Hold tight!
Webinar starts at 1pm.

“Pain in the Parvi”

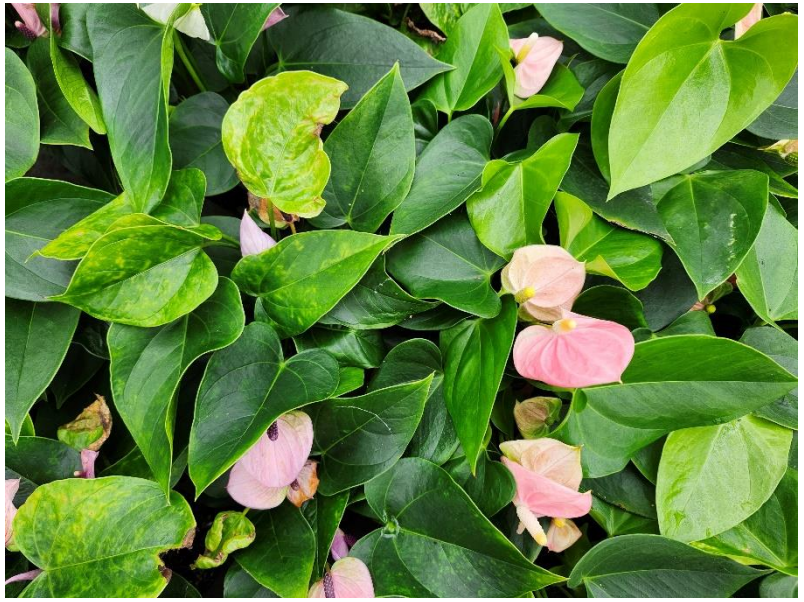
Plant Products Workshop, 2024

Judy Colley, IPM Lead
Plant Products

Sarah Jandricic, Greenhouse Floriculture IPM Specialist
OMAFRA

Where we're at: Parvipsinus control world-wide

- We've amalgamated research from other places and implemented it in Ontario
  - NL – limited biocontrol trials
  - US – pesticide screening, limited biocontrol trials
  - **Ontario – on-farm tests of pesticides & bios**
  - Georgia and ON – in-depth projects **happening in next year**



Ontario

Why all the hoopla you ask? $$$

- **2023 total wholesale losses due to Parvi $161,542.50 at one farm in Ontario alone.**

Date	Size	Product Description	Supplier	Plant Stick Week #	Reason for discard	Stage 1 of Discard	Stage 2 of Discard	Stage 3 of Discard	Avg Sell Price (CDN $) unit price	Lost Wholesale Value (CDN $)
dec 20/22	5"	anthur. Arisa white		22	pepper thrip	0	300	0	$ 9.50	$ 2,850.00
feb 14/23	5"	anthur. Arisa white		30	pepper thrip	0	240	0	$ 9.50	$ 2,280.00
mar 30/23	5"	anthur. Arisa white		22	pepper thrip	0	0	500	$ 9.50	$ 4,750.00
mar 30/23	5"	anthur. Arisa Pink		22	pepper thrip	0	0	1000	$ 9.50	$ 9,500.00
may 30/23	5"	anthur. Arisa Sweet		48	pepper thrip	0	0	1000	$ 9.50	$ 9,500.00
june 28/23	5"	anthur. Arisa Pink		48	pepper thrip	0	0	2500	$ 9.50	$ 23,750.00
july 19/23	5"	anthur. Arisa Pink		11	pepper thrip	0	3000		$ 9.50	$ 28,500.00
aug 30/23	5"	calathea misto		12	pepper thrip	0	0	200	$ 12.95	$ 2,590.00
sept 13/23	5"	calathea misto		22	pepper thrip	0	0	1500	$ 12.95	$ 19,425.00
sept 26/23	5"	calathea misto		22	pepper thrip	0	0	1000	$ 12.95	$ 12,950.00
sept 26/23	17cm	calathea misto		12	pepper thrip	0	0	50	$ 17.95	$ 897.50
Nov 7/23	5"	anthur. Arisa white		11	pepper thrip	0	0	600	$ 9.50	$ 5,700.00
Nov 8/23	5"	calathea misto		34	pepper thrip	0	0	3000	$ 12.95	$ 38,850.00
										$ 161,542.50

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Industry Losses

- **Peppers (Indonesia):** 23% crop losses
- **Peppers (FL):** $1.3 M from 1 grower
- **Mandevilla/Dipladenia (ON):** 60% crop loss in 2022 ($2.5 M); 20% losses in 2023; s/b 10% in 2024
- **Full, losses in ornamentals, US/CAN:** unknown

Figure 8 Damage of *Thrips parvispinus* in Pepper Field

Photos courtesy University of Florida Extension

Identification and Monitoring and Government-y Stuff

(Maybe the only thing we've got figured out…)

Ontario

Regulatory issues

Concerns:

- UNLIKELY to be a regulated pest in CANADA – **BUT still a quarantine pest in FL, pest of concern by USDA**
- Recently found in other states – action uncertain
- Still a **threat to border trade** – clean up before shipping is KEY

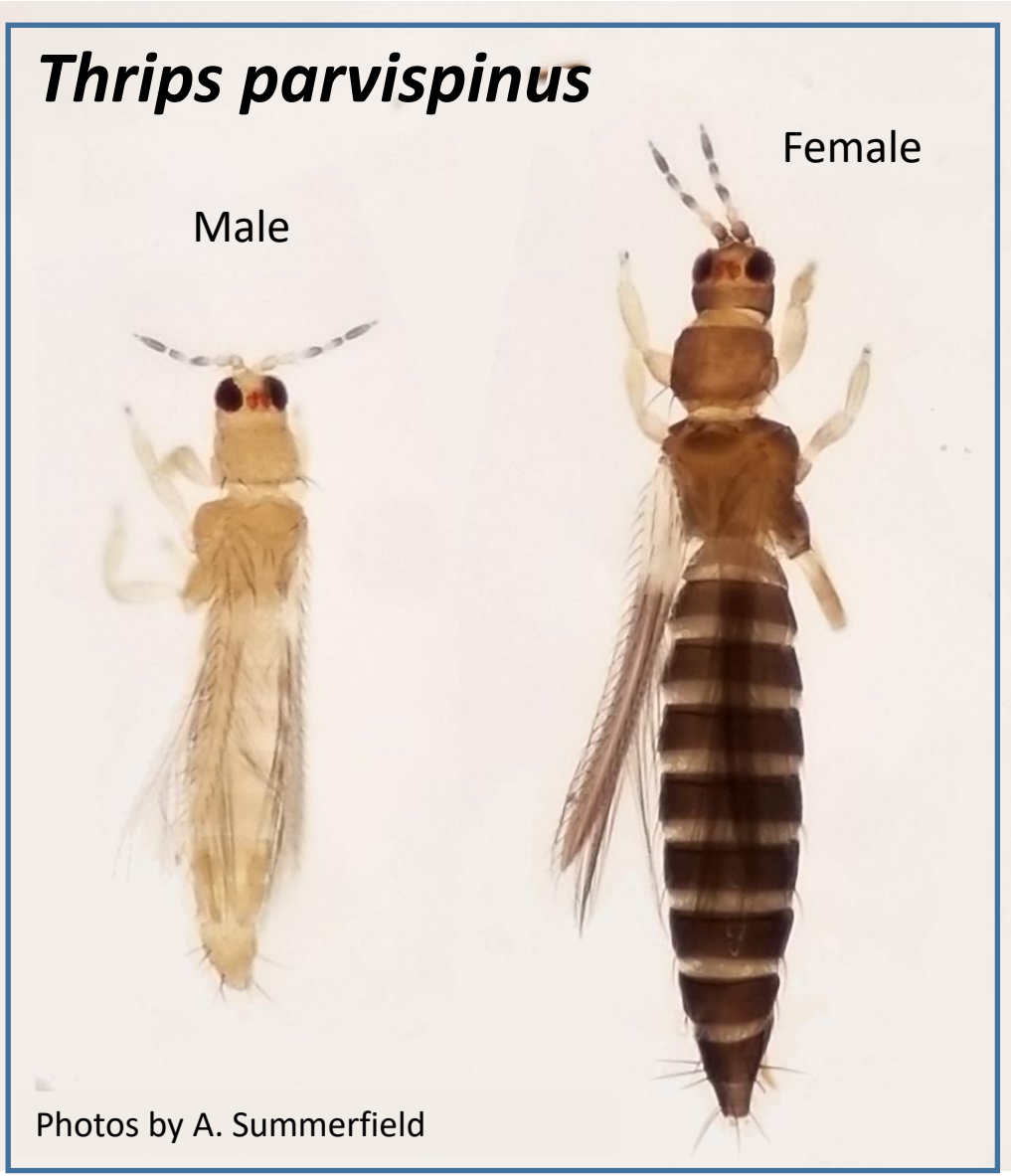
Red = confirmed; **orange = unofficial**

Ontario

Appearance / ID

Appearance:

- VERY small, dark brown, lighter head & thorax
- Wings pale at base
- Males yellow
- VERY red ocelli



vineland
RESEARCH & INNOVATION CENTRE

Ontario

Seeing dark thrips in your greenhouse?

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- **Is the HEAD DARK? NOT PARVI!!! Finding TONS on a CARD? NOT ECHINO OR BANDED !!!**

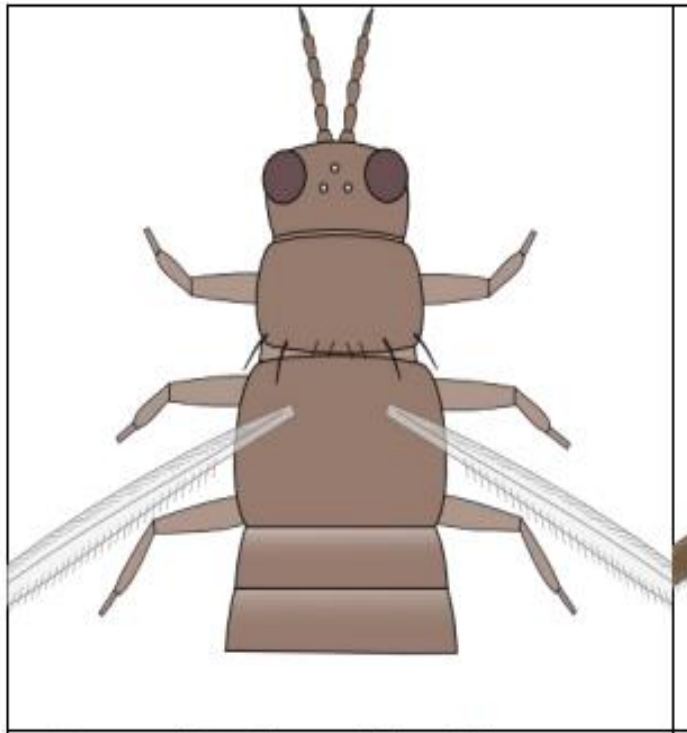
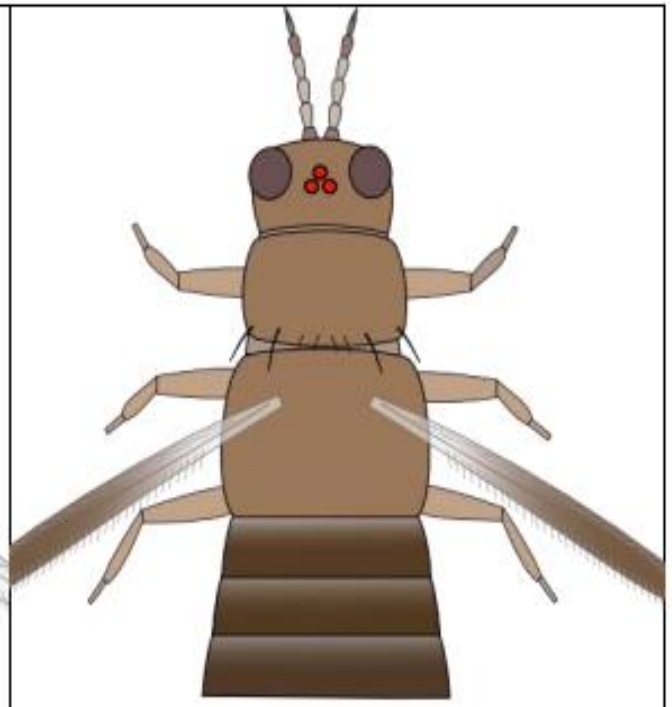
Echinothrips

GH Banded

Parvispinus

Appearance / ID

Find on ONFloriculture.com under "THRIPS IDENTIFICATION"

	
a. Grey ocelli/ocelli not visible; abdomen similar in colour to head and pronotum; wings uniform in colour and paler than the body: **dark morph Onion Thrips** (*Thrips tabaci*)	b. Red ocelli; abdomen often darker in colour compared to head and pronotum; wings brown at the ends with light patches at the top visible when alive or specimens are dry: ** ***Thrips parvispinus*** or ***Thrips setosus***; neither present in Canada but present in

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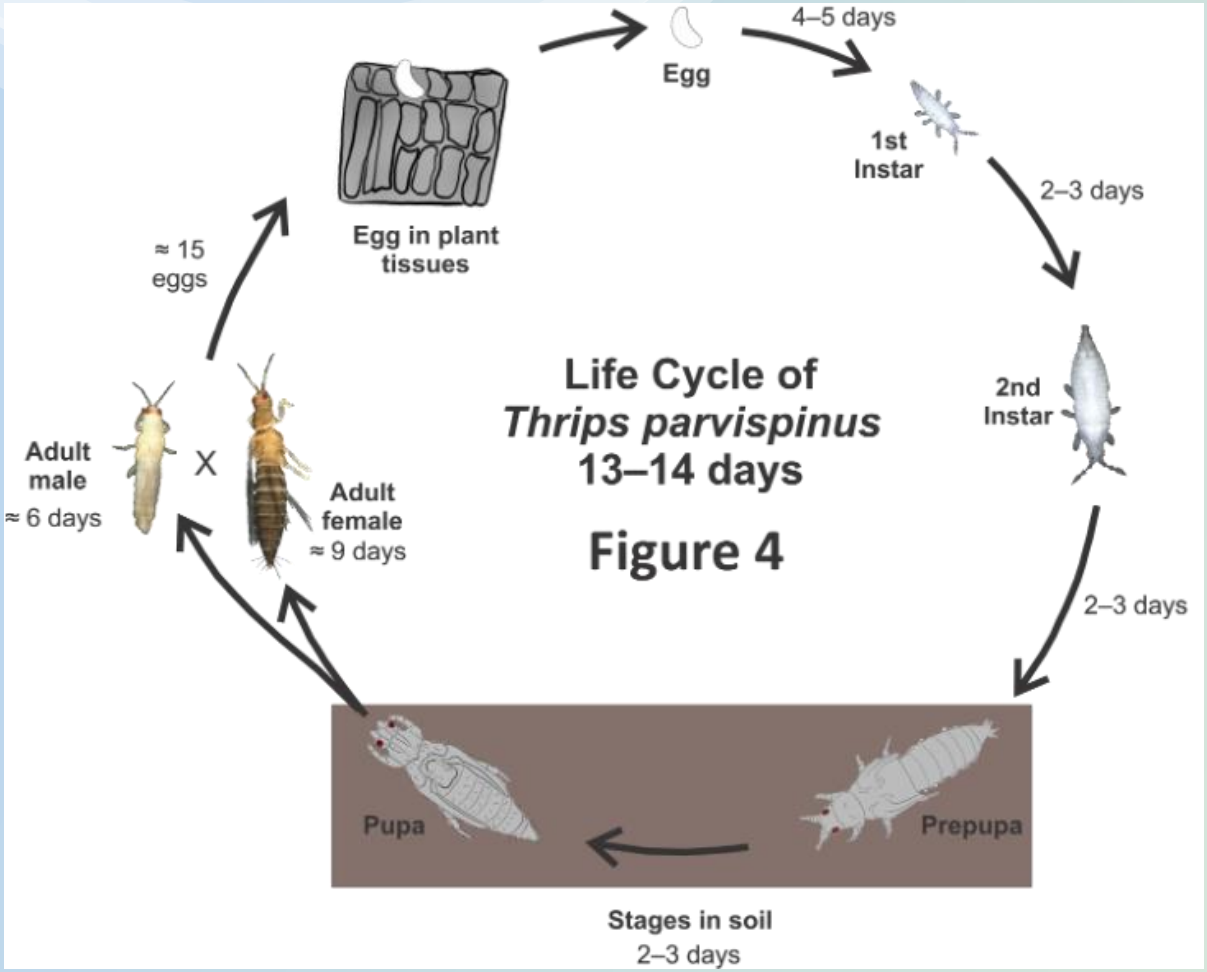
Thrips Life Cycle

Mean generation time (25 C): 25 days **(18 d at 30C)**
Intrinsic rate of increase (25 C): 0.15



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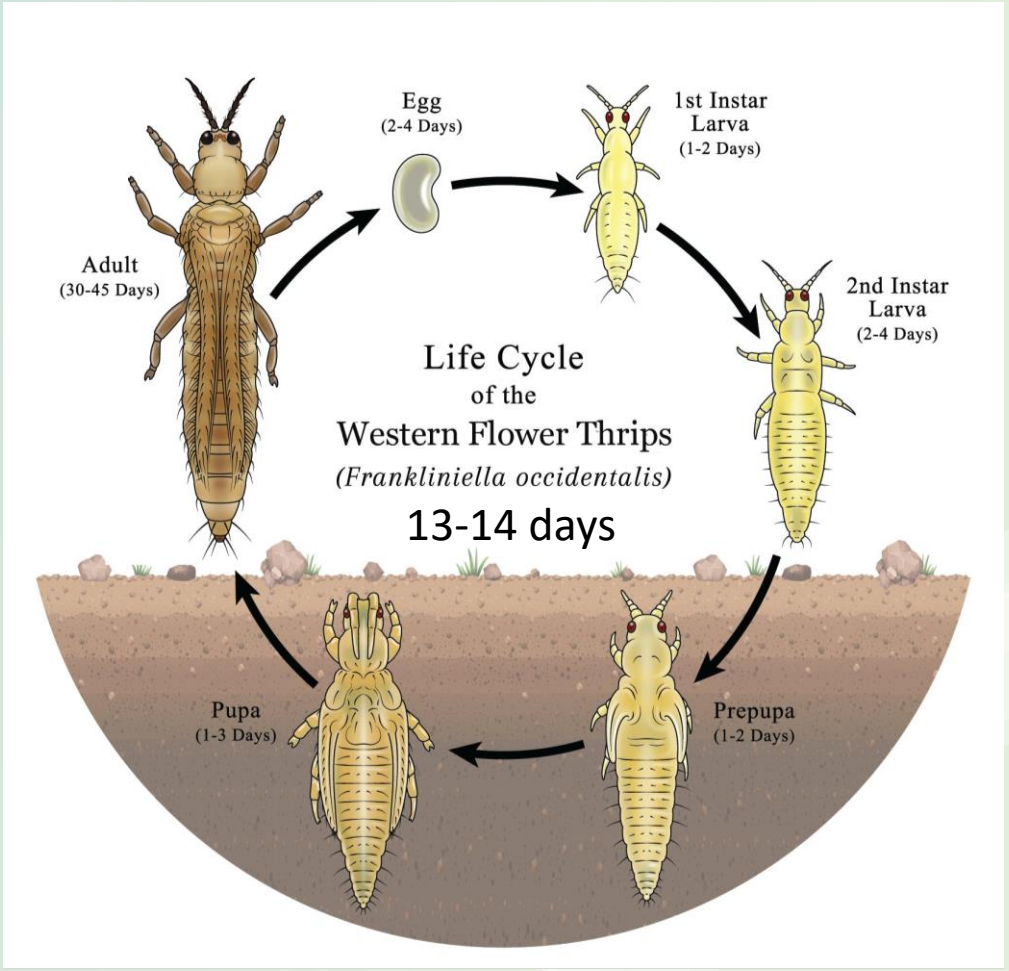

Life history characteristics don't explain why this is such a serious pest, EXCEPT at temps over 30 C

What we don’t know about these thrips: biology and behaviour

A) Do the secretions contain scent marking pheromones?

B) Are they territorial and kill each other to protect it?

C) How fast can these tropical thrips adapt to other host plants?

D) Can they complete their life cycles on these other plants?

E) Can we create pheromone sprays or more lures knowing what these secretions contain?

F) Can we manipulate them? Force them out with an agitator and then spray?

G) Are they eating mite eggs (thought to be!)

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Host list: Still Evolving

Common Name	Species name	Damage
Gardenia	Gardenia spp.	Leaves and flowers
Laceleaf	Anthurium spp.	Heavy stippling on leaves
Rocktrumpet	Mandevilla & Dipladenia	Brown scarring on leaves, damage growth tips, scar flowers
Schefflera	Schefflera arboricola	Brown scarring on leaves
Orna. / Bell peppers	Capsicum spp.	Brown scarring on leaves, infest flowers
Hoya	Hoya spp.	Leaf abortion
Prayer plant	Calathea	White scarring on new growth
Hibiscus	Hibiscus rosa	Stippling on leaves and flower scarring
Frangipani	Plumeria spp.	Leaf damage
Ficus	Ficus	Brown scarring on leaves
Periwinkle	Vinca	Stippling on leaves and flower scarring
Winter berry holly	Ilex verticillata	Damage foliage
Sweet alyssum	Lobularia maritima	No visible damage but reproduce on host
Garvinea/ hardy gerbera, Gerber daisies	Gerbera hybrid; *Gerbera jamisonii*	Damage to flowers only
Sweet potato vine	*ipomea*	Crinkly leaves

NOT seeing it on other reported hosts YET
- e.g. mums or other veggies

VERY host specific
- Some of these reports due to plants being NEAR a source host (jump-overs)

VERY variety specific

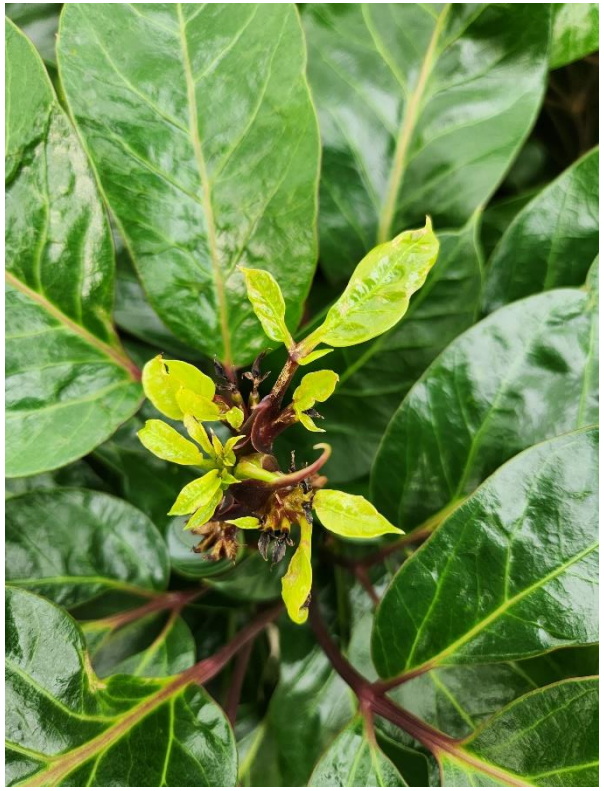
Ontario

Damage CAN vary by crop

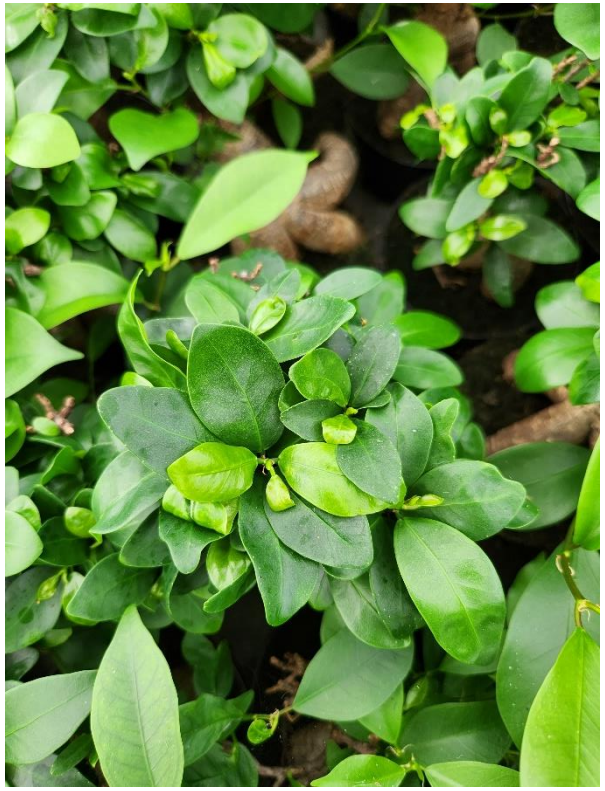
- “Normal” thrips feeding patterns on Hibiscus vs. scarring patterns

VS.

Damage on hibiscus vs schefflera. Photos by OMAFRA



Schefflera



Ficus

Calathea

Gaultheria

Damage

Parvi damage on PW Calathea, Gaultheria, Schefflera, Ficus and Ipomea

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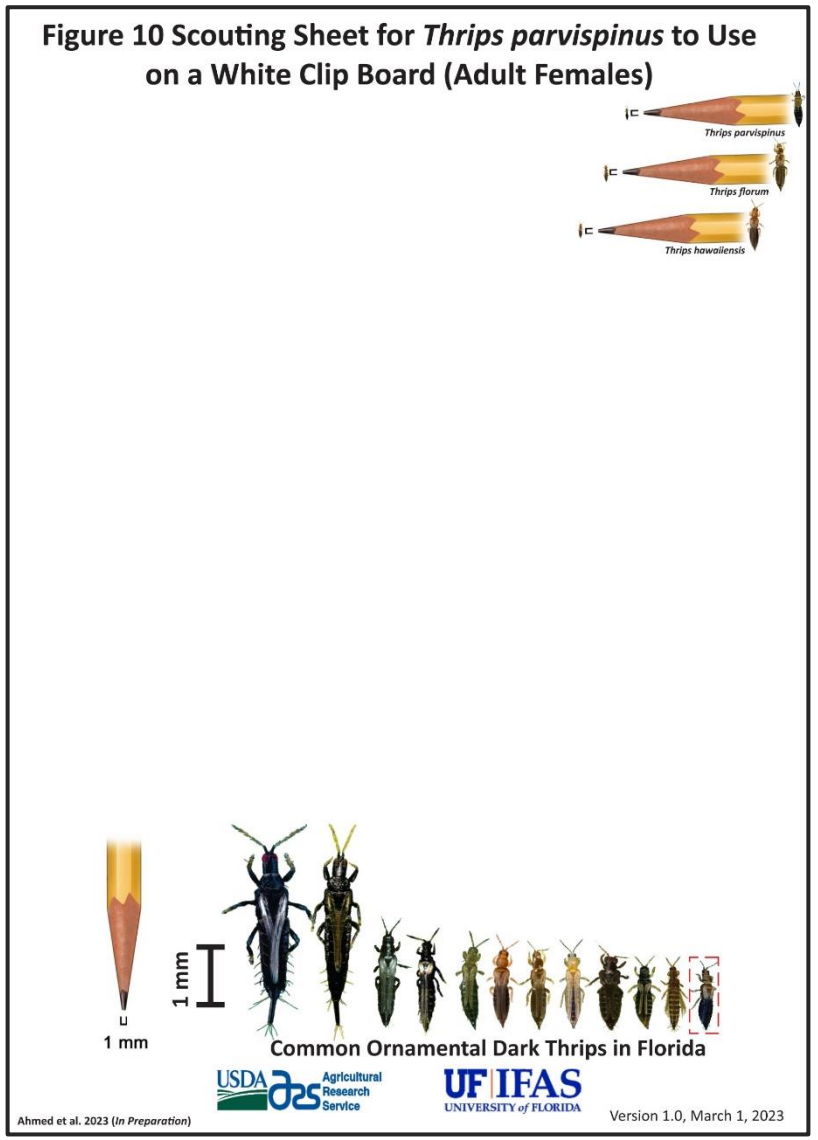
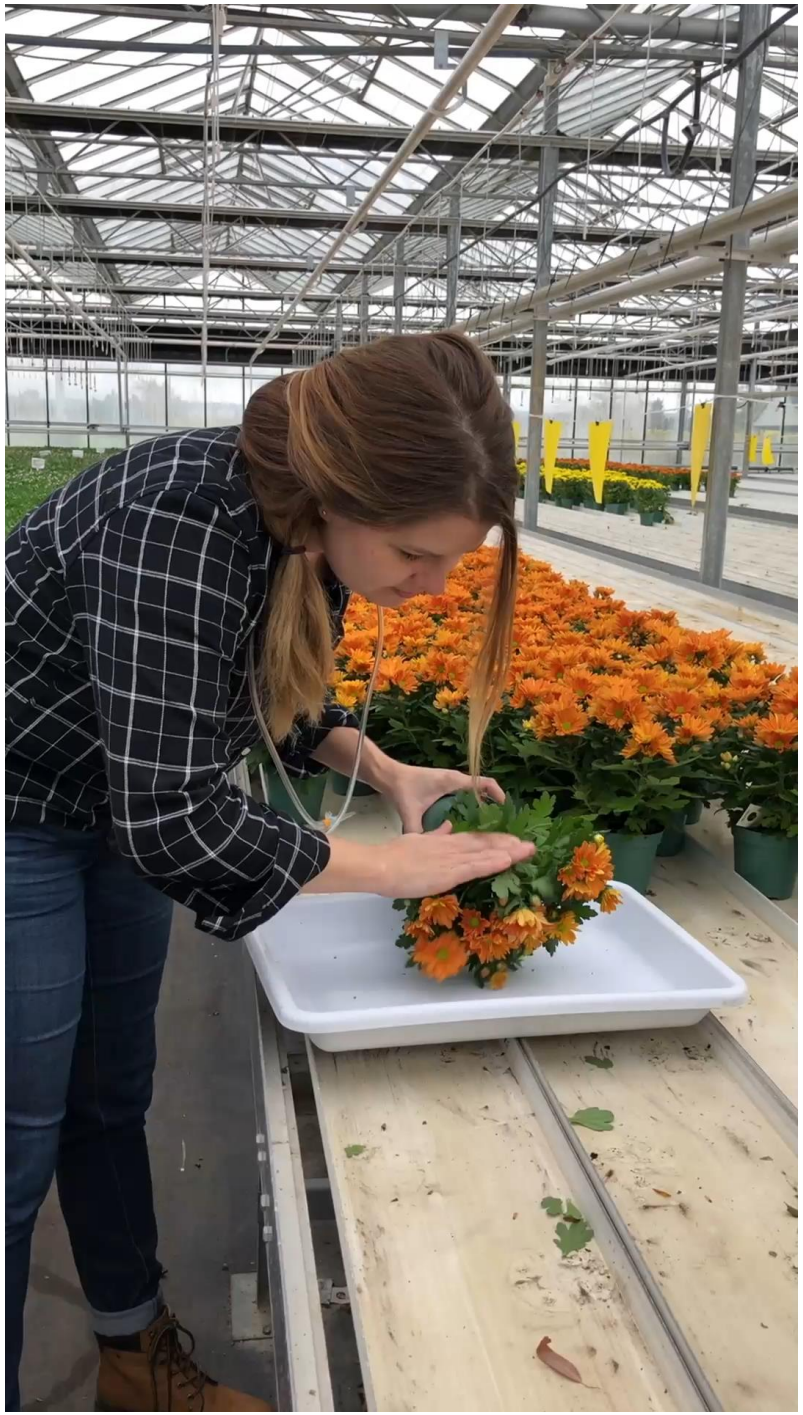
Monitoring

Plant taps

- Currently the BEST method
- Use white pan (dollar store) or scouting sheet covered in acetate
- A hand lens (10-15x) will make ID easier
- Look for *movement – VERY FAST*
- **STANDARDIZE** your plant taps – ***i.e.*. SAME NUMBER of plants** every time



Monitoring sheet developed by UF IFAS. Found on dedicated *Parvispinus* website.



Ontario

THRESHOLD NUMBERS

- What are the threshold numbers for this thrips?
- Will likely depend on crop AND variety
- If you see adults on the plant a wash will reveal some scary numbers of larvae!

Ontario

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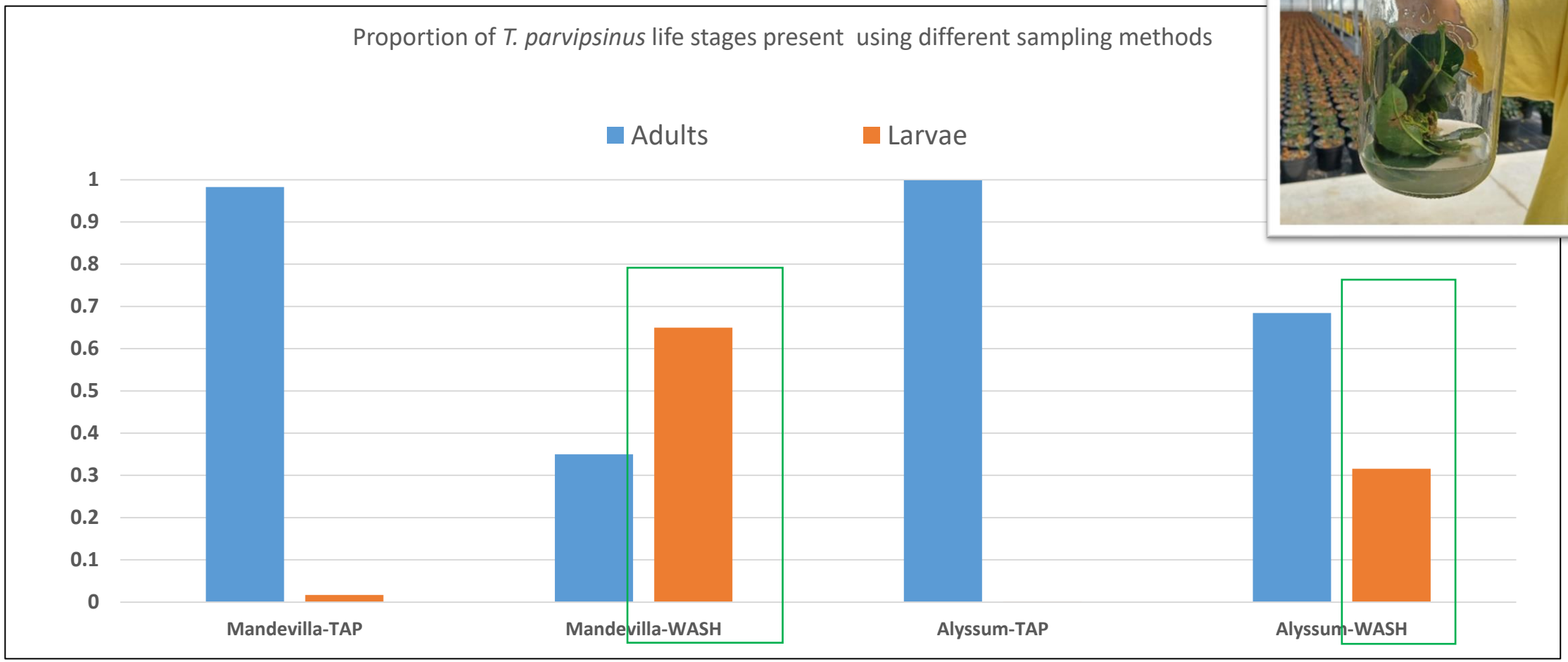
Plant Taps vs. WASHES



Washes show 30-65% of pop. hidden as larvae – do NOT tap out easily

Ontario

Sticky cards and *T. parvispinus*

- DO work well for this species
- NOT useful for initial detection
  - Look for damage, inspect flowers
  - Even do plant taps/washes
  - Trap plants (more on this later…)
- Best used to MONITOR populations after establishment
  - WHERE in greenhouse
  - Density?

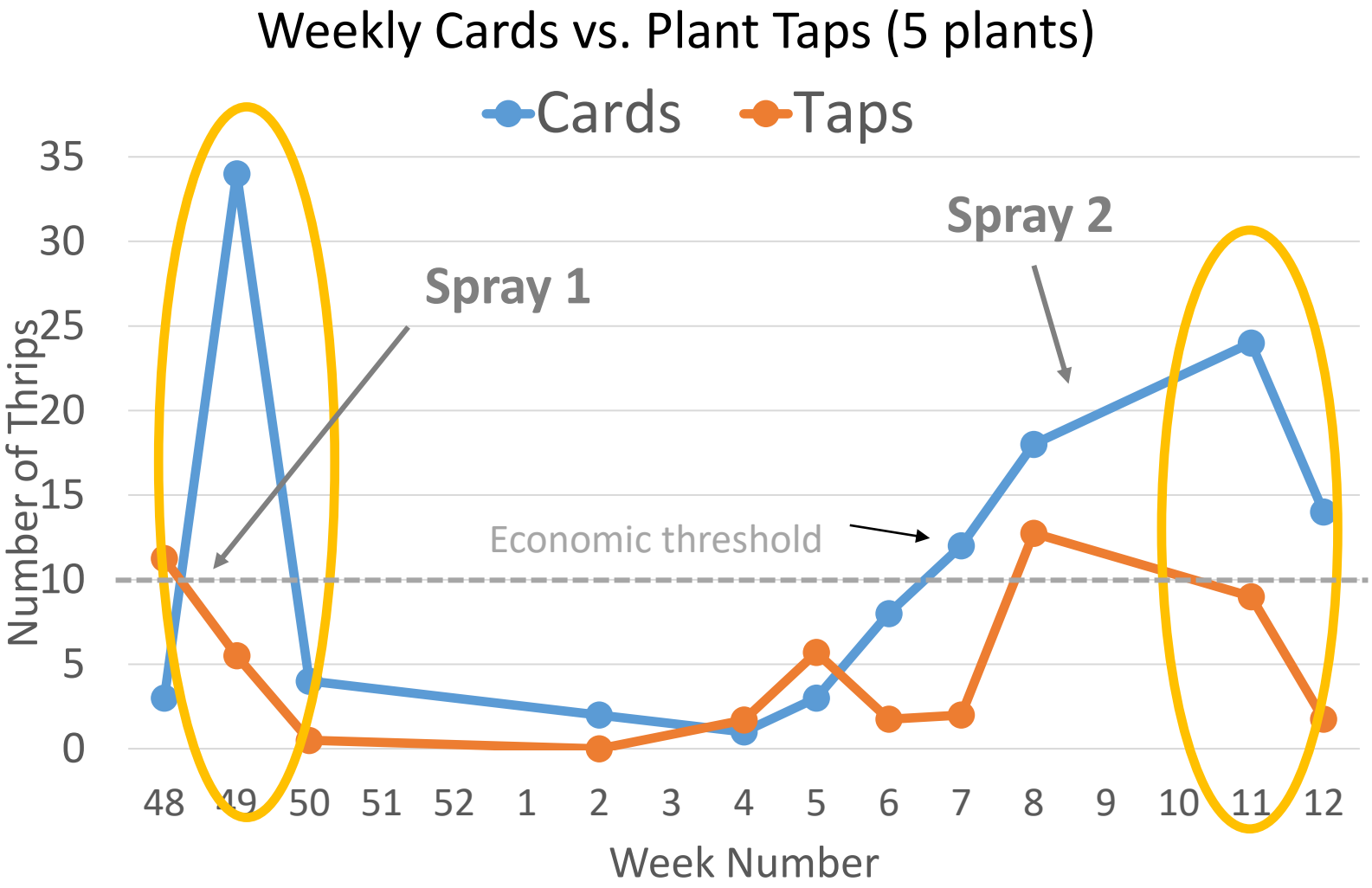
Red dots indicate *T. parvispinus* caught in a Mandevilla crop.

Ontario

Plant taps vs. Sticky Cards

Monitoring Control Efficacy:

- Great tool to detect **population increases**
  - Cards slower to show decreases, but faster to show pop. increases
  - Recommend doing plant taps after pesticide applications to confirm kill



On-farm data from 2022 showing T. parvispinus numbers on card vs. plant taps after pesticide applications.

Ontario

A Path to Easier Monitoring?

Cards + Plant Inspection?

- **Count cards weekly** – look for pop. Increases, track hot spots
- **Presence/Absence sampling** of 5-10% of each variety – similar to *Bemisia* whitefly in poinsettia
  - Inspect growing tips, flowers, foliage
  - **Could work if infestation low or on non-trellising plants**

Ontario

A Path to Easier Monitoring?

Cards + Damage Counts?

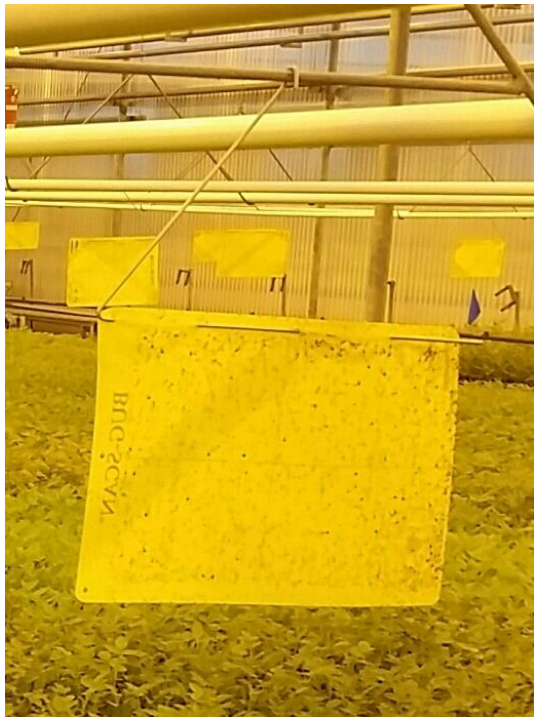
- Count cards weekly – look for pop. Increases, track hot spots
- Also do plant inspections (5-10% of each VARIETY)
  - **Trellising plants:** how many shoots are growing vs. damaged?
- May be most relevant but more work than presence/absence
  - But less work than plant taps/washes!

Ontario

Mechanical and Cultural Controls

"Traps are your friends"

Sticky cards



- Will reduce adult thrips populations anywhere from 17 to 30%
- Many ways to hang them so they are not unsightly
- NECESSARY for a complete IPM program
- A very cheap way to reduce pest numbers.
- The more the better! Especially in problem varieties

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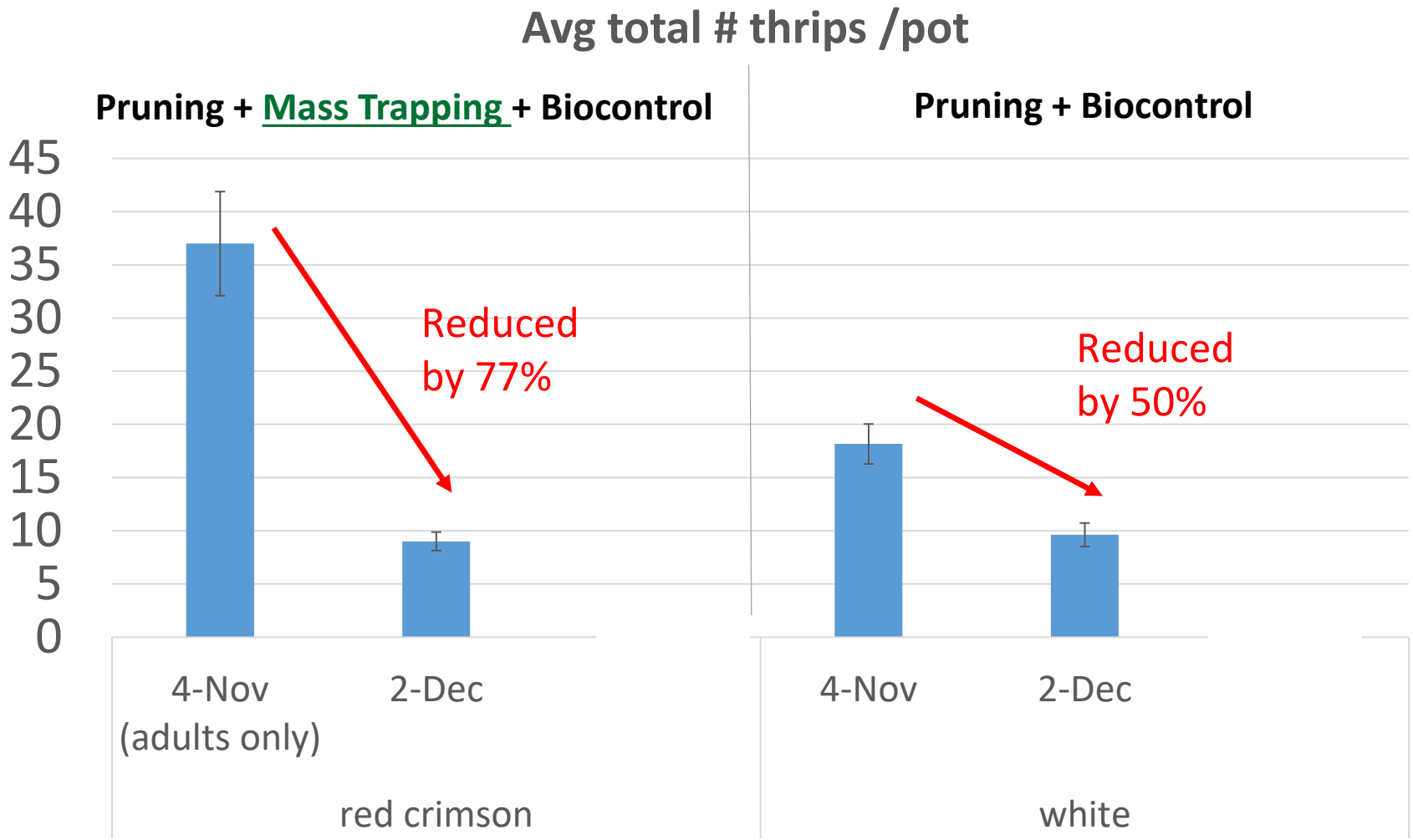
EXAMPLE: on-farm trial in Mandevilla, 2022

- Mechanical controls seemed to play a big a role as bios
  - **Better control in treatment with mass trapping**
  - **By over 25%**



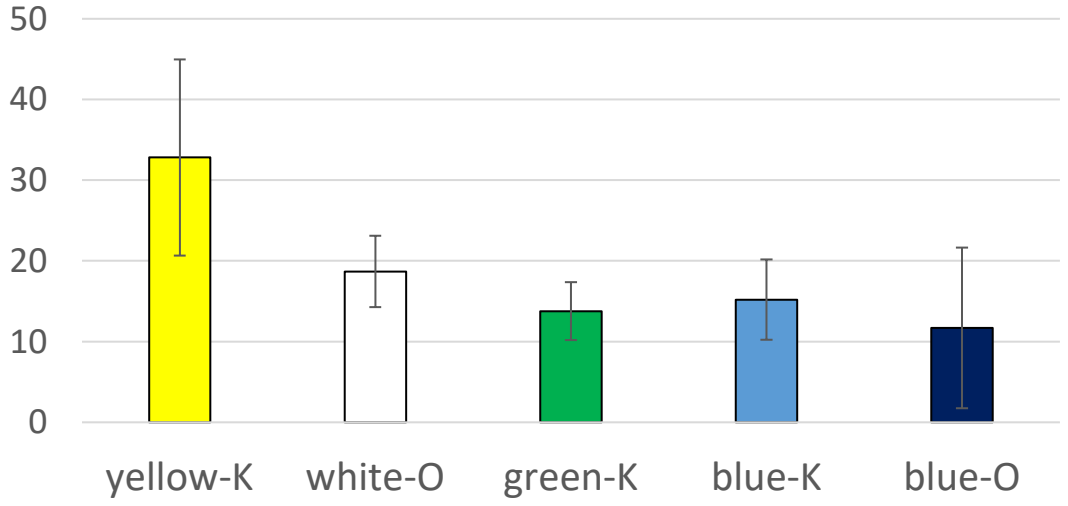
Ontario

Data courtesy of Vineland Research and Innovation Centre, Biological Control Lab.

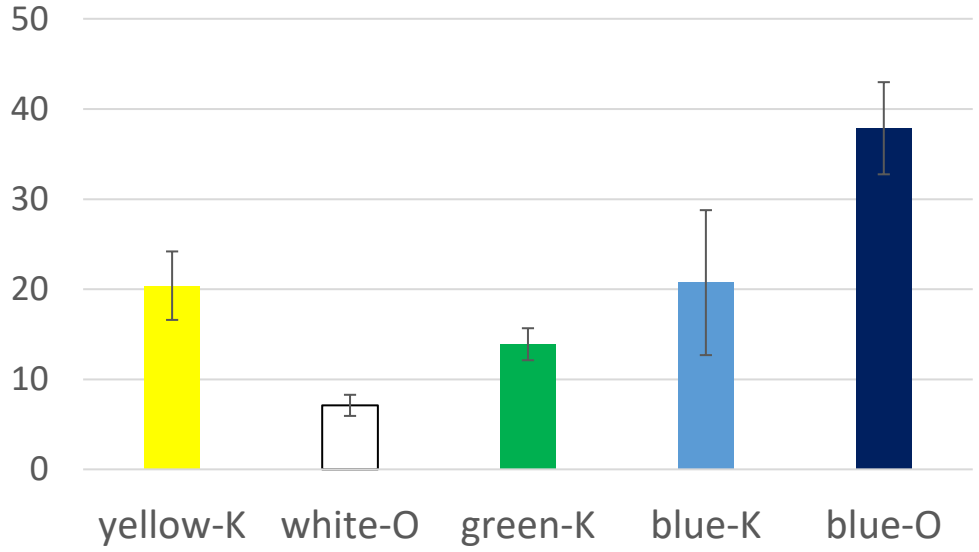
Sticky Cards - Colours

- Varies by GH/covering, location, light quality
- Plant Products/OMAFRA to do further tests
  - May get some consistent answers based on covering types for Ontario

Proportion of T. parvispinus caught on different colours of sticky cards, **GH1, SPRING**



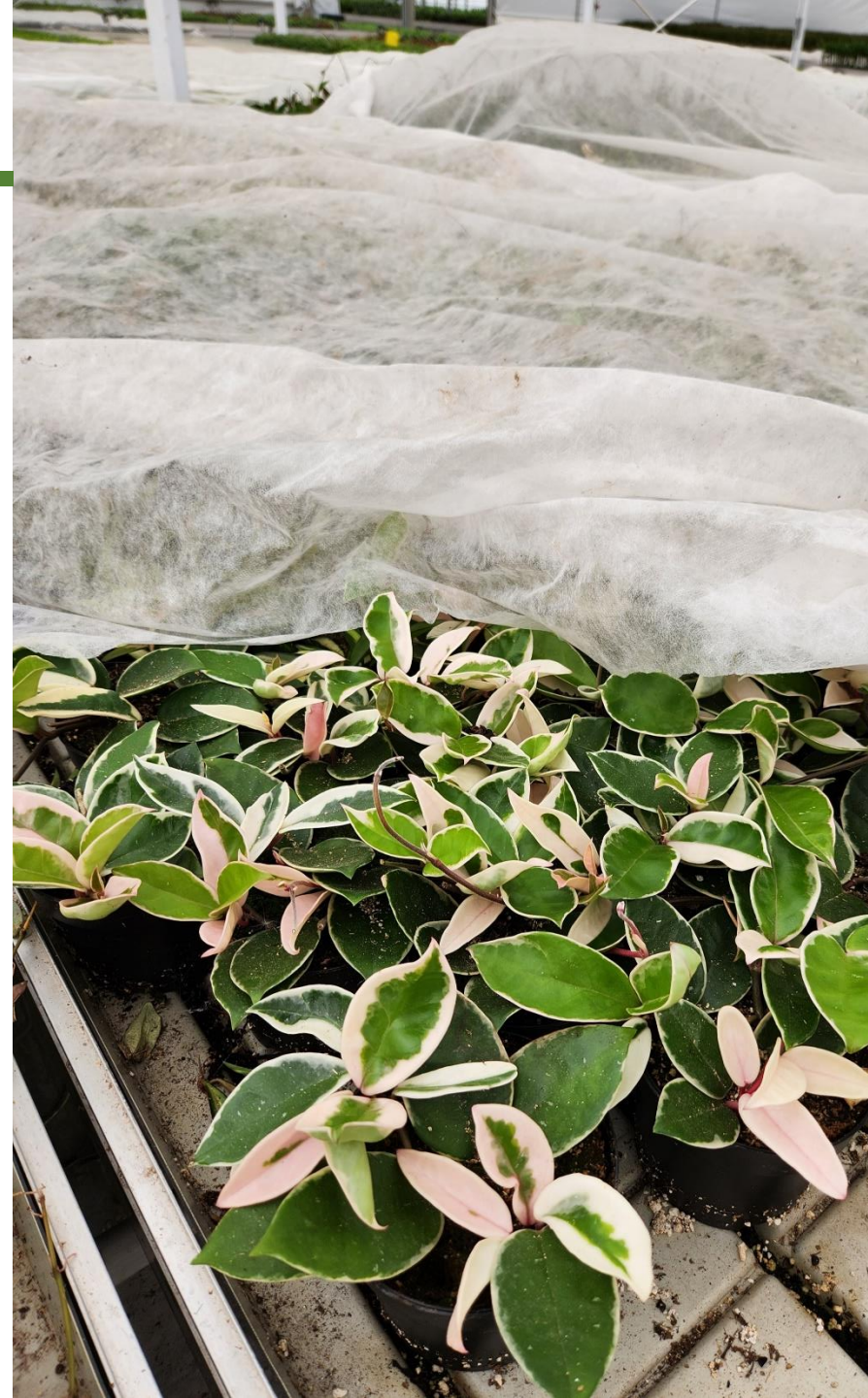
Proportion of T. parvispinus caught on different colours of sticky cards, **GH1, WINTER**



Ontario

Physical barriers

- Landscape/Strawberry cloth – protect more susceptible varieties
  - E.G. HOYA started noticing damage in 2018 which led to a successful cloth trial
  - Hang as curtains
  - NL using cloth between bays from floor to hip height.
- Prevent movement from varieties that breed thrips but don't show damage
  - ANOTHER PLACE WHERE PLANT WASHES COME IN – ARE YOU ONLY SEEING ADULTS?



Trap plants – Opposite to a banker plant

Giga White (Alyssum)

Latin Name: Lobularia maritima

Item #: 426G

ORDER BY PKT
Product Name:
CAD $3.15 / Pkt

ORDER BY M
Product Name:
CAD $9.33 / M
CAD $7.34 / M (5M)

Save Share

- Can we use Alyssum or susceptible varieties/cultivars to trap Parvi?

- Seed Alyssum vrs. PW vegetative cuttings indoors
- Pollen and no pollen

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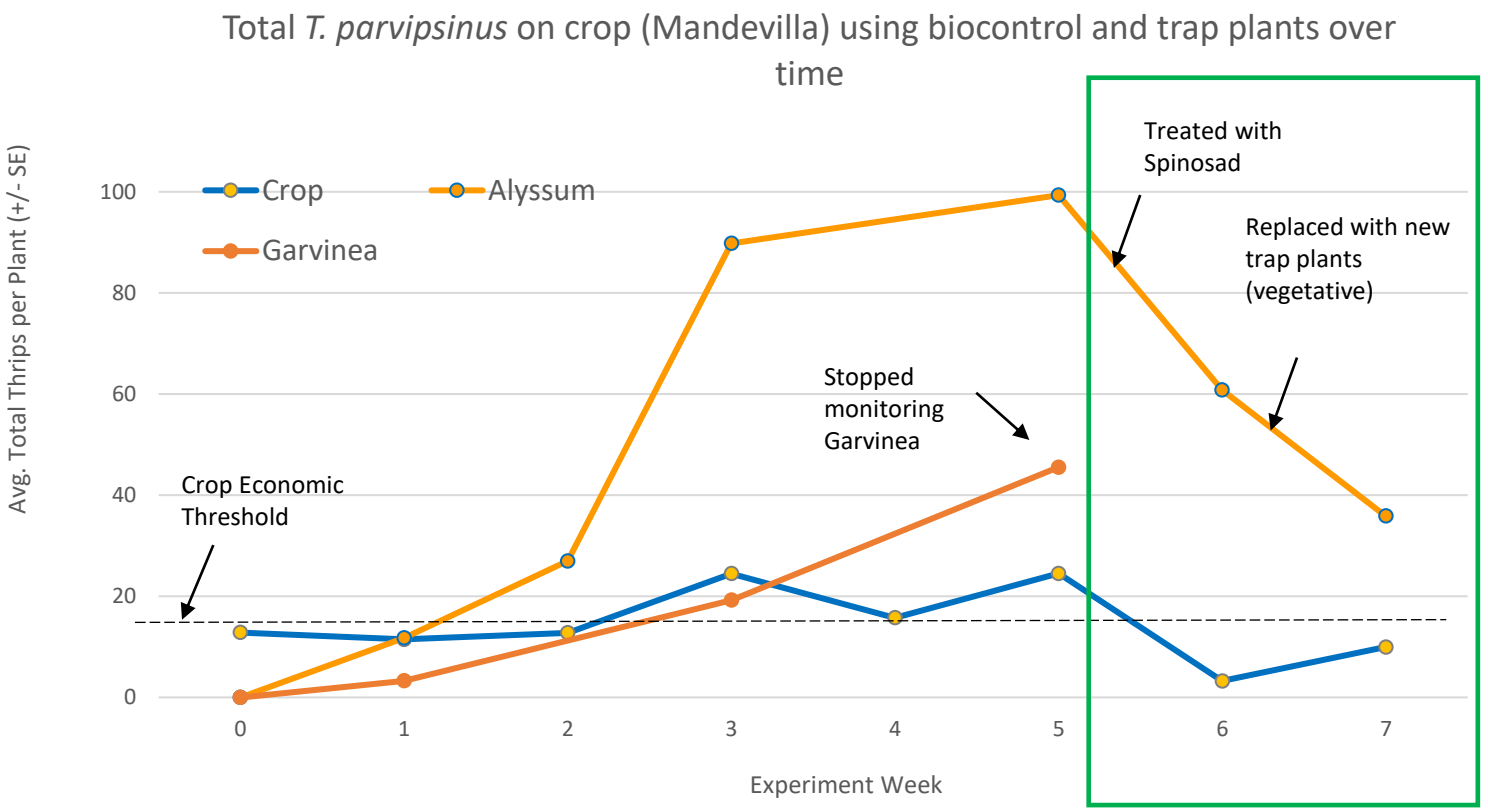
Trap Plants - Experiment in Mandevilla

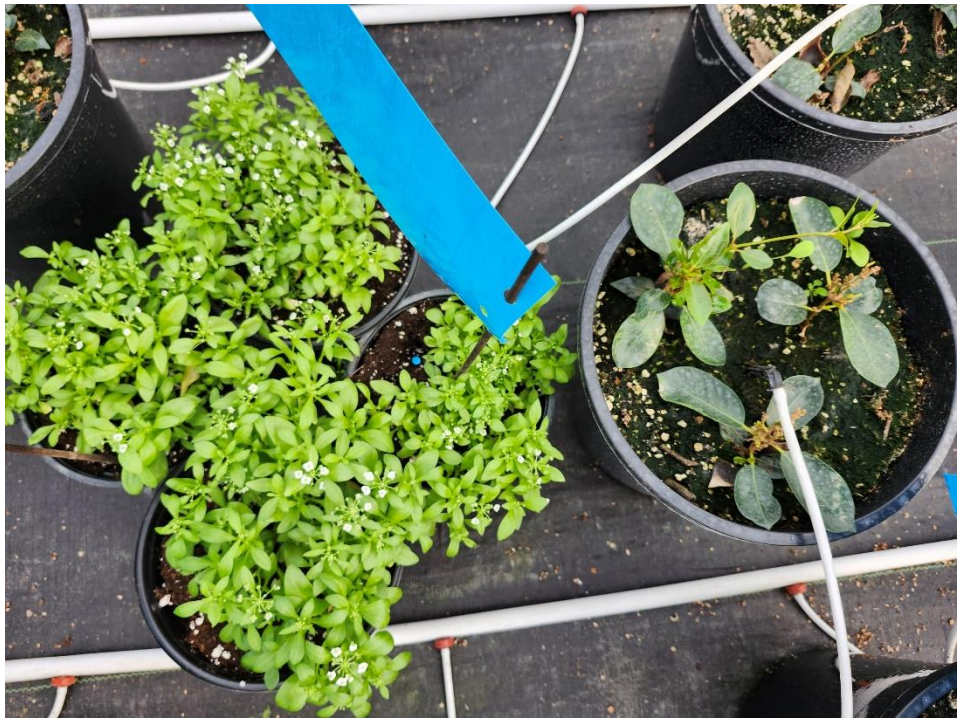
- Garvinia not that attractive
- Alyssum **2-7x more attractive than mandevilla** (when flowers removed)
- Most useful in **NON-flowering crops**
- MUST be **thrown out every 2-3 wks OR sprayed with effective pesticides**
- **Caveats:**
  - takes a lot of effort to grower/replace regularly
  - Difficult to treat with contact insecticides



Ontario

Thinking outside the box – Trap plants as a tool

- At very minimum, use for easy pesticide testing
- Place large sticky traps on the trap plants
- Alternate to replacing – spray your trap plants
  - Minimize resistance, maximize kills of adults
  - Clip it and bag it (from clippings could get efficacy info)



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Other Cultural Controls: Variety Selection

- Will be critical to survival of tropical industry ; eliminate susceptible varieties

Tolerant varieties of Anthurium. Photos courtesy of Judy Colley, Plant Products.

vs.

Highly susceptible varieties of Anthurium.

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Biological Controls

Not your WFT Biocontrol Program

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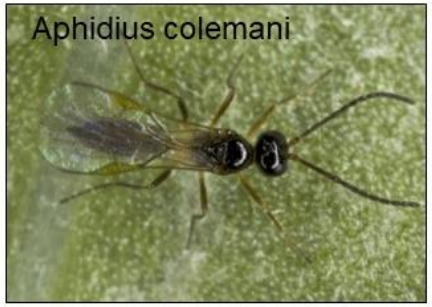
Rethinking bios

- We are NOT veggies: **things are NOT going to establish** (except Atheta and Hypoaspis)
- Think of EVERYTHING as weekly introductions: especially *Orius*
- Mechanical controls **– sticky cards are compatible w BIOS (<10% losses)**

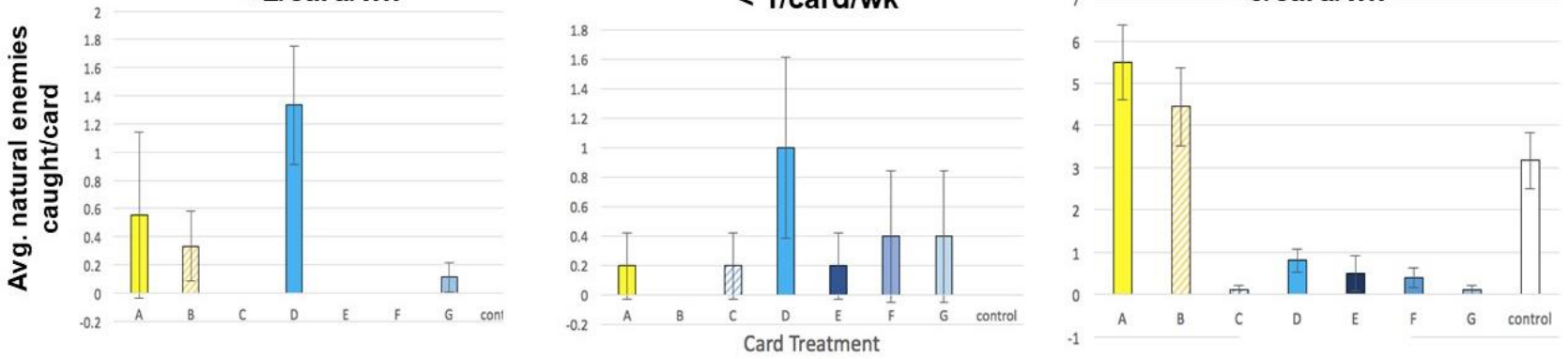
- Released rate: **500 per 10,000 sq ft (1/m²)** + *Aphidius colemani* banker plants

< 2/card/wk

< 1/card/wk



~5/card/wk



Orius diapause and feeding

But Orius diapause you say,….

No diapause could be induced in adults of *O. insidiosus* and *O. majusculus* that developed under rearing conditions of 25 °C/L16:D8: all females kept under such conditions as well as those transferred to short-day conditions (18 °C/L10:D14) commenced and continued to lay eggs during the course of the experiment (two weeks, $n = 17–20$).

- Orius reared commercially will not diapause
- The critical photosensitive stage is the 4th and 5th instar

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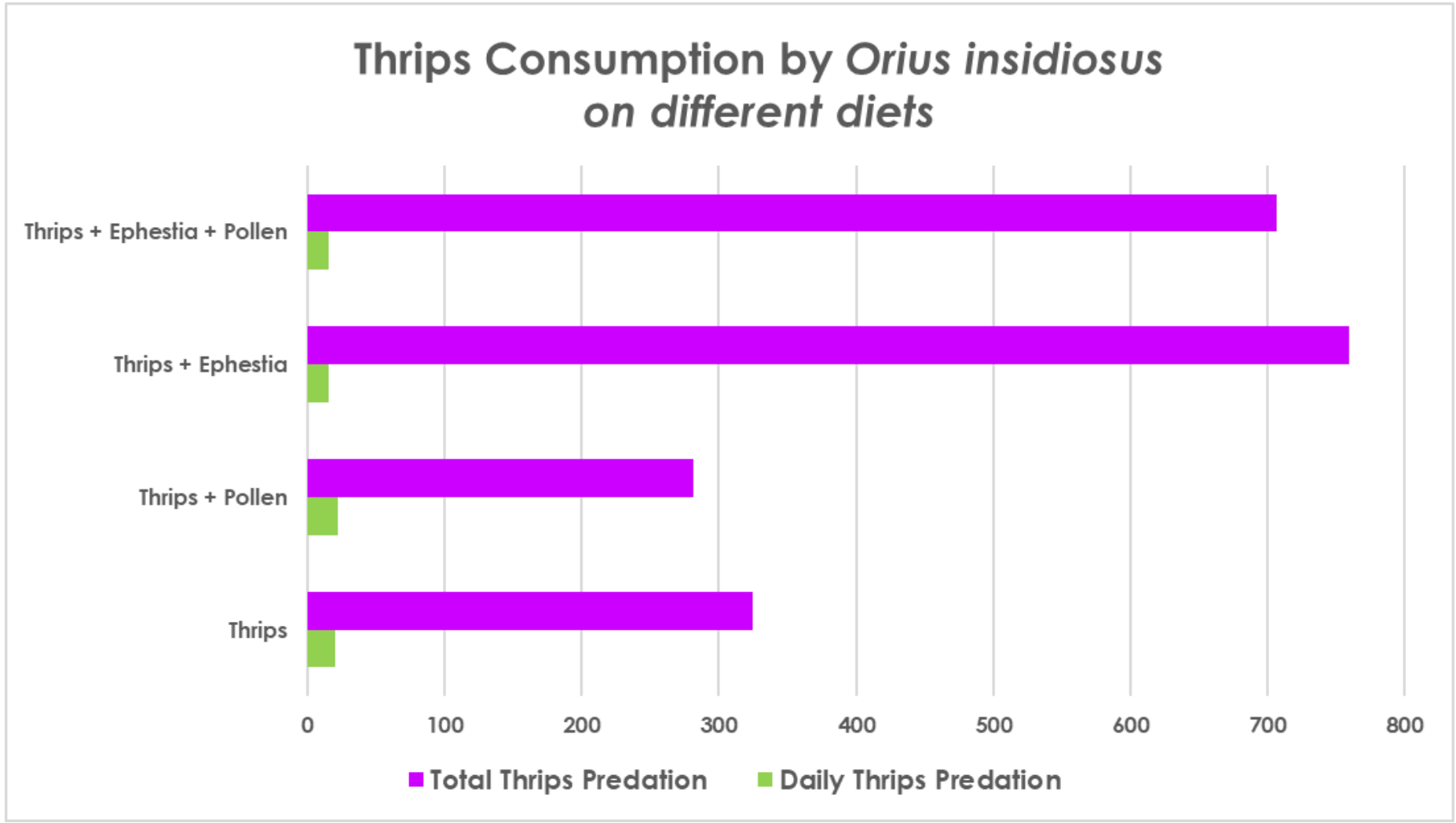
Entomologia Experimentalis et Applicata **73**: 127–137, 1994.

Induction and termination of diapause in *Orius* predatory bugs

R. A. F. van den Meiracker
Research Institute for Plant Protection (IPO-DLO), P.O. Box 9060, 6700 GW Wageningen, The Netherlands/Department of Pure and Applied Ecology, Section Population Biology, University of Amsterdam, Kruislaan 320, 1098 SM Amsterdam, The Netherlands

biobest® SUSTAINABLE CROP MANAGEMENT

Nutrimac® – Ephestia Supplement



T= 25 C HR 70 ±10%
Photoperiod= 12 h

Calixto et al, 2013. Effect of different diets on reproduction, longevity and predation capacity of Orius insidiosus (Say) (Hemiptera: Anthocoridae). *Biocontrol Science and Technology* (Volume 23, Issue 11, 2013)

biobest SUSTAINABLE CROP MANAGEMENT

Rates for Anthurium, Hoya, Ficus, etc

	BELGIUM (ORN)	SPAIN (PEP)	CANADA (ORN)	USA (ORN)
Swirskii		150-200/m2 + 4x 50/m2		
Dalotia coriaria (Atheta)		2/m2		1-2/m2
Stratiolaelaps scimitus (Hypoaspis)	3x 50 i/m2			100-200/m2
Cucumeris	250-500/m2 (weekly)	500/m2		
Orius		4-20/m2 *(O. laevigatus)*	**5-10/m2**	10-20 /m2
Nematodes			25-50K/m2 (sprench)	25K/m2 (foliar/sprench)
Chrysopa eggs	40 eggs/pl			200 eggs/pl
Chrysopa larvae	40/m2	40/m2		15/pl
Degenerans				5/pl
Botanigard		Soil/dripped (weekly)		
Azadarichtin (Neem Exctract)	Regular interventions			

Biocontrol for Parvi – Experiences 2021-2023

ANTHURIUM

- Smaller pot sizes (4-6 inch)
- Weekly production (more chances to experiment)
- Shorter crop cycle (24 weeks)
- Simple plant architecture
- Flowers don’t produce pollen/nectar
- STRONG varietal differences
- Grown at typical temps (20-25 C)

MANDEVILLA

- Variety of pot sizes (5-14 inch)
- Essentially 1 big crop / year
- Long production period (Jul-May)
- Dense plant canopy, trellising
- Flowers produce nectar/pollen
- Some varietal differences
- Grown at cool temps (14-18 C) in winter
- OUTSOURCE CUTTINGS (MOSTLY)

2022 Anthurium Biocontrol Trials- year round cycle

Program:

- Foliar **predatory mites NOT effective, tried cucumeris and swirskii**
  - Hypoaspis at planting
  - Nematodes- did they help?
  - **Switched to High levels of *Orius insidiosus* 1/sqft (11/m^2) for 6 weeks, then reduced to 0.5/sqft (5.5/m2)**
    - WEEKLY releases – not trying for establishment
- **Mass trapping**
  - Estimated contributed ~ 30% to control
- **Suffoil X at shipping**

Outcomes:

- Successful control, but expensive and still had some unsellable varieties.

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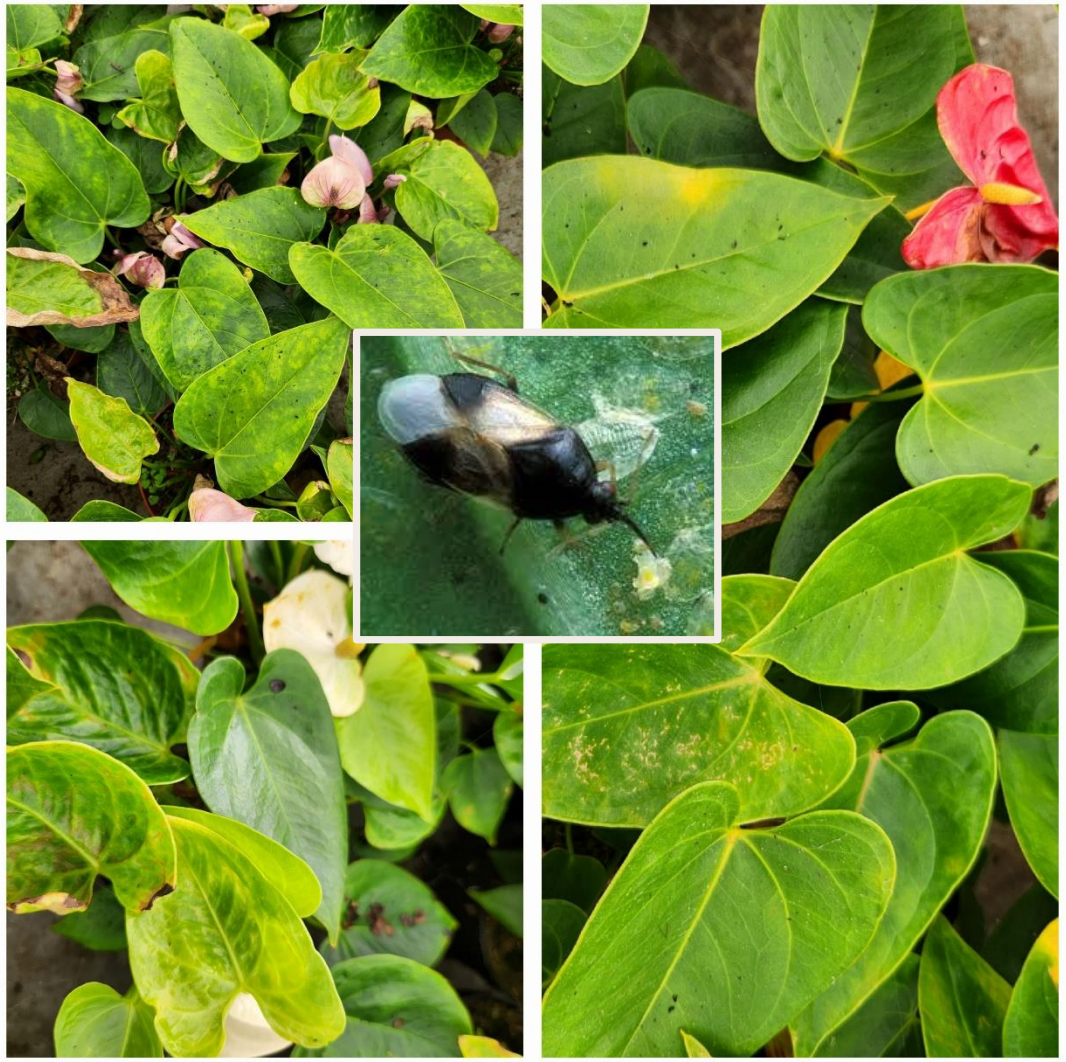

Parvipsinus damage on susceptible Anthurim varieties. Photos by J. Colley.

2023 Biocontrol Trials – Anthurium 24 week crop

Successes so far:

All cuttings are coming in with *Parvispinus, some varieties show damage others don't.*

- All new plantings the first 5 WEEKS are **treated 7 days apart for a total of 3 Lalguard M52 and 2 Success applications.** Both 1ml/L rates.
  - So far, all new growth even on susceptible varieties have nicely formed leaves.
- Bio program started on crop **after 5 weeks with Orius** being the heavy lifter.
- **2023 able to drop the Orius to 0.25/sqft (2.5/m2)** with the addition of Lalguard M52 and Success treatment at the beginning,
- **Finishing; crop is sprayed 1 week before shipping with Suffoil X at 1ml/L** to shine up leaves and remove any adults.
- Would like to try BotaniGard EC on mature plants at some point.

2024 Biocontrol Trials – Ontario Sourced Mandevilla Cuttings

History

Since 2016 the bio program on the "Ontario" Mandevilla has evolved; recipe is below;
All cuttings are coming in clean with NO *Parvispinus.*
Parvi is present in other ranges at the opposite end of this facility – PREVENTATIVE PROGRAM

- All plants received **1 application of Lalguard M52 at planting**. 53Ksqft on floor and 53Ksqft of hanging baskets. Rate of M52 is 1 ml/L applied as a **foliar sprench**. Want to try M52 at 0.5 ml/L rate next.
- Aphids are biggest problem in this crop. Crop has had 2 applications of BeLeaf and 1 Ventigra so far 2024.
- **Flowers checked and plants tapped weekly for thrips**.
- **PW Alyssum trap plants** (NOT BANKERS!) with a dark blue sticky card to check for presence/absence of thrips in the crop. Replaced every 2 weeks.
- BIOS; Orius released at 0.2/sqft rate weekly. Cucumeris sachets put in baskets primarily for broadmite control and other thrips species prevention since baskets are hard to scout.

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2024 Biocontrol Trials – Ontario Sourced Mandevilla Cuttings

Orius looking for thrips in the growing points of a mandevilla.

IF PARVISPINUS ARE FOUND:

- If thrips are found, a foliar application of Lalguard M52 is sprenched overhead at 1 ml/L rate.
- **So far, only 2 adult Parvi have been found in the flowers in early December**, these were most likely brought in on workers. Lalguard M52 was spot sprayed in the bays where the thrips were discovered. **There has been no Parvi in the flowers since the second application of M52.**
- **Dark blue sticky tape** has been put up between varieties where the thrips were found + **PW Alyssum trap plants with dark blue cards**
- **Parvi has been trapped on the cards in the Alyssum plants, no visible damage on the Mandevilla plants** and no thrips on tap out yet.
- BIOS; Orius released at 0.2/sqft rate weekly.
- End of Jan: plant washes were done on “suspect plants” : didn’t wash out any thrips!!! Confirms damage is old , after M52 apps (just like broad mite)

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Off-shore Mandevilla

- Cuttings received from Guatemala in June/July
- **Coming in infested**
  - Only a few thrips in dip water
  - Likely present as eggs
- Growing temps.
  - 19-25C over spring/summer
  - 16-18C over winter

Ontario

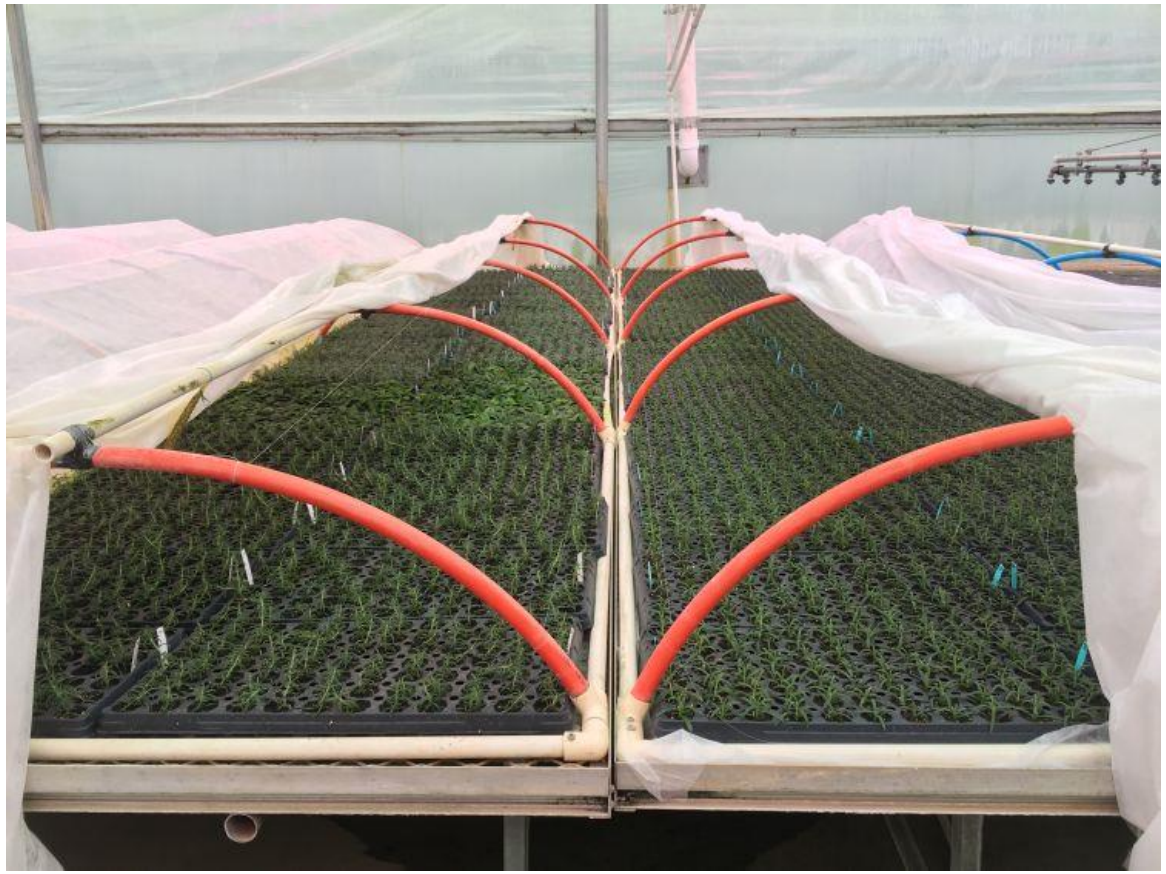
2023 Biocontrol Trials - Mandevilla

Project Goals:

- REALLY give biocontrol a chance
  - Use high rates if needed
  - Minimal pesticide use (except spot sprays)
  - “Drop dead date” of Dec 1 if not working
- Compare 2 programs
- Use Bemisia program as model

Plan in Propagation:

- Picked bios that could tolerate heat, but stopped once temps. **went >35C**
  - Swirskii, BotaniGard, S. carpocapse
- Didn’t seem to be many thrips in tents, but **thrips numbers exploded 3 weeks after tenting removed**
- **Dipped rooted cuttings in oil before potting**
  - **Reduced thrips by 70%**



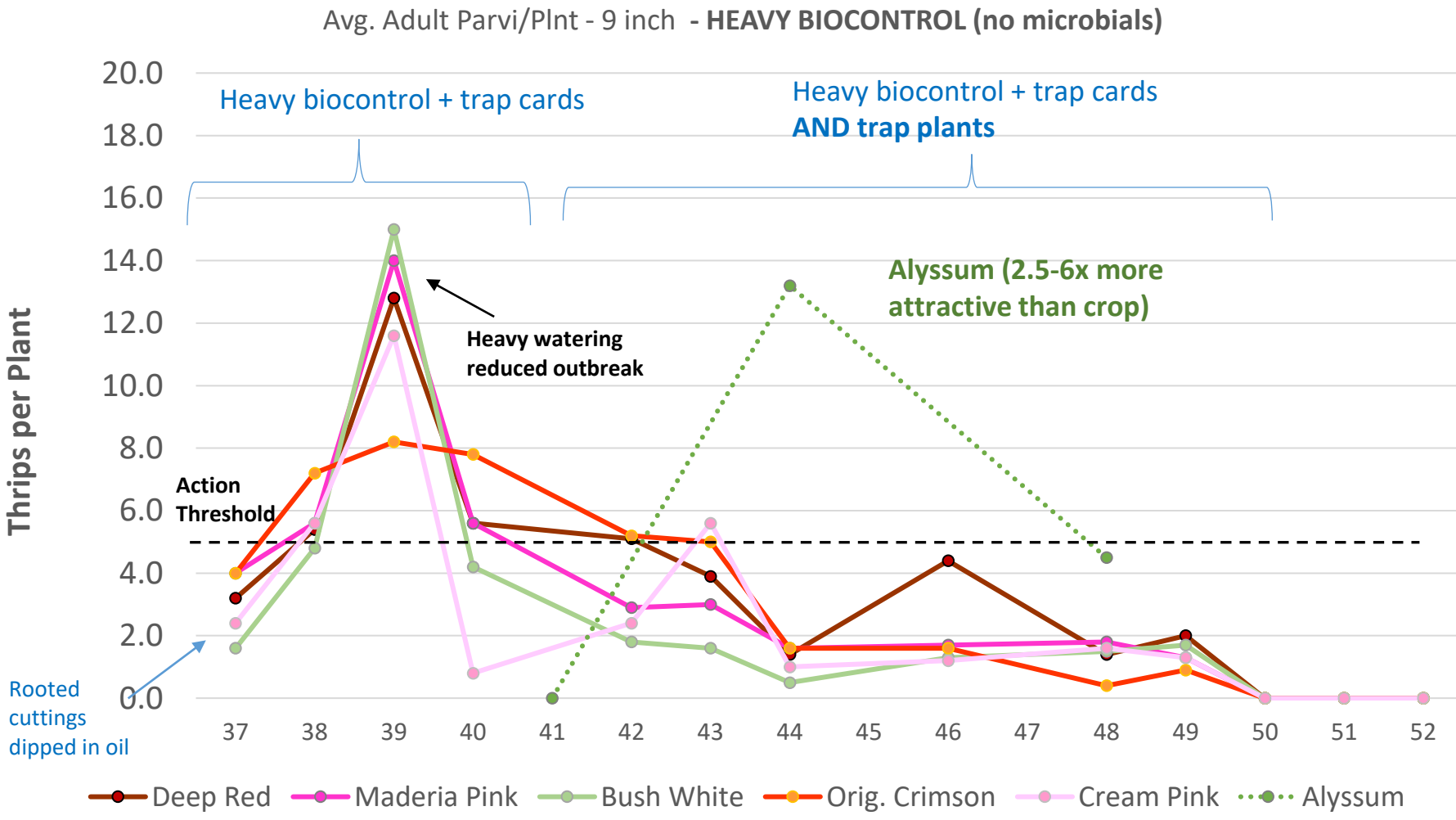
Tenting in propagation.

Ontario

2023 Biocontrol Trials - Mandevilla

Program 1: High Bios + Trap Plants (more expensive/labour intensive program)

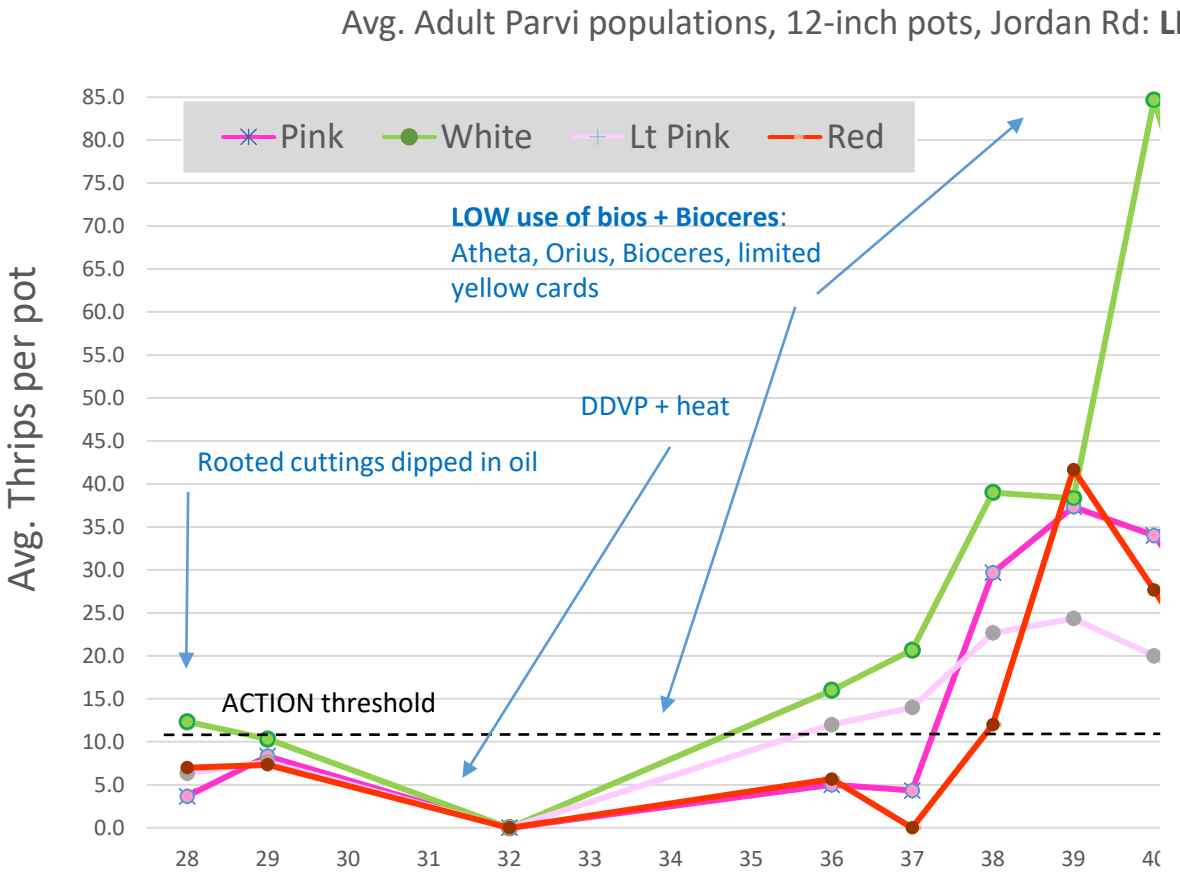
- Looked most promising in terms of numbers!
- Thrips taps < 4 thrips /plant on average
  - ~ 2 thrips/plant in fall
- Rates: starting at potting (1800m^2 zone)
  - Orius: 4/m^2 weekly at start
  - Reduced to 2/m^2
  - Atheta – weekly (1/m^2)
  - Hypoaspis –9/m^2 weekly
  - 1 trap plant/50 crop plants



2023 Biocontrol Trials - Mandevilla

Program 2: Low bios + Microbials (more economical program) – 9 inch pots

- More economical program was NOT as successful at first
- Rates:
  - Orius- 1 introduction at 2/m^2
  - Atheta : 1/m^2
  - Hypoaspis weely
  - Bioceres EC – high rate (weekly)



Numbers started to climb quickly after implementation

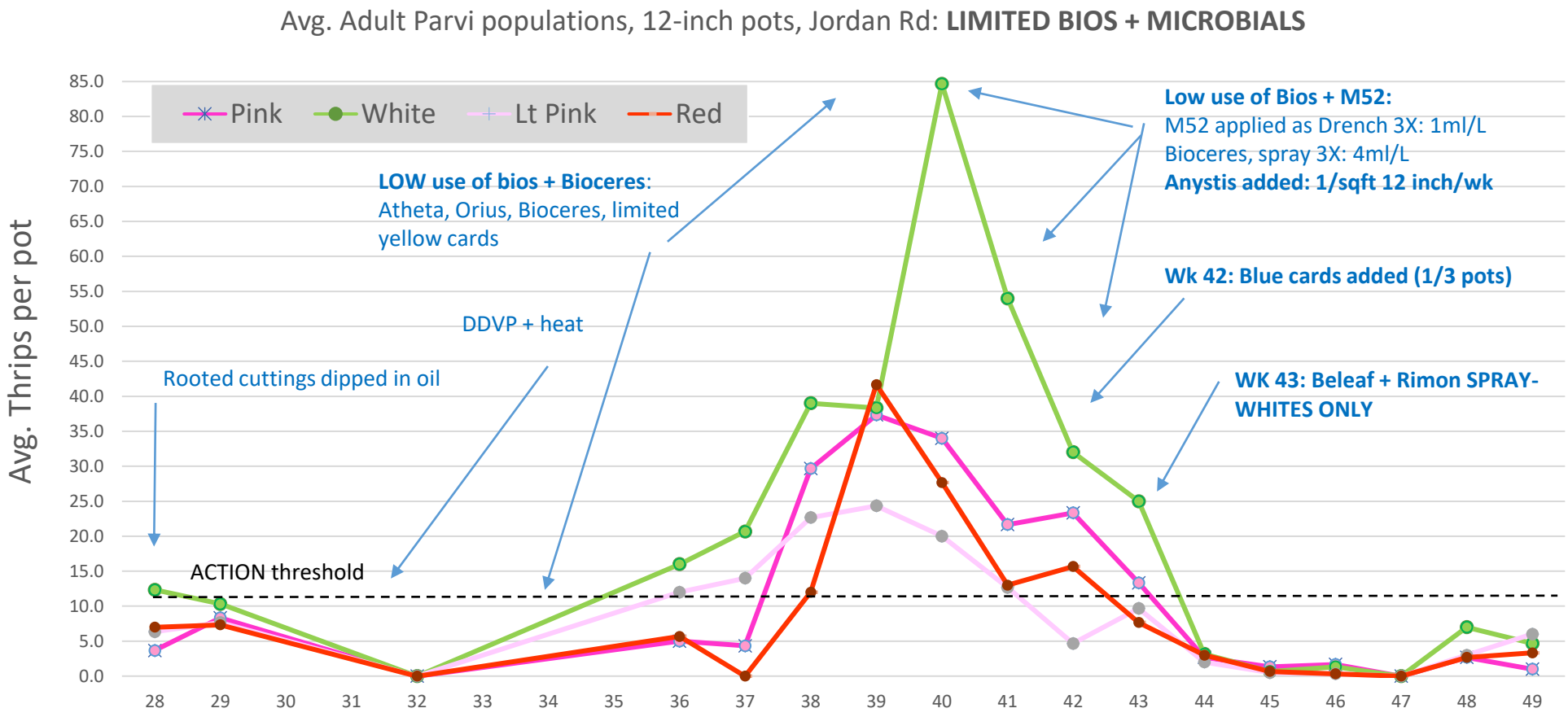
- Especially in white variety

Ontario

2023 Biocontrol Trials - Mandevilla

Program 2: Low bios + Microbials (more economical program) – 12 inch pots

- BUT…
- **Spike in pop. rescued by addition of M52, Anystis**
- **Anystis:** 2/m² in most heavily infested crop; reduced 0.5/m²
- **"Soft" Spray needed in whites**
- Thrips numbers remained low into Nov



Ontario

2023 Biocontrol Trials - Mandevilla

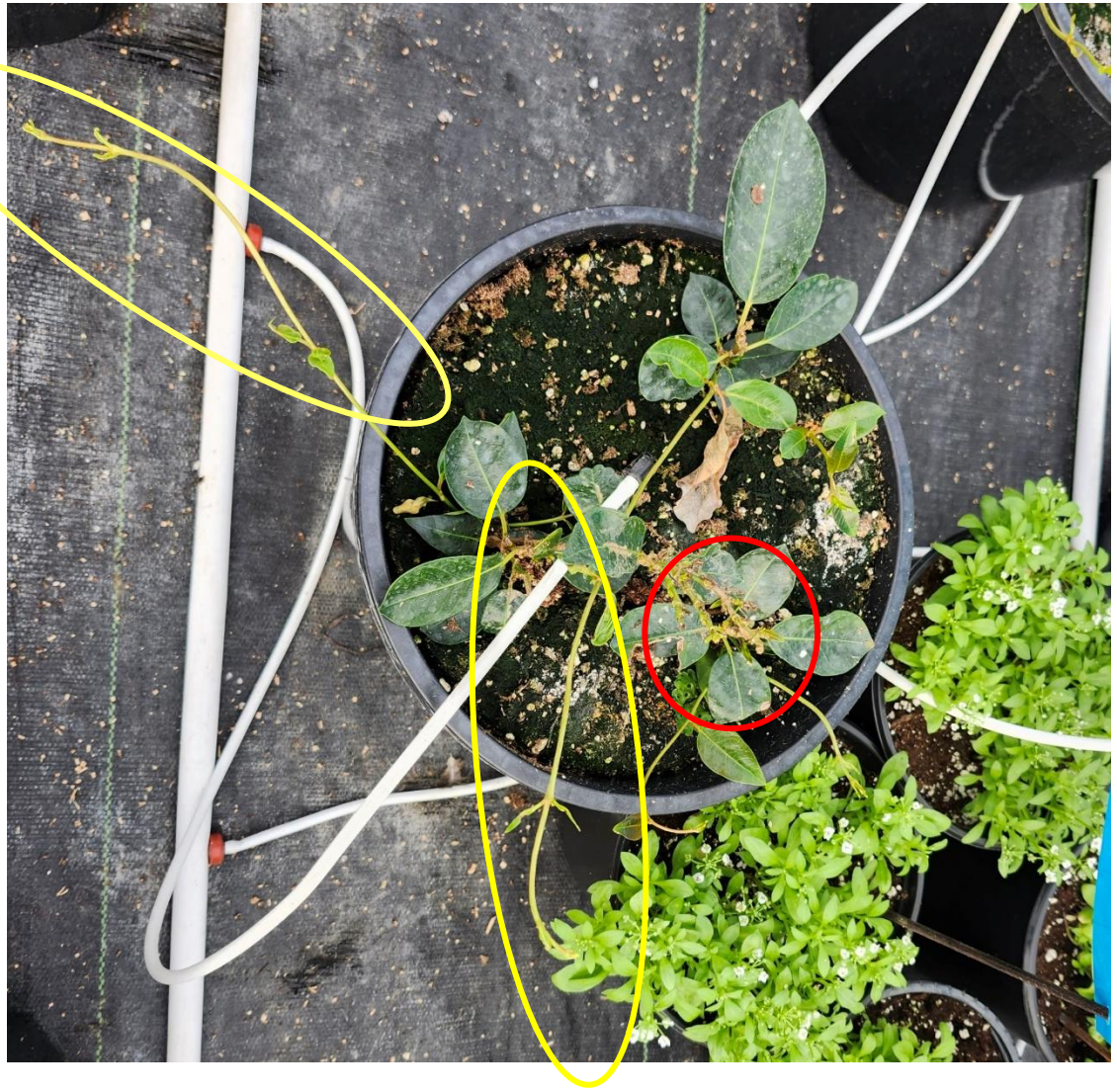
Comparing programs: Curative program for Mandevilla

Neither as successful as we'd hoped

- **Thrips pressure:** both successful in terms of generally keeping **thrips populations to threshold of < 5 thrips** per pot 9/12 inch pot
  - Much lower than previous attempts with predatory mites and lacewing (10 thrips per pot = lowest)
  - High Bios program + trap plants more stable

- **Damage:** BOTH programs had to switch to sprays in late Nov (same as 2022) due to lack of growth
  - Overall, growth better in bios + microbials program
  - Actual damage threshold is obviously much lower than 5 thrips/plant – neither program could keep up

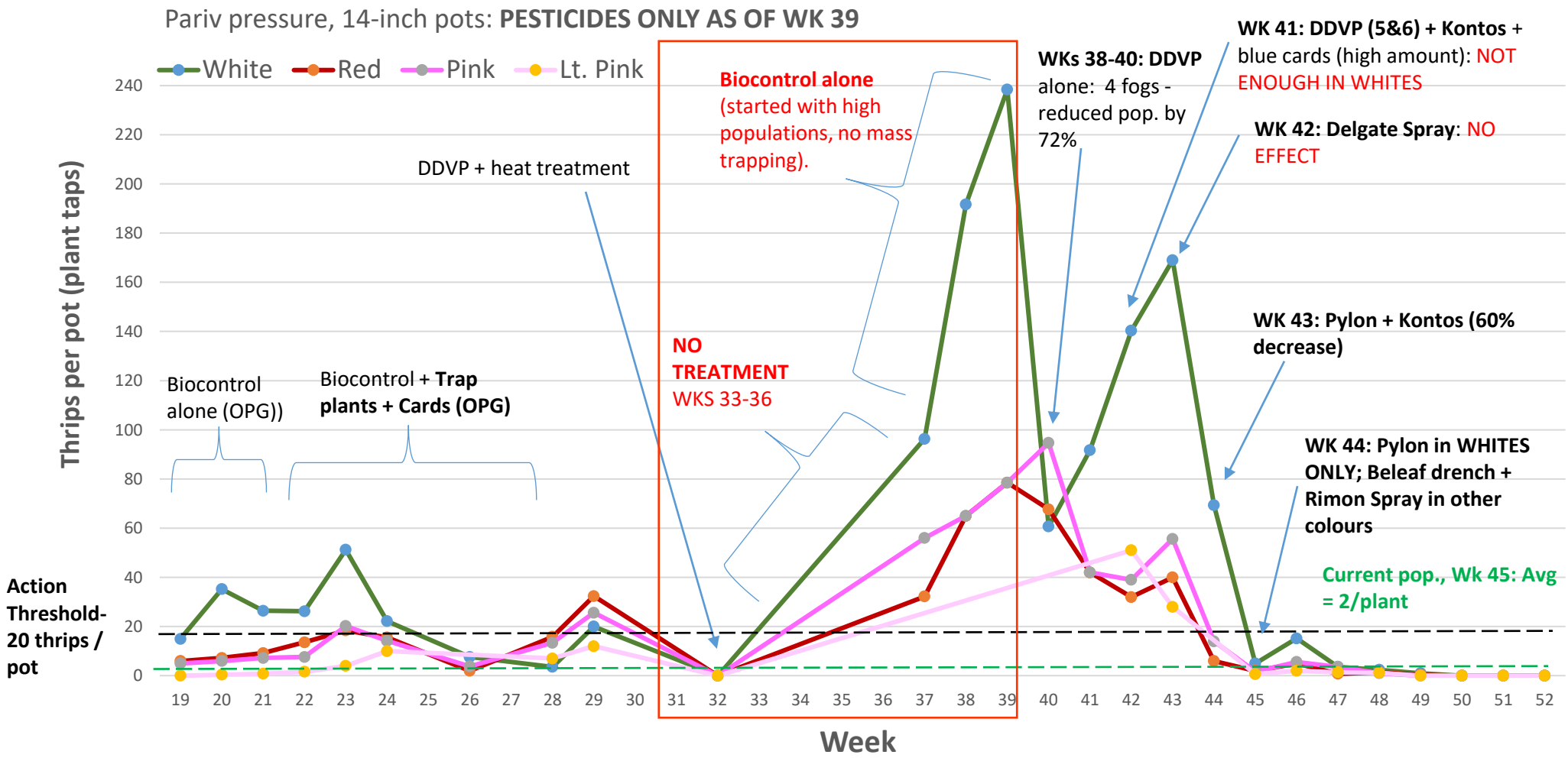
- **Cost:**
  - Bios only program more expensive
  - Neither program economically feasible yet



Biocontrol in Mandevilla: **LESSONS LEARNED**

1. Can never have a period of NOTHING

- Need lots of mass trapping cards at a minimum; Bios + soft pesticides or microbials
- Any gap in control leads to outbreaks – need to go to hard chemicals at this point



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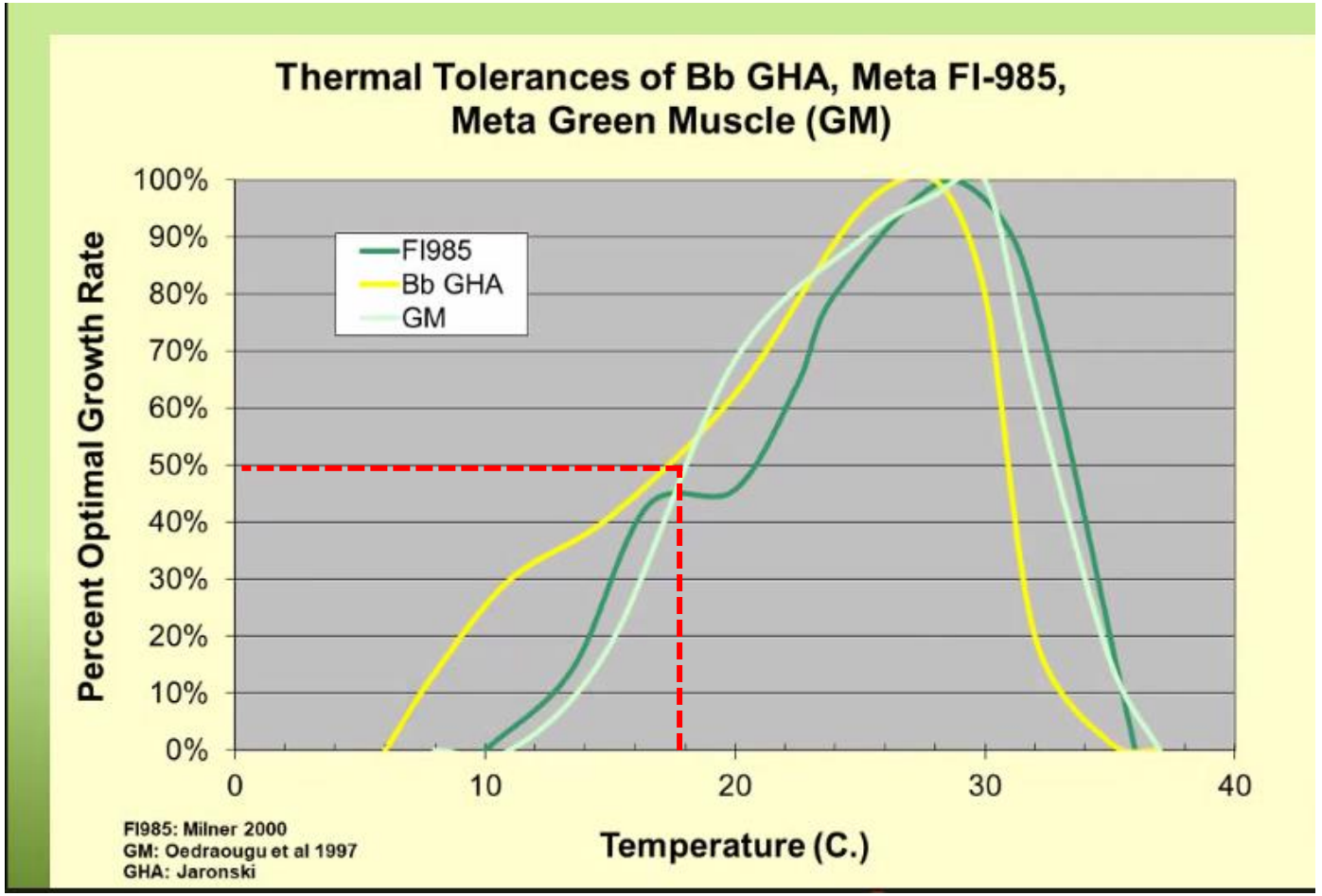
Biocontrol in Mandevilla: **LESSONS LEARNED**

2. Biocontrol may not be possible in Winter

- We already know that low temps/light conditions means lower efficacy of bios
  - Including microbial pesticides – not effective below 20C
- But low plant growth also means plants can't outpace damage
- Parvi keep going anywhere above 7C
- Pesticides may always be needed late Oct – late Feb if Parvi already present
- But early use of bios/microbials preserve chemicals for when you WILL need them



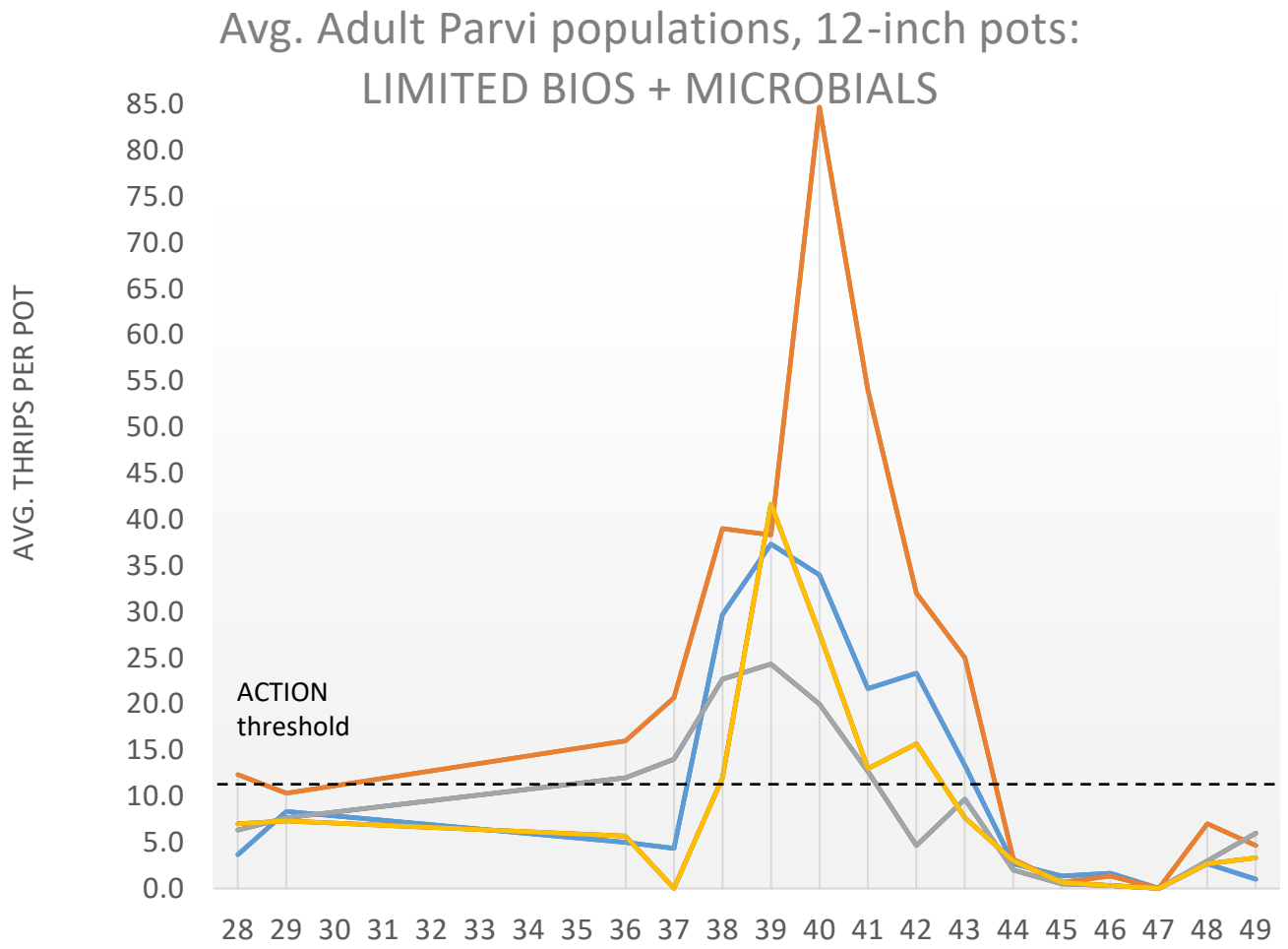
Slide courtesy of S. Jaronski

Ontario

2023 Biocontrol Trials - Mandevilla

3. Monitoring / Thresholds still needs work

- Even through **thrips levels did end up at less <5 adult thrips per pot, new growth damaged**
  - Larvae don't tap out well BUT could see them running on stems – likely responsible for bulk of damage
- Suggests **Fall/winter threshold needs to be set MUCH lower** (1/adult pot on average?) or **need to use a different metric**
  - Develop seasonal thresholds? Go by damage alone? Do something if ANY visible larvae? How to use card data?
  - COULD monitor just the "thripsiest" variety and use that as a metric



Ontario

Chemical Controls: Propagation through Finishing

They're working…for now

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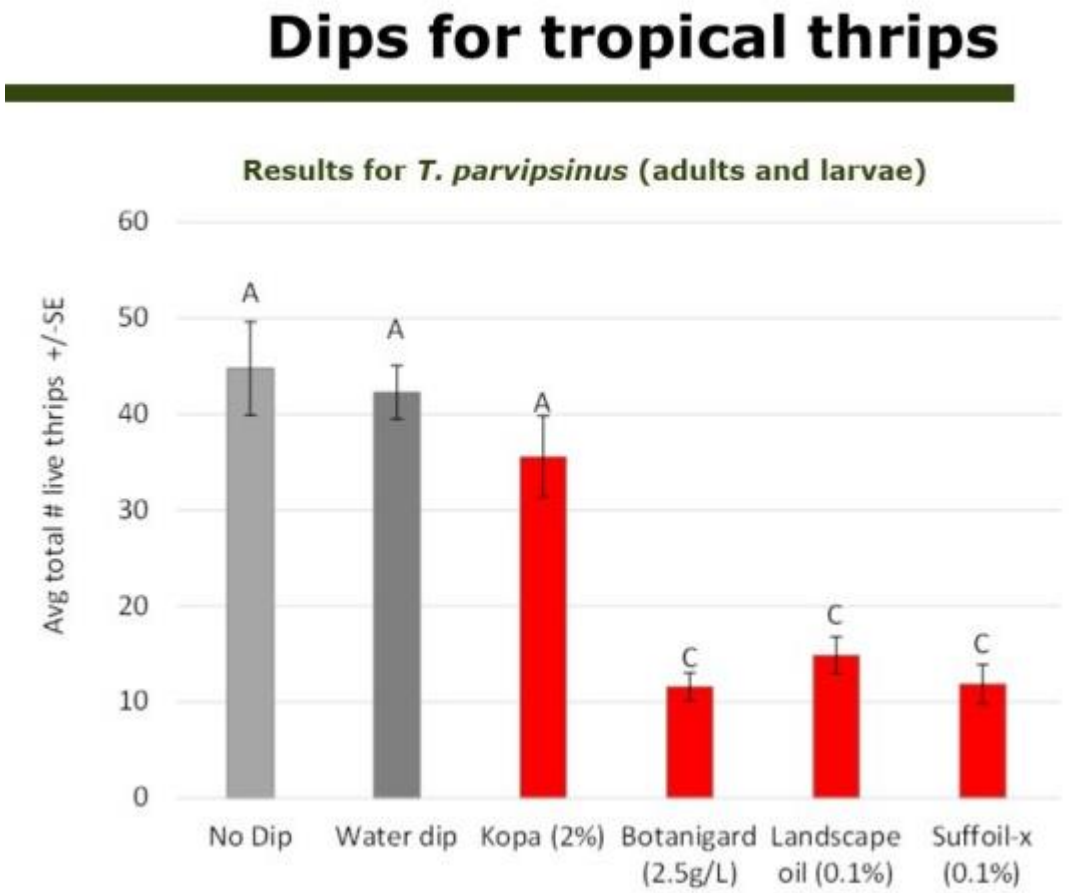
Pesticides- Preparation

- **Inspect cuttings** for thrips life stages present
- **Dip all cuttings**
  - seem to be coming in mostly as eggs, but still an important preventative step
- **Do 2nd dip 17 days after sticking OR at time of potting** in OIL
  - Gets next generation
  - Oil will help kill eggs – plants can handle it better once rooted



Data courtesy of R. Buitenhuis, Vineland Research and Innovation Centre

Ontario

Biorational's

- There is no known resistance to these
- Don't forget to include these in your chemical rotations
- The use of these will add to your list of AI's
- Spray during optimal temperatures for the biorationals to be effective

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Ontario

Data Courtesy of Dr. Alexandra Revynthi University of Florida

UF UNIVERSITY of FLORIDA

Biorational Pesticides: *Mostly untested on-farm (BOLD = working somewhat)

U.S. Product	Canadian Product (Registration Status)	Chemical Name	IRAC Group	Kills Larvae	Reduces Larval Feeding	Kills Adults	Reduces Adult Feeding
Bioceres EC	**Bioceres EC**	***B. bassiana* ANT-03**	**NC**	**50-100% (direct and indirect)**		**80%**	**X**
BotaniGard WP	BotaniGard WP	*B. bassiana* GHA		20-40%		<10%	
Ultrafine	NR	92% mineral oil	NC	20-30%	X	40-60%	X
Bee Safe	NR	Sesame oil	NC	20%	X	15-40%	X
Suffoil-X	**Suffoil-X**	**Mineral oil**	**NC**	**20%**	**X**		
Bush Doctor	NR	Garlic oil	NC	10%	X		X
M-pede	Multiple soaps available	Soap	NC	10%	X		X

M52 not formally tested yet but seems to be working VERY well on-farm

Ontario

First Line of Defense

- Early Chemicals (prop and vegetative), young plants with delicate root systems

- Biorationals; Soaps, Oils, WP formulations

    - M52
    - BotaniGard WP
    - Bioceres WP
    - Safers Soap
    - Suffoil X

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Second line of Defense

- Later propagation and pot tight; well rooted plants

- Oils and Biorationals and EC formulations
  - Oils are better as a dip for rooted cuttings OR at finish
  - Oils are better than soaps because oils will kill thrips eggs in leaf

- M52
- BotaniGard EC
- Bioceres EC
- Suffoil X

*note; above 35C fungi aren't effective

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Data Courtesy of Dr. Alexandra Revynthi, University of Florida

UF UNIVERSITY of FLORIDA

Chemical Pesticides:

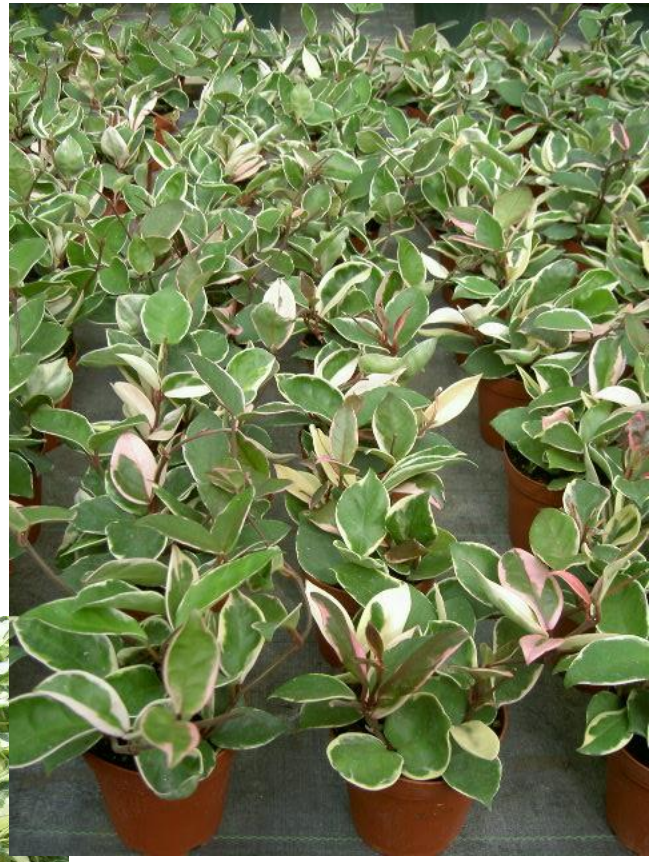
U.S. Product	Canadian Product (Registration Status)	Chemical Name	IRAC Group	Kills Larvae	Reduces Larval Feeding	Kills Adults	Reduces Adult Feeding
Conserve	**Success (GH)**	**spinosad**	5	X	X	X	X
Xxpire	**Closer (LO) +Delegate (LO)**	**sulfoxaflor + spinetoram**	4C+5	X	X	X	X
Piston	**Pylon (GH)**	**chlorfenapyr**	13	X	X	X	
Timectin	**Avid (GH)**	**abamectin**	6	X	X		X
Kontos	**Kontos (GH)**	**spirotetremat**	23	X	X		
Pedestal	**Rimon (GH)**	**novaluron**	15	X			
Tristar	**Tristar (GH)**	**acetemeprid**	4A			X	
Pradia	Harvanta (NR) + Beleaf (GH)	cyclaniliprole + flonicamid	28+29	X	X		X
Hatchi-Hatchi	Not registered	tolfenpyrad	21A	X	X		
Mainspring	**Ference (GH)**	**cyantraniliprole**	28		X		

LO = landscape ornamentals only
GH = Greenhouse ornamentals
NR = Not registered on ornamentals

Ontario

Third line of Defense

- Chemicals for LARVAE in propagation
  - Several applications may be necessary
  - ROTATE the correct larvicide.



- Ference
- Beleaf
- Rimon
- Kontos
- Rycar

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Fourth line of Defense

- ONLY when adults emerge
  - You may need to include miticides in rotation, spraying for thrips agitates spidermites.
  - Check the recommended label rates for spidermites and thrips and choose the higher of the two.
  - Some chemicals have a max number of times you can use per crop cycle.

- Pylon
- Success
- Avid
- Tristar

ONCE YOU'VE GONE TO 4TH LINE OF DEFENSE **YOU WILL BE FINISHING WITH CHEMICALS**

ROTATE ALL DEFENSE LEVEL TREATMENTS!

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Finishing

- This point worried about ADULTS
  - Larvae – no one will find at border/sales floor

- This is where you might need an adulticide + a larvicide to make it last longer
  - Example; Success (adult/larvae) + Avid (larvae)

  - **REMEMBER** tank mixing is **off label**.
  - **ALWAYS** test before you spray a tank mix. Tank mixing is always risky and what works at one facility may not work at yours or cause phyto at your facility.

Pesticides: Important Considerations

- Stage is important – don't use and adulticide when lots are larvae are present.
- Pesticide rotation will be key
- Tank mixes- MIGHT be more effective (Bemisia in poinsettia) BUT will reduce your rotation time (instead of have 10 chemicals now have 5)
- Will NOT be a calendar spray program – can't be
- HAS to be based on monitoring, thresholds
  - E.g. example with 16 weeks of control in Mandevilla – what if we'd gone in every 2 weeks
- Spraying by threshold based on SPECIES and VARIETY
  - **Will help avoid resistance. How?**
    - **Refugia**- areas where populations can survive through unfavorable conditions
    - Farm wide spraying = road to resistance

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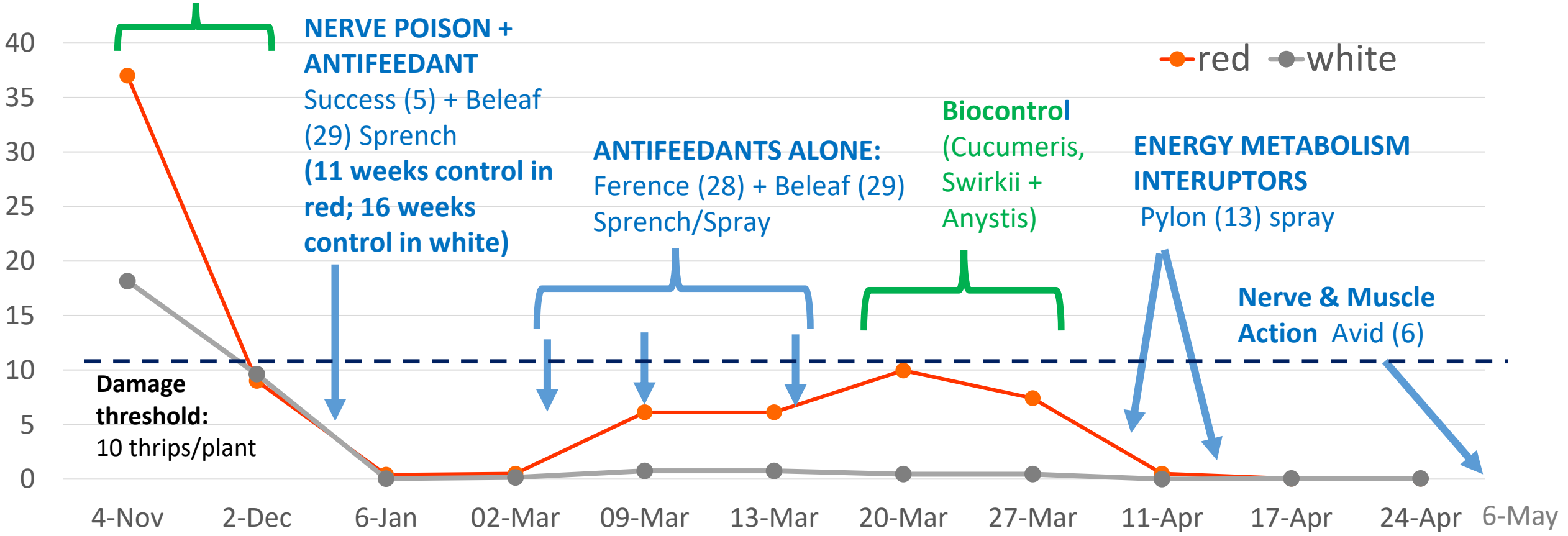
Chemical controls: Rotation Program 2022

Ontario

***Whites only got initial Success and then nothing until final cleanup with Pylon and Avid**

Biological/Mechanical Control (Anystis, Lacewing, Dicyphus, Cucumeris)



Refugia: Presence of susceptible thrips reduces resistance

Ontario

Interbreeding with susceptible populations speeds up decline in resistance in the absence of spraying

With 100% resistant thrips the level of resistance remains unchanged after 8 months with no exposure

Table 2. Resistant factors (95% confidence intervals) at lethal concentration 50 level towards spinosad in *F. occidentalis* populations with initial frequencies of 0, 25, 50, 75 and 100% of resistant individuals, tested bimonthly during eight months.

Strain	Month				
	0	2	4	6	8
0 r + 100 s	1.0	0.7 (0.3–1.4)	1.1 (0.5–2.4)	0.8 (0.4–1.8)	0.6 (0.3–1.4)
25 r + 75 s		8.4 (4.3–16.4)	5.7 (2.5–12.9)	9.5 (4.6–19.6)	14.6 (6.6–32.3)
50 r + 50 s		10.4 (3.8–28.8)	4.1 (1.5–11.0)	21.1 (9.9–44.7)	19.4 (8.8–42.6)
75 r + 25 s		406 (114–1442)	125 (48–326)	211 (85–523)	430 (149–1246)
100 r + 0 s	38,765 (18,561–80,959)	44,245 (23,954–81,725)	23,198 (11,090–48,525)	41,976 (21,550–81,764)	54,538 (27,515–108,099)

Even 25% susceptible thrips drops resistance level of population by 100-fold in just 2 months

Bielza et al. 2008. Stability of spinosad resistance in *Frankliniella occidentalis* (Pergande) under laboratory conditions. Bull. Entomol. Res., 98, 355-359

SUMMARY: A and B Team Pesticides for Parvi

Ranked Based on ON-FARM Experience:

A Team

- Success (Spinosad) - foliar (A,L)
- Pylon (Chlorfenapyr)- foliar (A,L)
- Rimon (Novaluron) - foliar (L)
- M52 (M. brunneum F52) - drench (P) and/or foliar (A,L)
- Bioceres EC – B. bassiana ANT-03 - foliar (A,L)

-Idea is to rotate with A and B team products as needed, depending on dominant life stage, pest pressure

- Always check label to see if tank mixing allowed in your province/state

B Team

Notice "B Team" mostly tackles just larvae

- Avid (Abamectin) – foliar (L)
  - better as a tank mix
- Kontos (Spirotetremat) – foliar (L)
  - Can take a while for effects to show
- Rycar (Pyrifluquinazon) – foliar (A,L)
  - Fair control – use as part of rotation
- Ference (cyantraniliprole) – foliar or drench (L)
  - suppression only – use as part of rotation
- Beleaf (Flonicamid) – foliar or drench (L)
  - suppression only; use as part of a rotation or tank mix

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IMPORTANT TO KNOW

- Just because you spray at the end does not mean the program failed!
- Goal is to bring the thrips numbers down into tolerable levels and to ship a nicely developed plant

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Sanitation

The final step of "finishing"

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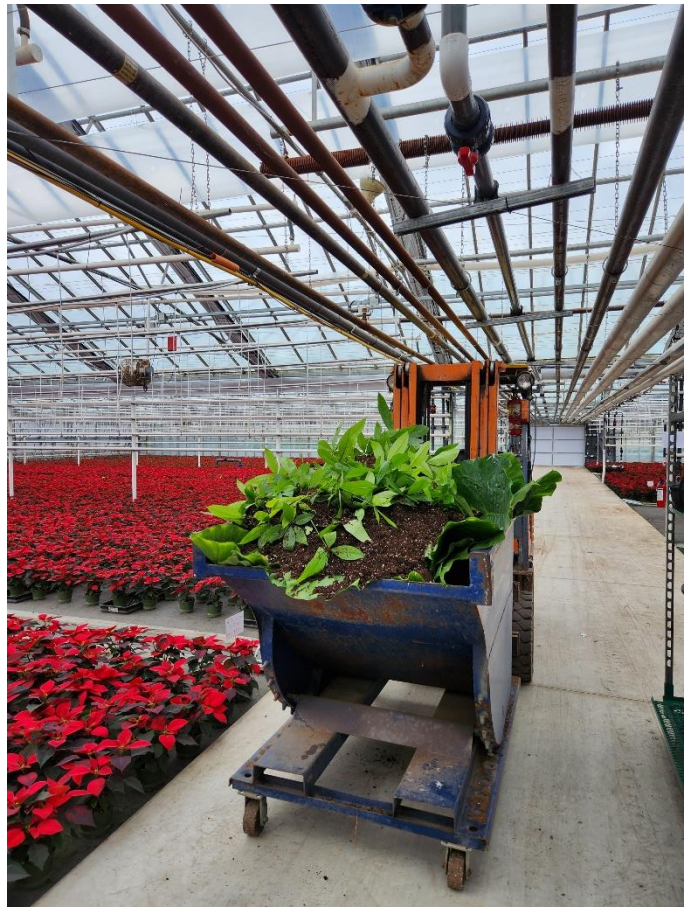

- Don’t leave contaminated compost bins in clean greenhouses

PACE SOLUTIONS

Pace ACBD System® – 3 Easy Steps
Always Clean Before Disinfecting

Step 1: Scrub the area with appropriate cleaner.
Step 2: Thoroughly rinse the cleaner off with water.
Step 3: Apply a broad spectrum disinfectant at recommended concentrations to kill target microbes.

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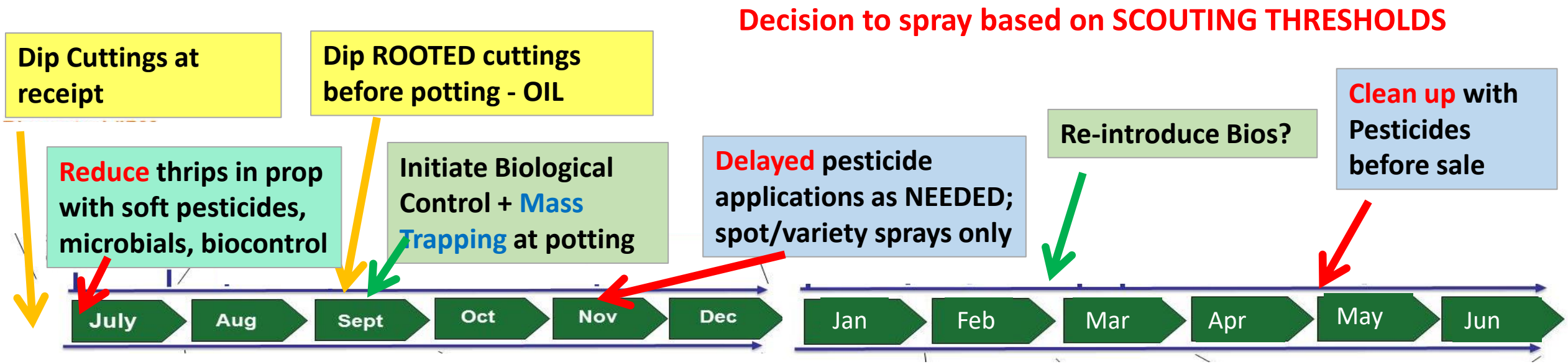
Putting it All Together

What we know… and what we don't

IPM plan, *T. parvispinus* in MANDEVILLA



Plan for 2024:

- Select varieties that can tolerate more damage
- Make use of bios/soft pesticides in propagation
- Reduce action thresholds to <10 thrips/20 pots (e.g. 0.5 thrips per pot)
- Incorporate damage metrics (i.e. low thrips numbers but plants not growing? SPRAY)
- Use softer pesticides with biocontrol as needed, along with spot sprays
- Switch to pesticides as soon as weather gets colder/cloudier (mid Oct?)

Ontario

Which Bios???

- **Orius**
  - Trials from NL (Biobest) on Ficus and in ON in Anthurium (Plant Products) suggest Orius should be the backbone of biocontrol programs
  - Jury is still out in more dense crops like Mandevilla…
- **Microbials**
  - Bioceres EC only *Beauveria* proven effective BUT other EC formulations were not tested
  - M52 seems effective (no lab tests yet)
- **Other big bios**
  - Next likely contenders: Anystis, Lacewing (some evidence C. rufilabrus more effective than C. chrysoperla), Dichyphus, Predatory thrips (US and NL)
- **Soil-Dwelling Bios**
  - Hypoaspis, Atheta, nematodes could be helping, but contribution unclear.
- **Mites**
  - **Degnerans + pollen, being trialed with some success**
  - Cucumeris, Swirskii NOT working, even in high numbers (sachets, broadcast) – do not seem to like tropical plants. Promise for other species? Or just not worth cost?

Struggle will be to find a **cost-effective program** for EACH crop

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What we do know,…

- We need your help and feedback in order to create a program that works.
- We need to make sure that chemical label rates are followed so that if they work, we know exactly what was applied.
- We need time and patience to complete the trails.
- We will make sure that the final product you ship will be sellable.

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