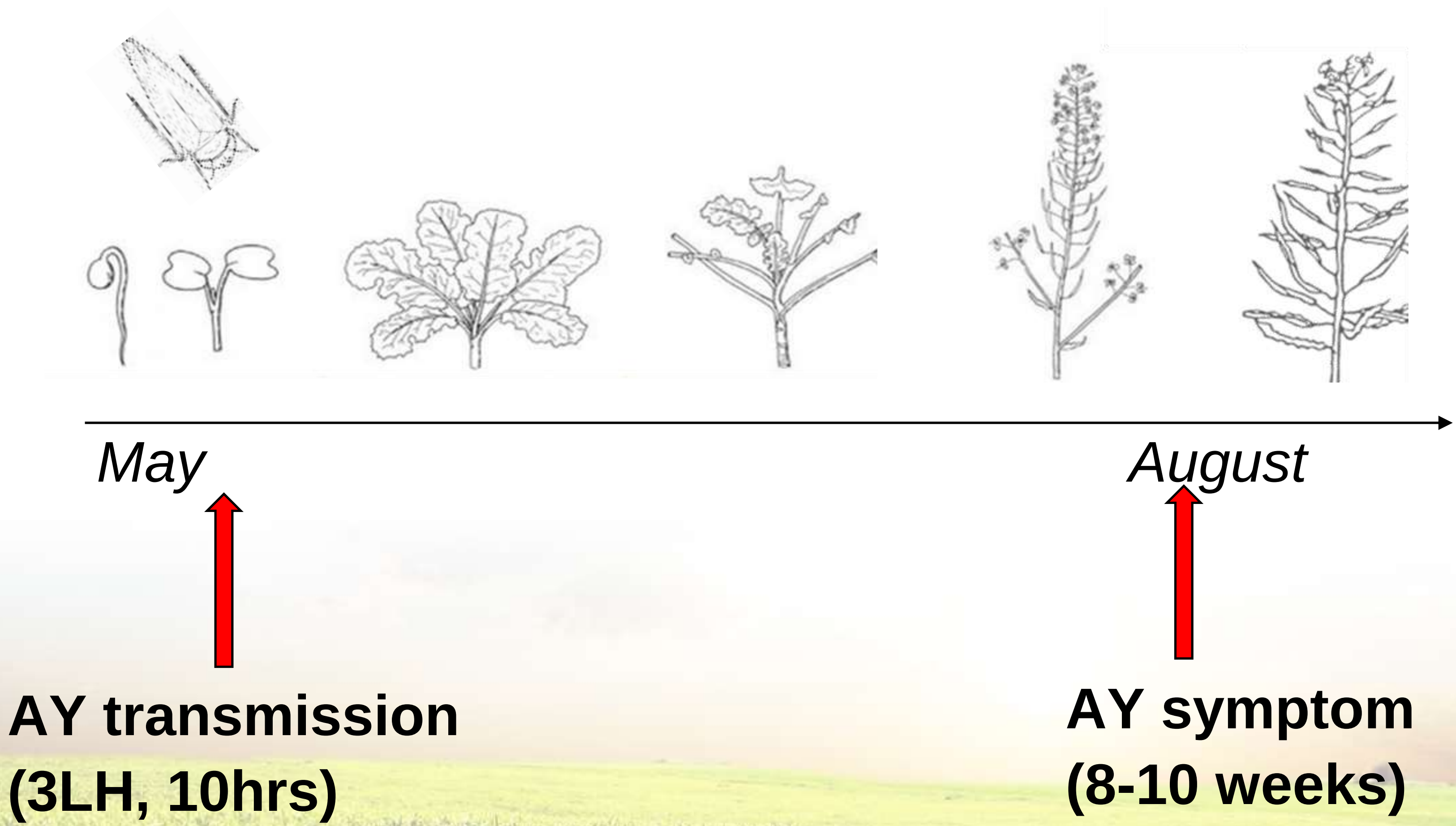
Untreated plants

17.01%

14.07%

($F_{2, 14} = 6.53$; $P = 0.010$)

AY transmission



% LH mortality at 24hrs - 72hrs

Growth stage	**Dry soil, 20ºC**		**Wet soil, 20ºC**	
	Untreated	Neonic Treated	Untreated	Treated
Cotyledon	5-10%	96-100%	3-12%	81-91%
1^{st}-2^{nd} leaf	0-3%	96%	0%	71-88%
3^{rd}- 4^{th} leaf	0-4%	98-100%	0-4%	87-98%
4^{th}-5^{th} leaf	0-4%	98-100%	0%	95-98%
6^{th}-7^{th} leaf	0-4%	99-100%	0-3%	94-97%

*Seed treatment: Helix Xtra

% plants with AY (PCR test)

Growth stage	Dry soil, 20ºC		Wet soil, 20ºC	
	Untreated	Neonic Treated	Untreated	Treated
Cotyledons	0%	0%	18%	0%
1st-2nd leaf	8%	0%	27%	7%
3rd- 4th leaf	6%	0%	39%	5%
4th-5th leaf	17%	0%	8%	6%
6th-7th leaf	14%	0%	33%	0%

30 plants/exp

Seed treatment: Helix Xtra

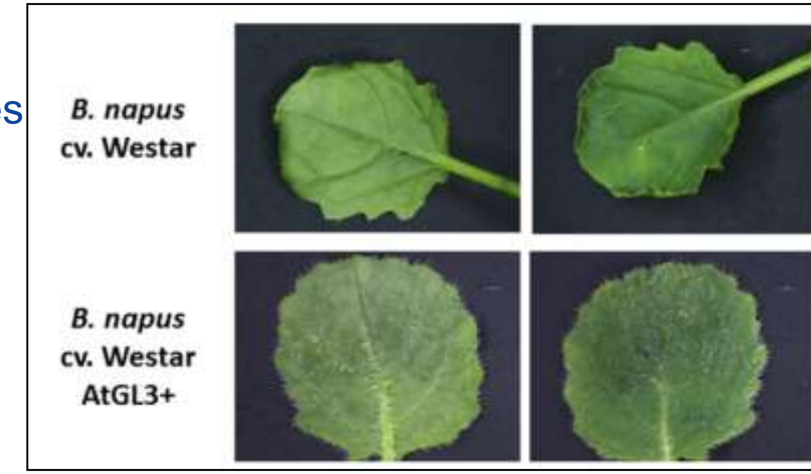
Alternatives to neonics

- Seed treatment with Lumiderm or Fortenza
- AI is cyantraniliprole, Group 28 insecticide (diamide)
  - Less water soluble than neonics
- Foliar sprays
  - Daily scouting
  - More equipment and fuel use
  - Human health?
  - Foliar sprays and water bodies???
  - AI amount?
  - Harm to non-target, beneficial insects
    - ex. Floate et al. 1989, synthetic pyrethroid spray made ground toxic to ground beetles for one week (+chlorpyrifos, carbofuran, dimethoate)

Hairy canola

Courtesy of Chrystel Olivier
AAFC

Hairy canola: "Hairy" transgene reduced damages by crucifer FB (Gruber et al., 2006; Soroka et al., 2011; Alahakoon et al., 2016).



Genetic diversity study:

Hairy *B. napus* lines (DOS)
(Self pollination/double haploid)

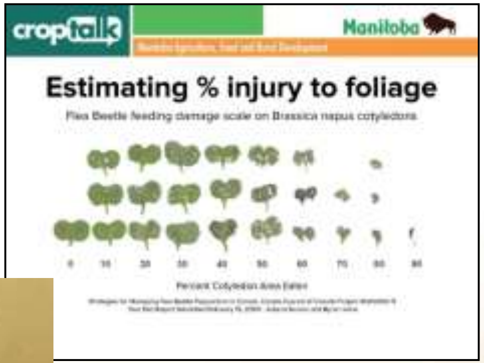
Hairy *B. villosa* (Bvil)

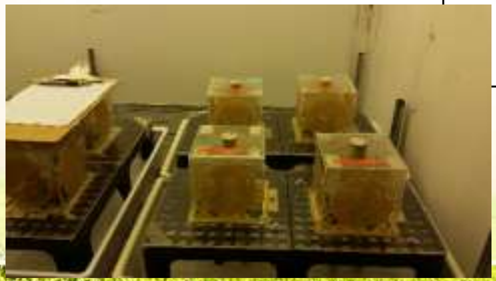
Bioassay-Feeding damages

Feeding damages after 1-5 days in choice/ no-choice bioassays with Ac Exel, DOS, Bvil, RR lines, transgene lines. Partial results….replications still in progress.

Set-up:

4 plants & 10 fb/cage; 5 rep
2 growth stages (cotyl, 1&2 leaf);
2 temperatures (12ºC night/18ºC day and 22ºC night/25ºC day);
4 soil moistures: dry (20-30%), wet (40-50%), very wet (60-70%) & saturated (100%).
16L/8D, 50-60% relative humidity, and 400-500 µmol/m^2 /s.
Damages: % damaged leaf areas.

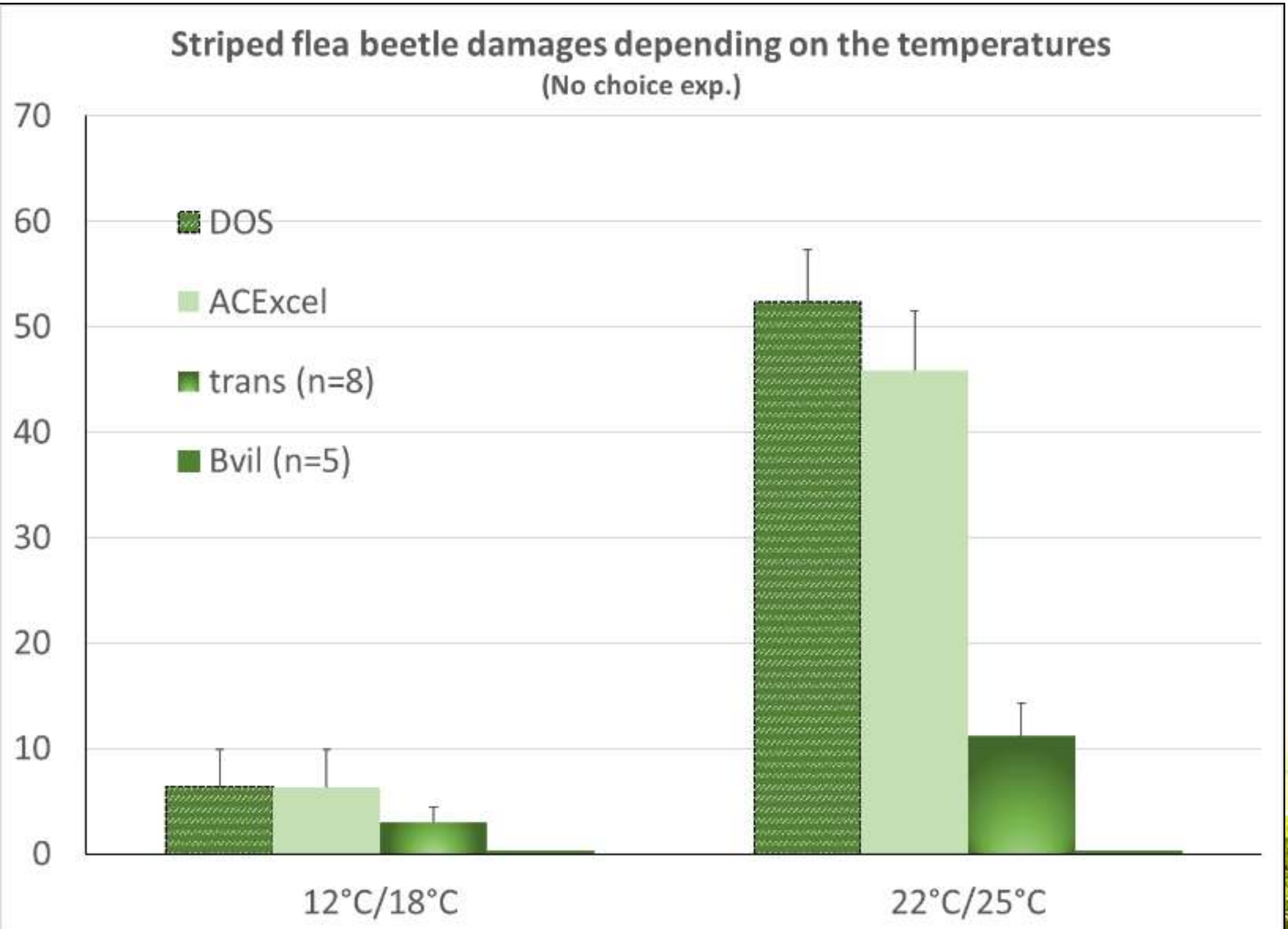




Feeding damages - results

Striped flea beetle damage higher

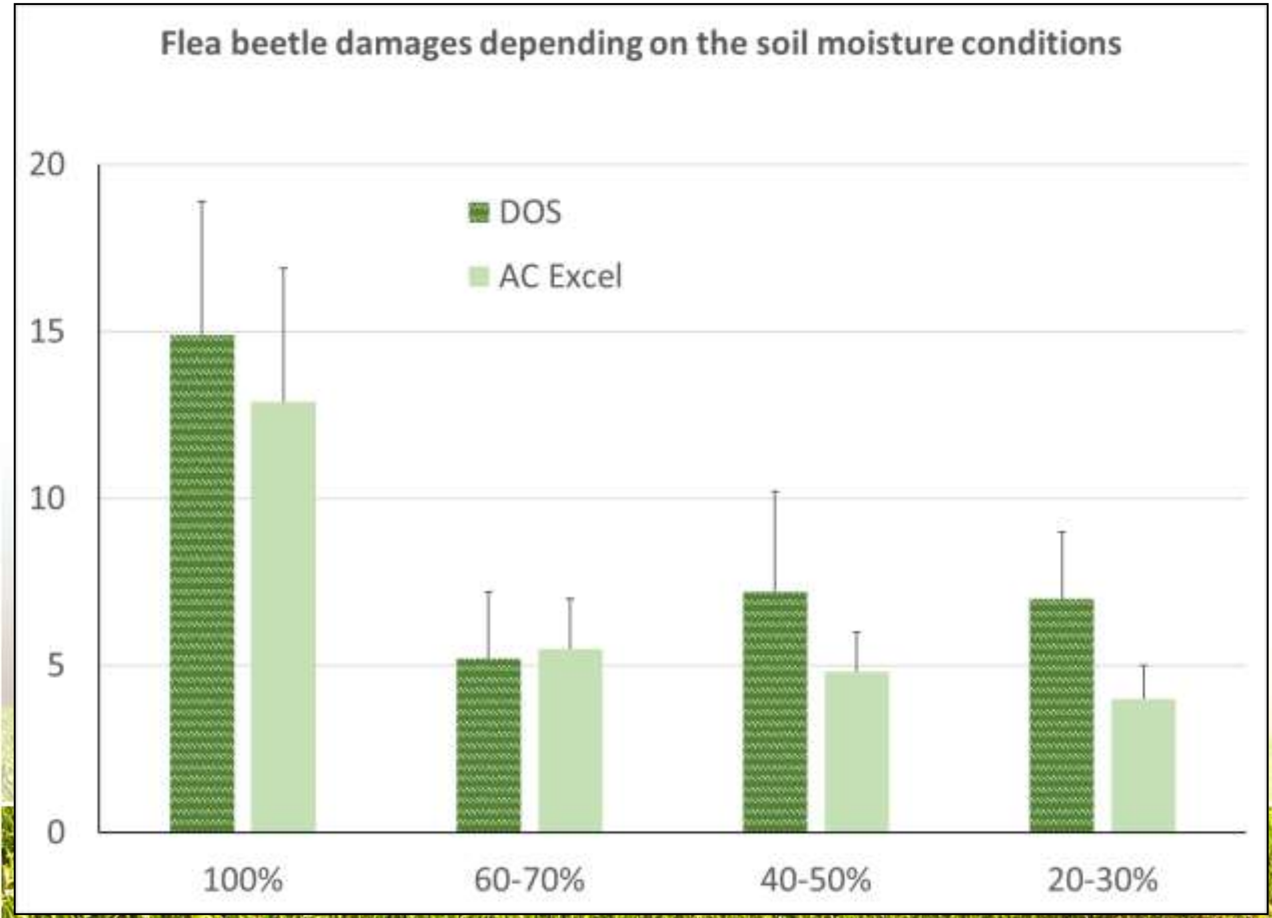
- **in warm temperatures compared to cold temperatures.**



Feeding damages - results

Striped flea beetle damage higher

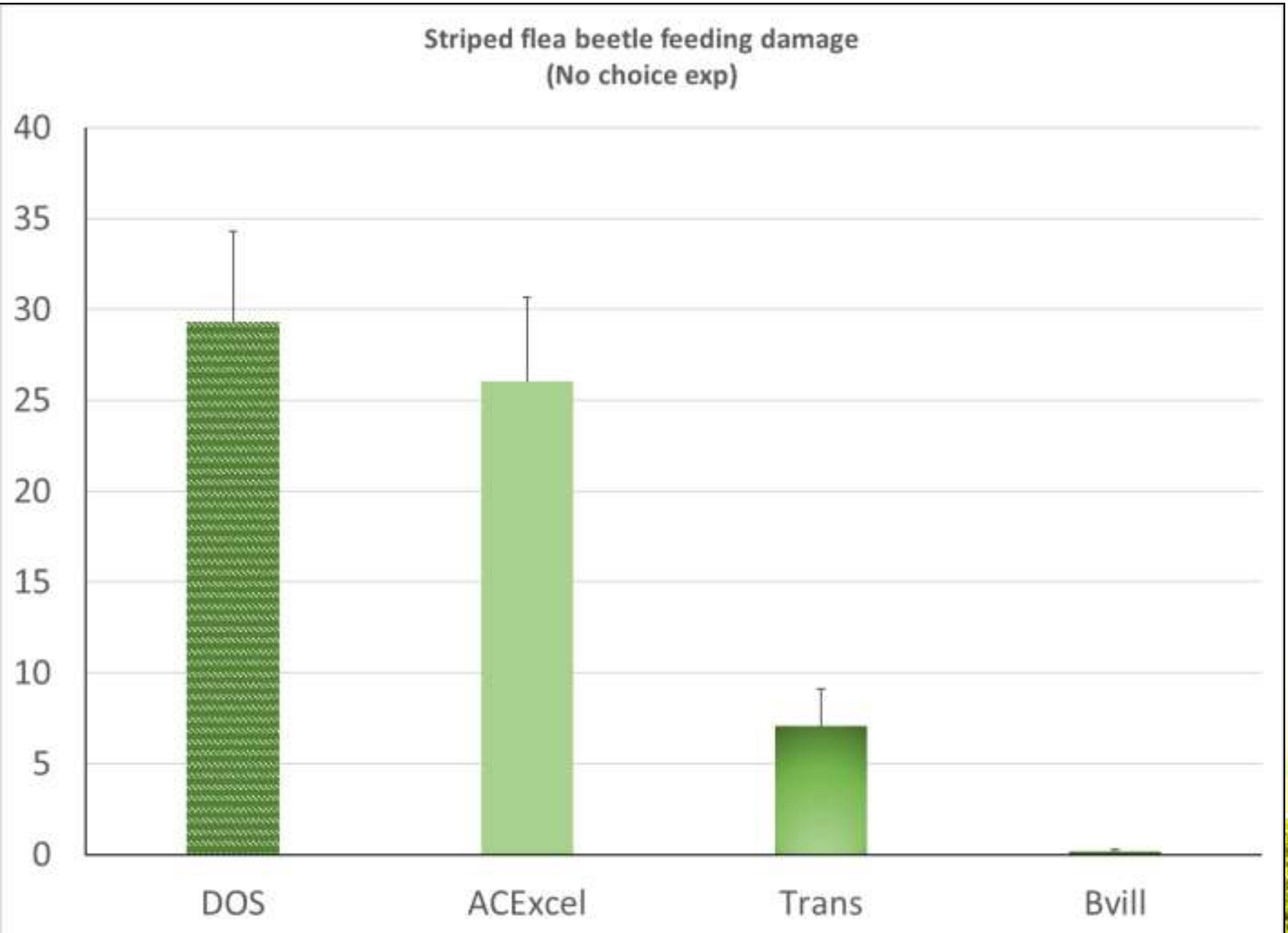
- in warm temperatures as compared to cold temperatures.
- **In saturated soils as compared to drier soils.**



Feeding damages - results

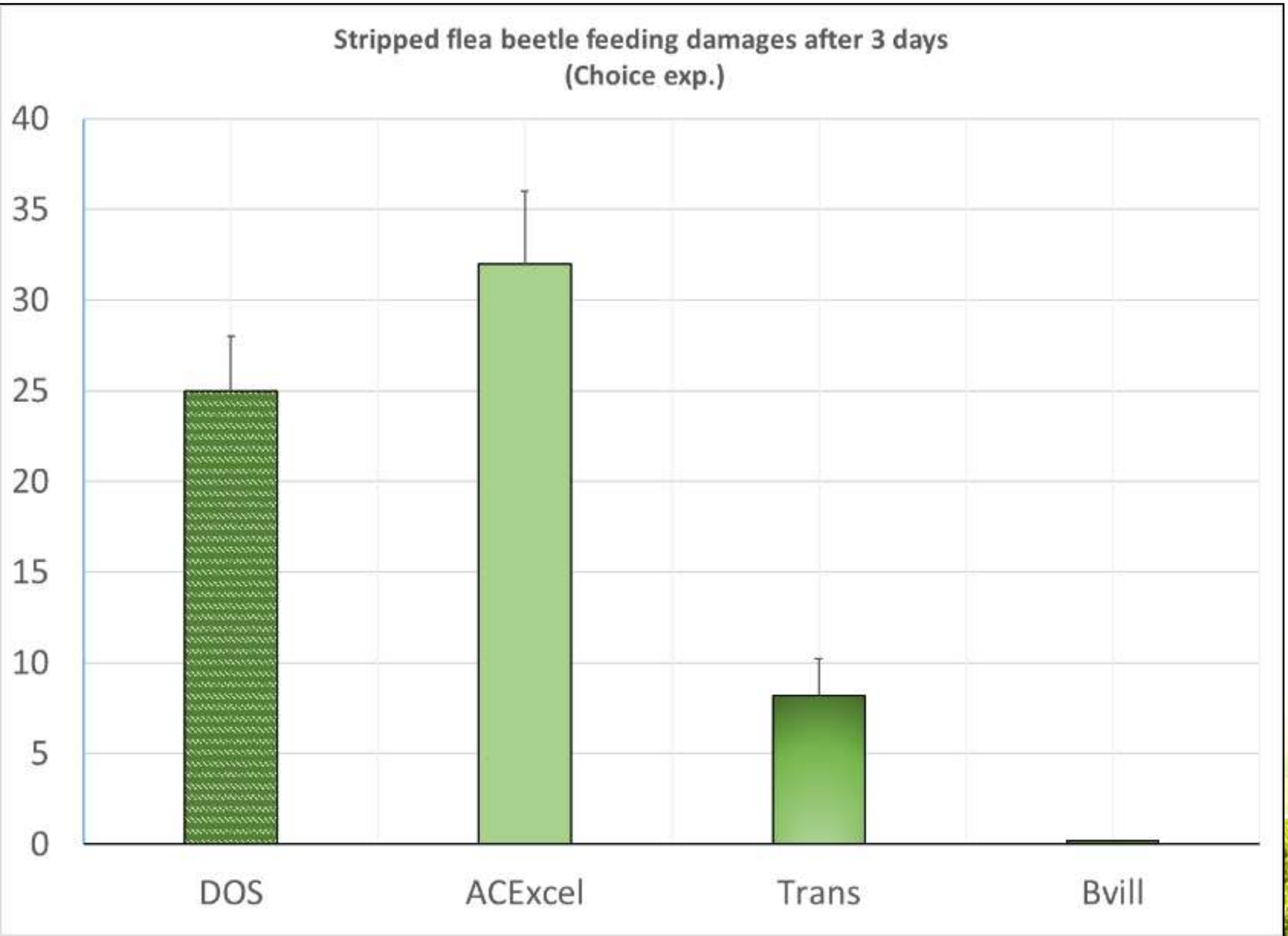
Little to no feeding on *B. villosa* and Trans plants when given no choice of plants

Feeding on DOS and ACExcel similar in no choice bioassays.



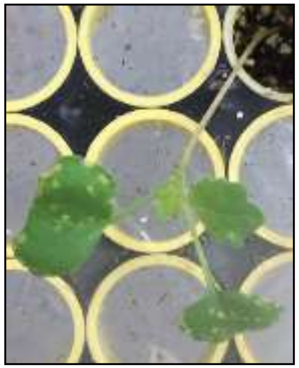
Feeding damages - results

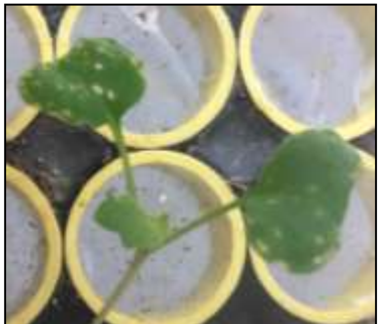
Little feeding on *B. villosa* and Trans plants when given a choice
Less feeding damages on DOS as compared to ACExcel in choice bioassays.

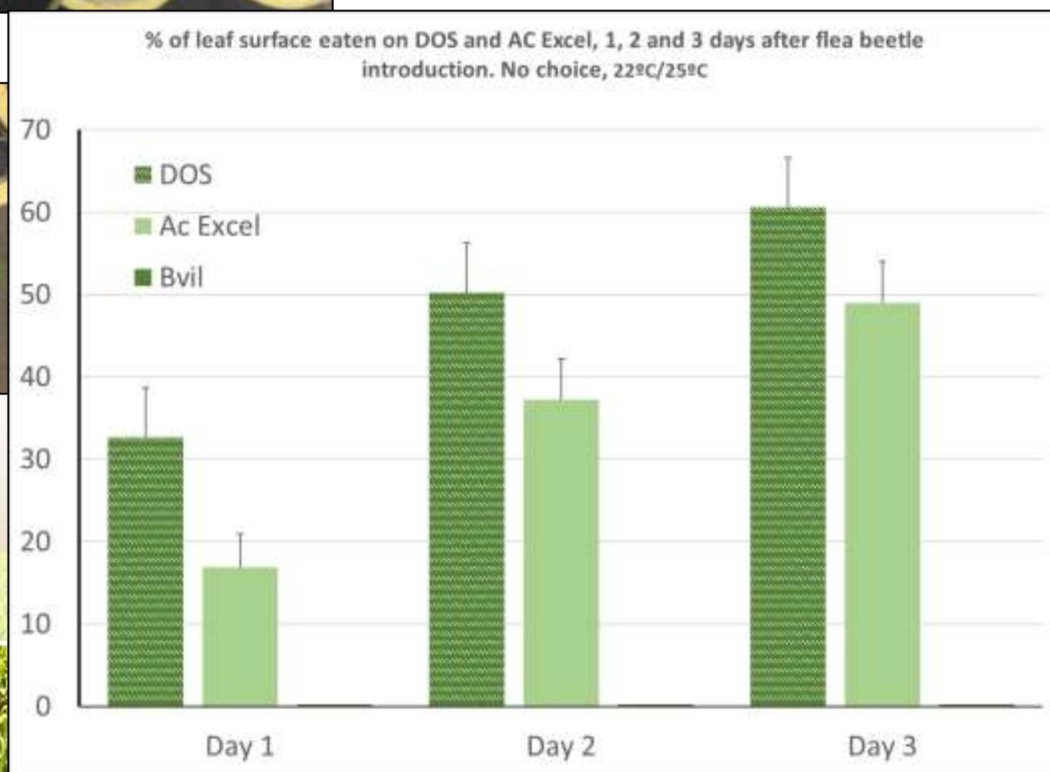


Feeding damages - results

DOS plants tend to be clipped by flea beetles at the stems and petioles, compared to AC Excel. Flea beetles do not clip/eat Bvil.

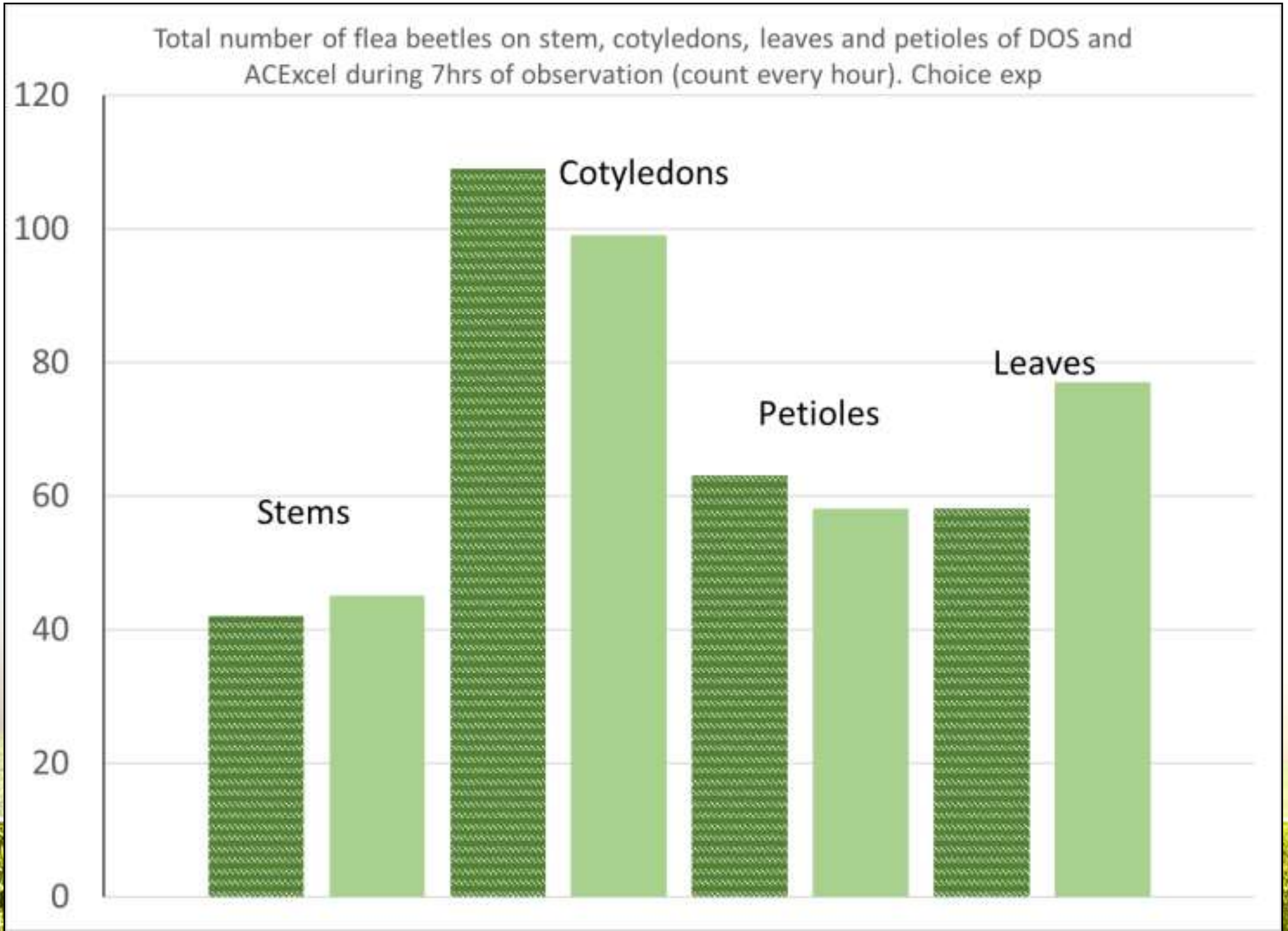






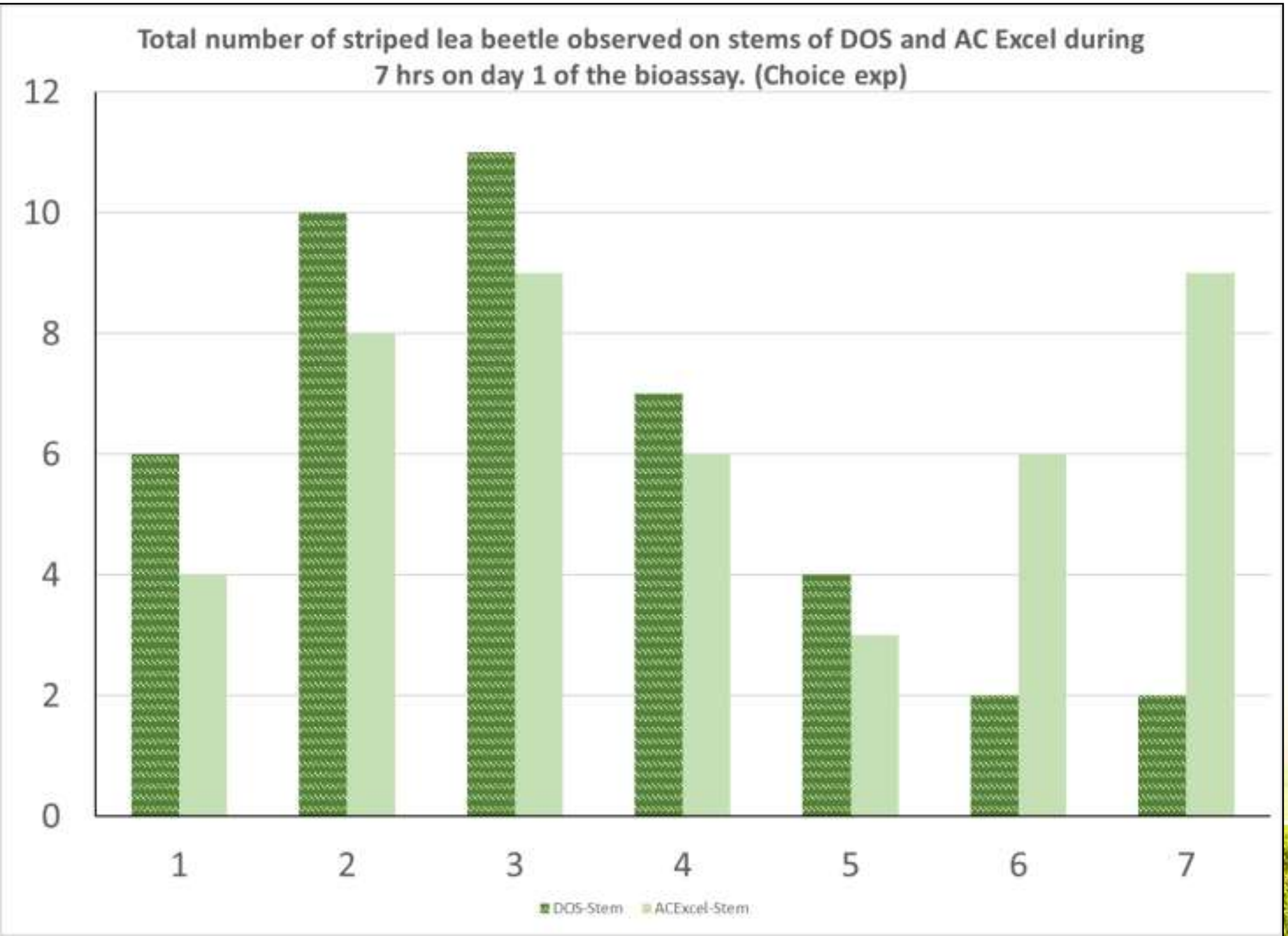
Distribution - Results

Striped Flea beetles prefer cotyledons over other tissues.



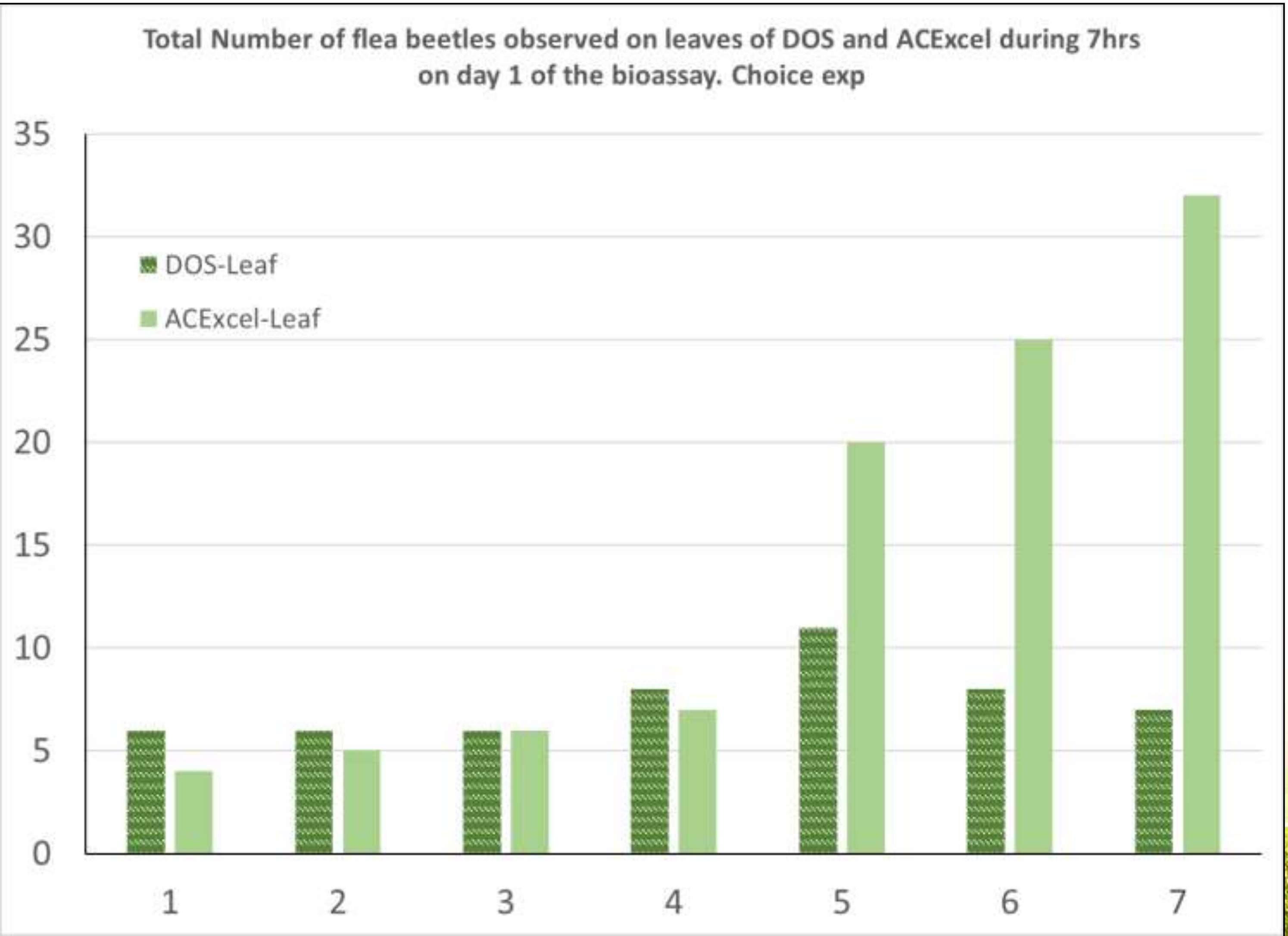
Distribution - Results

More Striped Flea beetles on stems of DOS than ACExcel.



Distribution - Results

More Striped Flea beetles on leaves of ACExcel than DOS, after 5hrs: *avoiding the hairy parts?*



Further reading on Europe

- HFFA report: http://hffa-research.com/new-hffa-research-paper-published-the-economic-and-environmental-costs-of-banning-neonicotinoides-in-the-eu/
- EFSA on Bee Health: http://www.efsa.europa.eu/en/topics/topic/bee-health
- EU Commission report on Bee Health: https://ec.europa.eu/food/sites/food/files/animals/docs/la_bees_health_honeybee_health_communication_en.pdf
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Questions?

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