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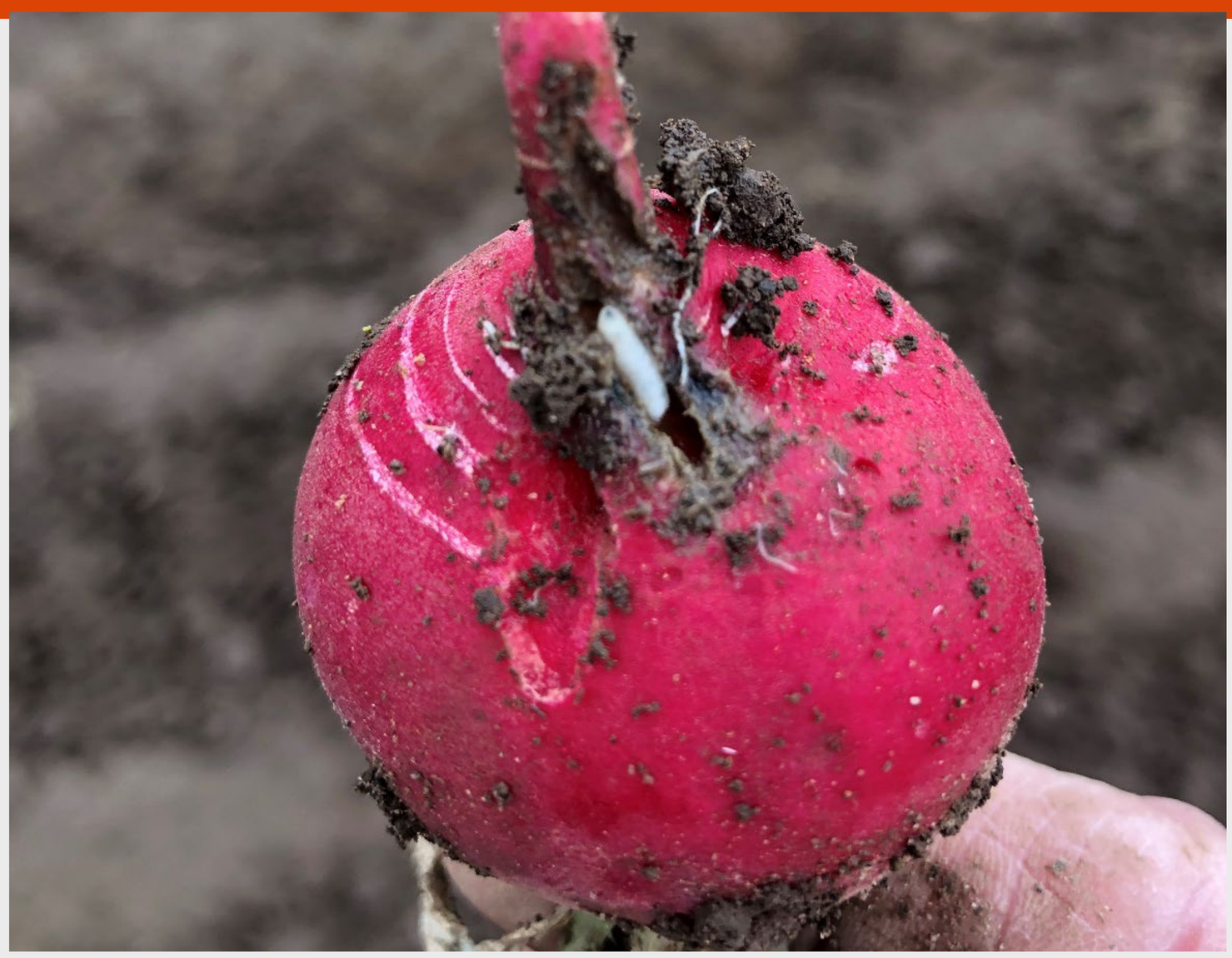
CABBAGE MAGGOT IN THE PNW

Kristie Buckland, Vegetable and Specialty Seed Crop Specialist



- Overview
- Identification
- Life cycle
- Predicting adult presence
- IR-4 trial results
- New approaches
- What's next?

Visit the cabbage maggot portal for all the latest research
https://agsci.oregonstate.edu/cabbage-maggot

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CABBAGE MAGGOT IDENTIFICATION

- Multiple Delia spp. could be present
- Identification and management needs to consider crop, crop growth stage, and weather conditions

Species	Crops attacked[1]	Lifecycle	Egg location	Egg Number/ Oviposition	Main damage	Occasional Damage	Damage Threshold
D. radicum CABBAGE MAGGOT	Radish Turnip Cabbage Misc. crucifers	Apr- Oct, 3-5 generations	On stem at soil level or just below	10-100+ per female	Mine and burrow into roots and stem	heads, cause browning and rotting	early: 5-10% later: 100% if sufficient water
D. floralis TURNIP MAGGOT	Turnip Cabbage Cauliflower	July-Sept 1 generation	On stem at soil level or just below	'in clumps', similar to D. radicum	mine and burrow, but not as deep as D. radicum	petioles of lower leaves	Not as severe due to timing, if well established, >80 per root
D. planipalpus RADISH MAGGOT	Radish Cabbage Cauliflower Turnip	Apr-Oct many generations	On exposed root or inner surface of lower petiole	laid singly	tunneling in the root	not observed	not larval density per se, rather secondary problems caused by root damage (lodging, unmarketable roots, etc.)
D. platura SEEDCORN MAGGOT	Crucifers infested with other Delia species, other vegetable hosts (corn, bean, etc.)	late June-early Sept	Higher on stems	in clumps, sometimes interlaid with eggs from other species	roots	unknown	unknown

J.Green based on Brooks (1951) and other references.

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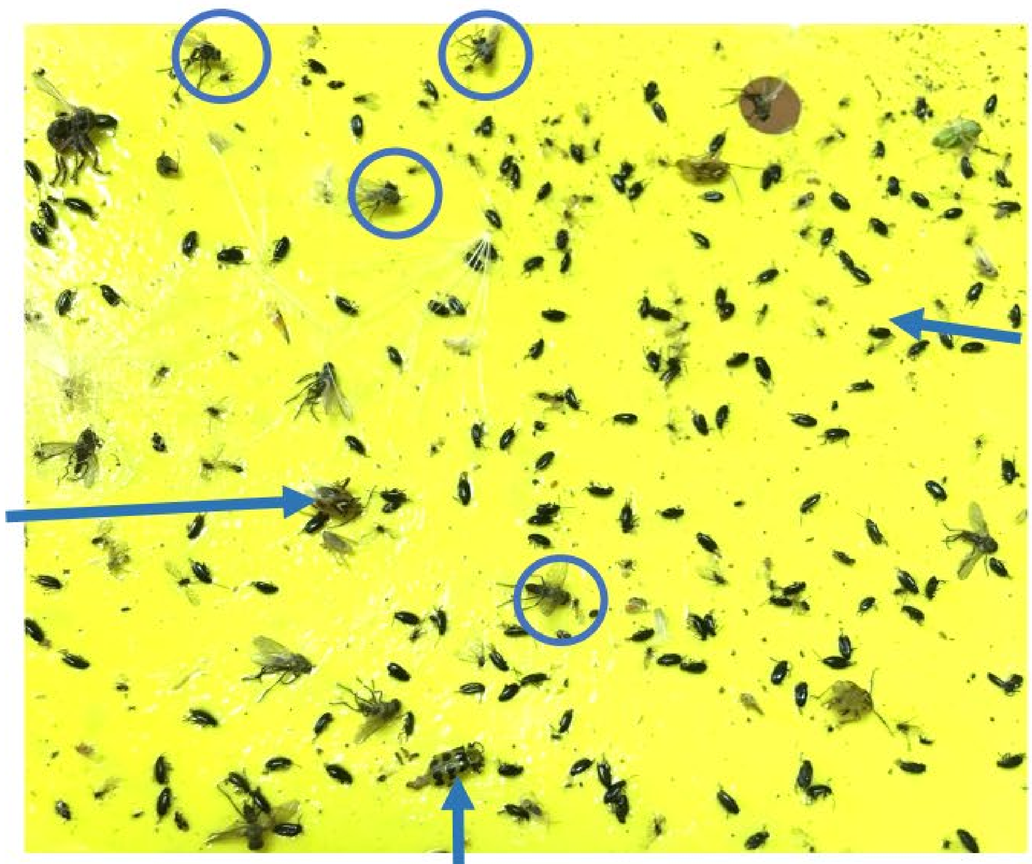
CABBAGE MAGGOT IDENTIFICATION

Trapping cabbage root flies

- Lures have not been very effective
- Sticky traps
  - Weekly maintenance
  - Can put in cling film or plastic bag to ID later
- Bucket traps
  - Daily maintenance
  - Use 2” strip of black tape or paint to minimize bee capture

Identifying adult flies on sticky traps



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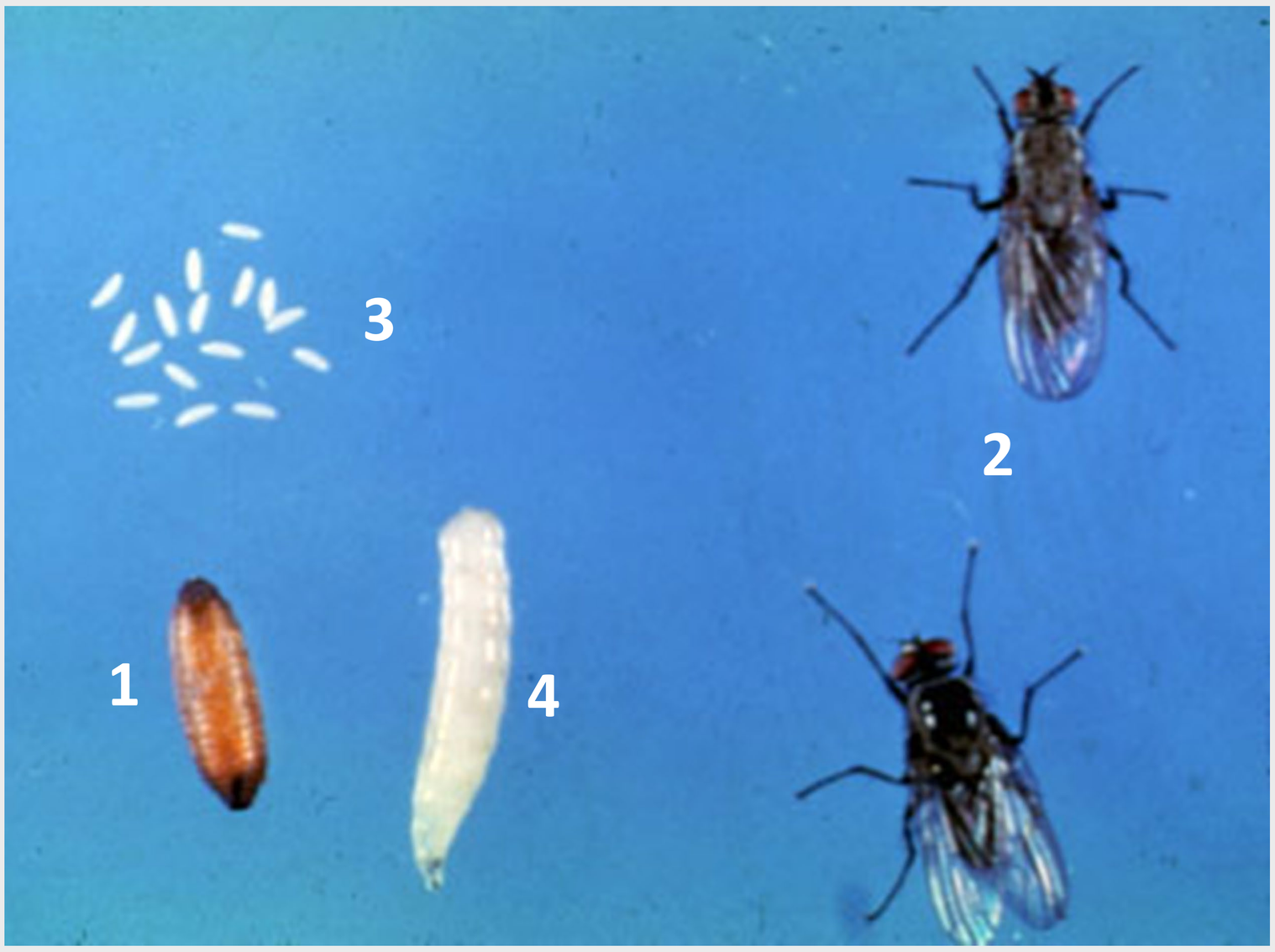
CABBAGE MAGGOT LIFE CYCLE



1. Overwinter as brown pupae in soil and crop residue and emerge as adults in spring

2. Adults lay eggs on lower stems of host plants or in soil cracks

3. After 4-10 days, eggs hatch into larvae (maggots)

4. Larvae move down into the soil to feed on roots for around 3 weeks

5. Larvae pupate underground, remaining as pupae for at least two weeks

6. Multiple overlapping generations occur each summer

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PREDICTING ADULT PRESENCE

WWW.USPEST.ORG

Model category: insects

Select model: (see list)

cabbage maggot - UC Extension (model params)

Output in: Fahrenheit °F

Start: Jan 1 2019

Starting date instructions: calendar date - set on Jan 1

End: Dec 31 same yr Note - start date reset to database default.

Model validation status: partly validated **Region(s):** Pacific Northwest

Forecast type: after 7day use NMME extended seasonal forecast

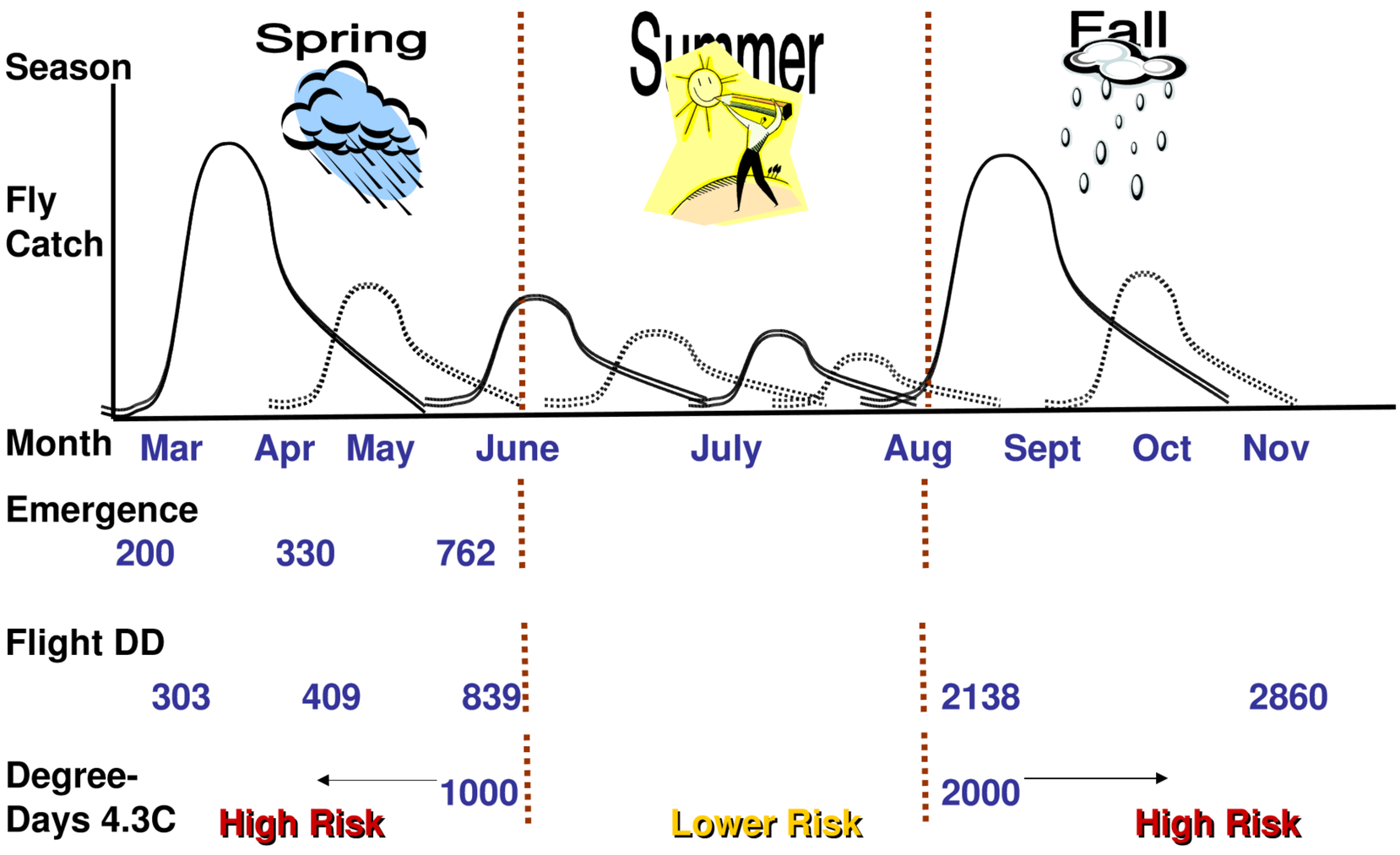
Weather data QA score 1.00; 0 days missing

Model preview: all

Date		DDs	Event
Jun 4	166 days ago	1521	end of spring flight (95%)
Aug 28	81 days ago	3849	fall flight begins
Nov 22	5 days away	5160	fall flight ends approx. first frost

future events

Western Oregon Emergence and Flight of the cabbage maggot (*Delia radicum* L.) AJDreves Dec 2005



QR code for the online model at uspest.org

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PREDICTING ADULT PRESENCE

WWW.USPEST.ORG

Output from uspest.org/wea insect degree-day/phenology model program:
Heat Units and predictions of key events from daily weather data

==========MODEL INPUTS==========

Model species/general links:	cabbage maggot - *Delia radicum* (L.)
Type:	insect
Model source/other links:	UC Extension OSU DDs info cards (pdf)
Calculation method:	single sine
Lower threshold:	39.7 degrees Fahrenheit
Upper threshold:	86 degrees Fahrenheit
Directions for starting/BIOFIX:	calendar date
No starting/BIOFIX date, set to:	default date 1 1
No ending date, set to:	default date 12 31
Model validation status:	partly validated
Region of known use:	Pacific Northwest

==========EVENTS TABLE==========

1. 360 DD after Jan 1: initial spring emergence (10%)
2. 601 DD after Jan 1: spring peak emergence (50%)
3. 750 DD after Jan 1: egg-laying notes a) need plants at least 30 days after planting
4. 900 DD after Jan 1: notes b) prefer maturing plants with developing roots, > 7 leaves
5. 1050 DD after Jan 1: notes c) at least 7 days after peak flight
6. 1200 DD after Jan 1: notes d) lasts ca. 5 weeks, mostly during 2 weeks
7. 1521 DD after Jan 1: end of spring flight (95%)
8. 3849 DD after Jan 1: fall flight begins
9. 5160 DD after Jan 1: fall flight ends approx. first frost

Threshold values are important! Just any old DD calculator will not work. You need to have the model set up specifically for the pest of interest—cabbage maggot values are different than other pests so if you use a DD calculator somewhere else, set the limits appropriately.

The spring emergence data is not 100%--this initial number is set for 10%, can be of course influenced by field conditions. Remember, we are dealing with the temperature of soil heating which also can be greatly affected by moisture content, cover crop/vegetation coverage/etc. ESTIMATE 7-10 day of variability with emergence, which is not great.

Accuracy of this model decreases with overlapping populations, field variability, etc.

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PREDICTING ADULT PRESENCE

WWW.USPEST.ORG

==========MODEL OUTPUT==========
Weather station: 2019 ARAO Agrimet AURORA OR Lat45.2817 Long-122.7503 Elev:141

mn	day	max	min	precip	DD39	CUMDD39	event
1	1	43.10	27.80	0.00	0.70	0.7	* START *
1	2	40.60	27.70	0.01	0.10	0.8	
1	3	54.10	39.90	0.04	7.30	8.1	
1	4	51.60	44.60	0.21	8.40	16.5	
1	5	50.50	39.90	0.02	5.50	22.0	
1	6	45.10	38.10	0.26	2.23	24.2	
1	7	46.10	33.10	0.05	2.02	26.2	
1	8	52.10	41.20	0.25	6.95	33.2	
1	9	52.10	40.30	0.14	6.50	39.7	
1	10	56.90	43.70	0.02	10.60	50.3	
1	11	48.50	38.80	0.00	4.07	54.4	
1	12	52.80	29.90	0.00	4.51	58.9	
1	13	51.60	28.70	0.00	3.87	62.7	
1	14	50.10	28.10	0.00	3.21	66.0	
1	15	43.20	35.90	0.00	1.09	67.0	
3	17	68.60	42.30	0.00	15.75	255.0	
3	18	70.80	45.80	0.00	18.60	273.6	
3	19	77.10	51.60	0.00	24.65	298.3	
3	20	75.20	50.90	0.00	23.35	321.6	
3	21	55.50	45.50	0.01	10.80	332.4	
3	22	53.90	37.20	0.22	6.27	338.7	
3	23	58.30	40.90	0.01	9.90	348.6	
3	24	60.10	40.20	0.00	10.45	359.0	
3	25	51.60	45.20	0.21	8.70	367.7	initial spring emergence (10%)
3	26	60.30	34.70	0.01	8.76	376.5	
3	27	55.20	41.50	0.35	8.65	385.1	
3	28	62.70	34.80	0.20	9.94	395.1	
3	29	60.40	44.40	0.01	12.70	407.8	
3	30	67.50	38.20	0.00	13.29	421.1	
3	31	67.20	37.60	0.00	12.94	434.0	
4	1	61.50	46.50	0.03	14.30	448.3	
4	2	59.40	50.80	0.34	15.40	463.7	
4	3	58.90	45.40	0.00	12.45	476.1	
4	4	57.70	44.10	0.23	11.20	487.3	
4	5	55.80	43.50	0.41	9.95	497.3	
4	6	55.70	41.50	0.98	8.90	506.2	
4	7	55.50	46.90	0.87	11.50	517.7	
4	8	58.00	47.00	0.52	12.80	530.5	
4	9	56.20	46.10	0.04	11.45	541.9	
4	10	52.10	45.30	0.05	9.00	550.9	
4	11	51.90	47.90	0.11	10.20	561.1	
4	12	59.40	46.70	0.00	13.35	574.5	
4	13	51.80	41.90	0.22	7.15	581.6	
4	14	51.40	39.20	0.01	5.64	587.3	
4	15	52.00	36.50	0.16	5.18	592.5	
4	16	59.20	42.90	0.04	11.35	603.8	spring peak emergence (50%)

Notice the DD accumulations in each date are really variable!

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PREDICTING ADULT PRESENCE

Managing spring emergence starts with fall/winter crops!

Pupae on roots of culls serve as first generation for next year.

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IR-4 EFFICACY TRIALS

Radish Trial 2018

Products and delivery methods	% Damaged Early Sample	% Damaged Harvest
UTC	32.5	40.0
Lorsban in furrow	35.0	57.3
Verimark in furrow	57.5	51.3
Harvanta in furrow	43.3	39.5
Harvanta post-plant spray	36.7	47.5
Exirel post-plant spray	51.1	32.2
SPE-120 seed treatment	32.5	44.4
SPE-120 seed treatment plus post-plant spray	45.0	38.2
Radiant seed treatment	57.5	47.8
Radiant post-plant spray	53.9	50.0
p-value	p=0.67	p=0.23

There were no differences between insecticide treatments for any plant measure.

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IR-4 EFFICACY TRIALS

Radish Trial 2019

Treatments	Rate/acre (oz form.)	30 DAS % damaged	37 DAS % tunneling damage
Untreated check	NA	100	11.7
SPE-120 seed treatment[a]	NA	100	19.2
Verimark[b]	13.5	98.3	16.7
Radiant SC[c]	10	100	6.67
SPE-120[d]	1	96.7	12.5
P > F		0.577	0.354

[a] Applied as a seed treatment at 500 mg per 100 g seed

[b] Applied in-furrow at planting

[c] Directed spray at 3 DAS and 20 DAS

[d] Directed spray at 13 DAS

There was no significant difference among treatments for cabbage maggot damage incidence or severity at any sample date.

Scan the QR code to read the full article.

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IR-4 EFFICACY TRIALS

Broccoli Trial 2021

Treatment	Rate/acre (oz form.)	14 DAP		21 DAP		28 DAP	
		Incidence %	Severity	Incidence %	Severity	Incidence %	Severity
Untreated check	N/A	12.5	0.4	32.5	1.9	20	0.6
Entrust SC[a]	10.0	32.5	1.0	22.5	0.8	32.5	1.1
Mustang Maxx[b]	4.0	32.5	1.2	37.5	1.38	35.0	1.3
Verimark[c]	13.5	60.0	2.0	35.0	1.3	26.8	0.9
P > F		0.081	0.254	0.796	0.254	0.797	0.652

[a] Two directed sprays, 1 and 15 DAP

[b] Four directed sprays, 1, 8, 15, and 22 DAP

[c] Tray drench day of transplanting

There was no significant difference among treatments for cabbage maggot damage incidence or severity at any sample date or in final biomass.

Scan the QR code to read the full article.

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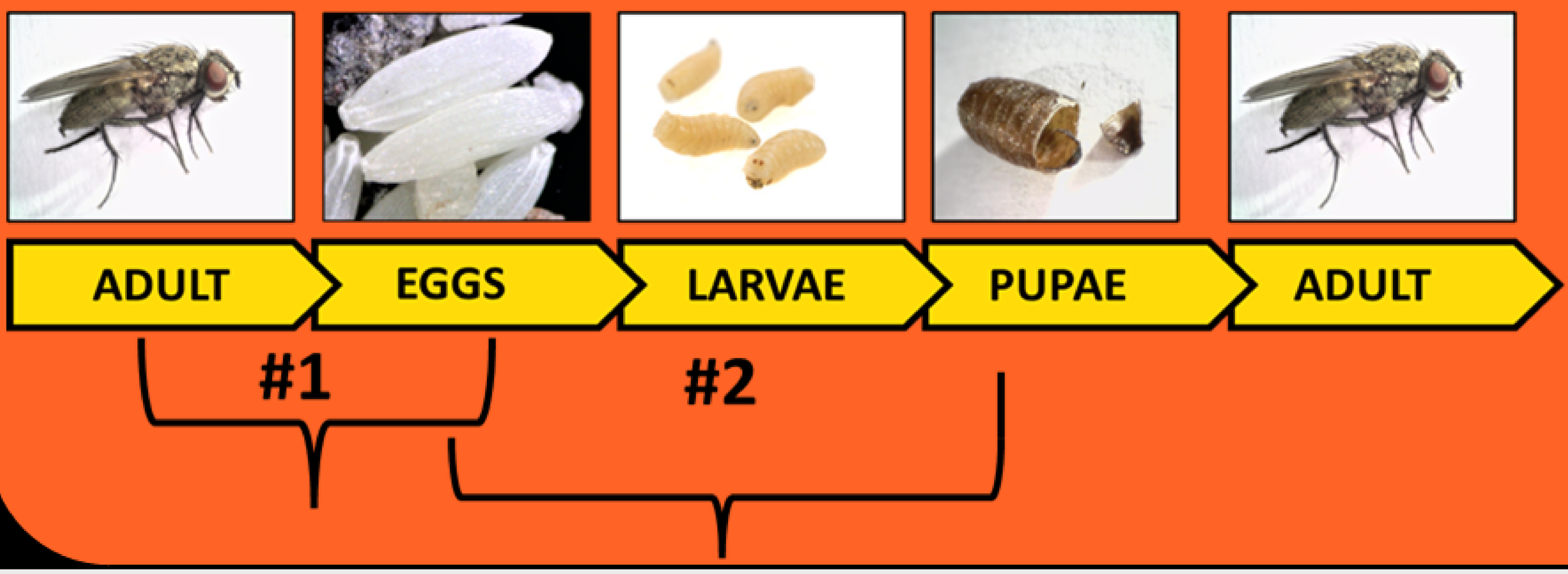
A NEW APPROACH

Monty Matteson, Lightle Lab, OSU NWREC

Dani Lightle, OSU NWREC

Greenhouse Trials



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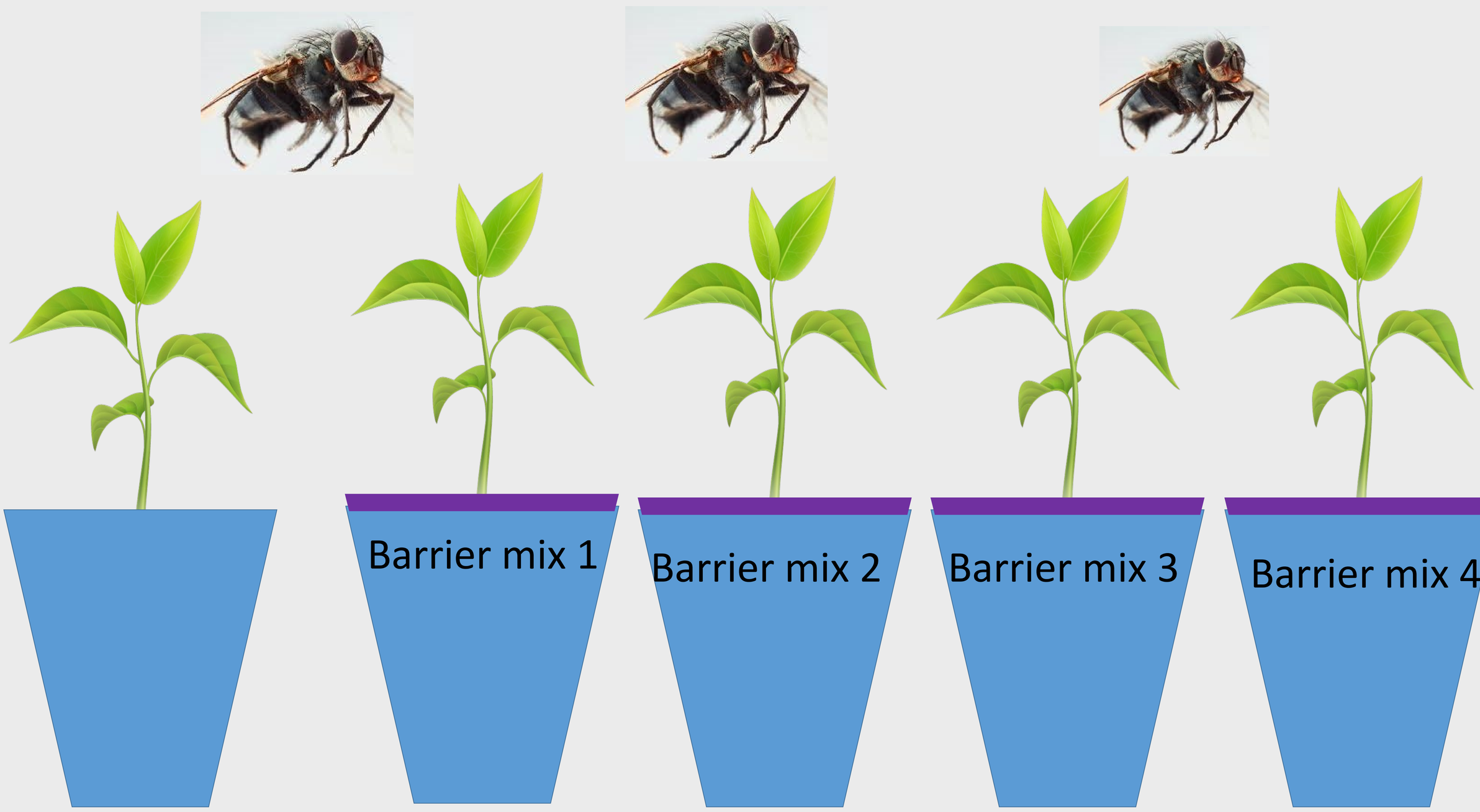
A NEW APPROACH

Physical Barrier Technology

Hydromulch greenhouse bioassay



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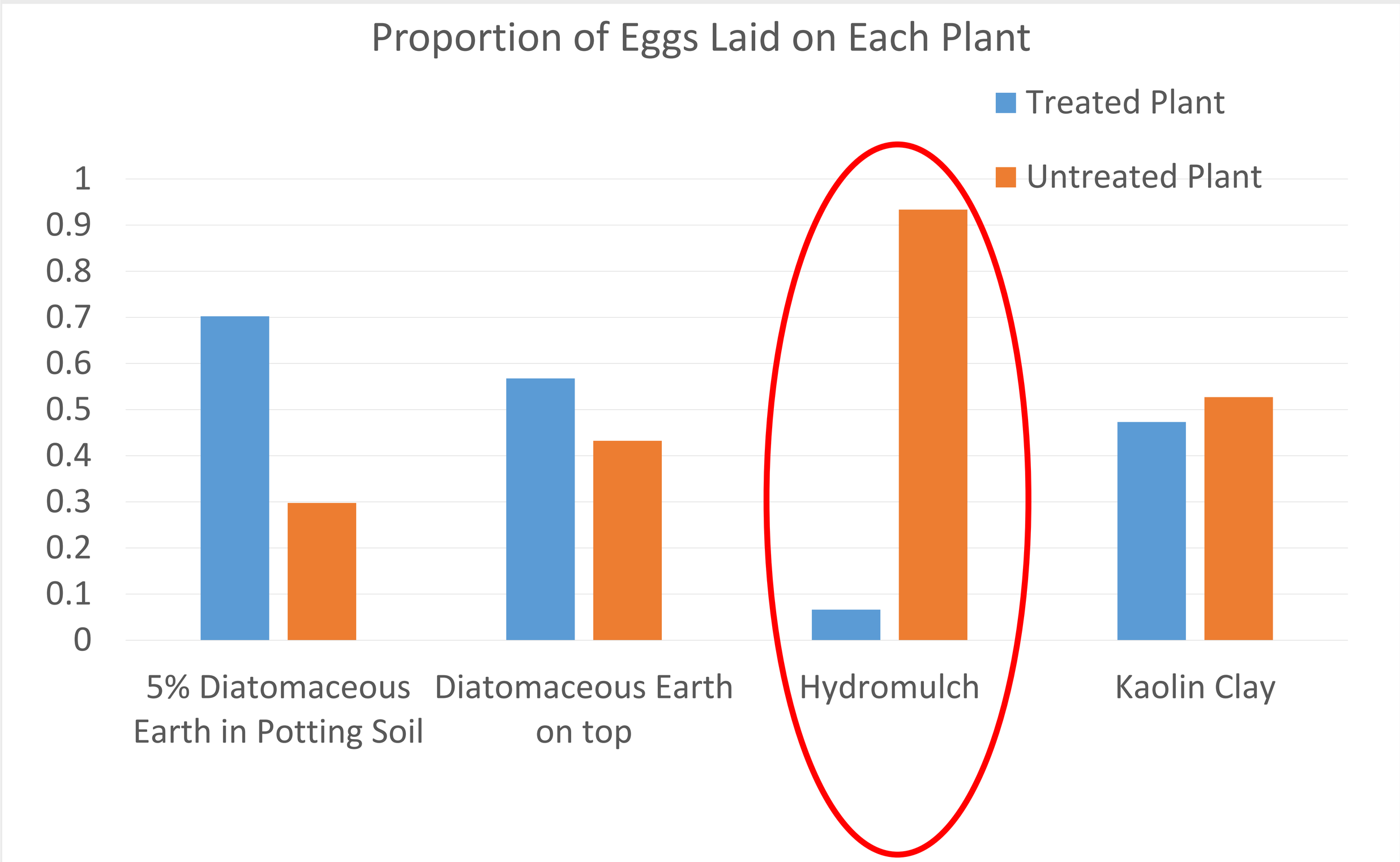
A NEW APPROACH

Physical Barrier Technology

Objective 2. Evaluate the efficacy of hydromulch at reduction of cabbage maggot damage in the field.



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A NEW APPROACH

Physical Barrier Technology

- Pesticides alone are not solving the problem
- Registration for any new chemistry takes multiple years
- Greenhouse trials point to potential efficacy of barrier technology
- Previous literature demonstrated field efficacy with limitations of cost and feasibility
- Our goal is to demonstrate efficacy and solve the cost/feasibility problems

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A NEW APPROACH

Physical Barrier Technology

Objective 1. Develop methods for application of hydromulch during planting or transplanting operations.

1a. Fabricate a hydromulch application system.

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A NEW APPROACH

Physical Barrier Technology

Variable:	Options:	Looking for:
Mulch	Paper fiber, wood fiber, CBD hemp waste fibers	Longevity, ease of application, less water required to mix
Tackifier	Starch, Guar Gum, Lime	Doesn't allow mulch to wash away under irrigation, maintains stiffer texture that is deterrent to fly
Dye	Water soluble, water miscible	Ease of mixing, longevity

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A NEW APPROACH

Physical Barrier Technology

Objective 1b. Optimize the hydromulch mixture.

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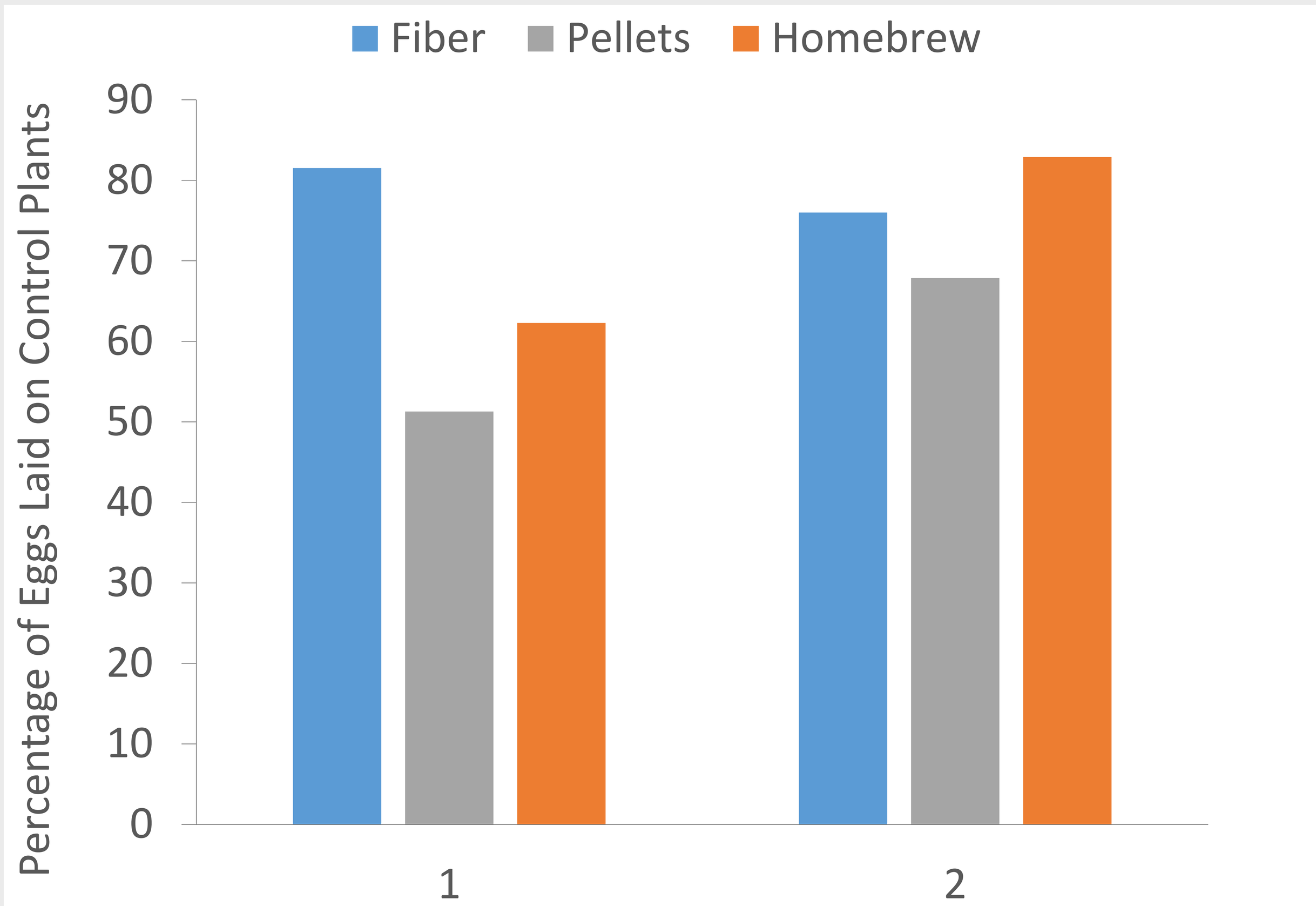
A NEW APPROACH

Physical Barrier Technology

Objective 1b. Optimize the hydromulch mixture.



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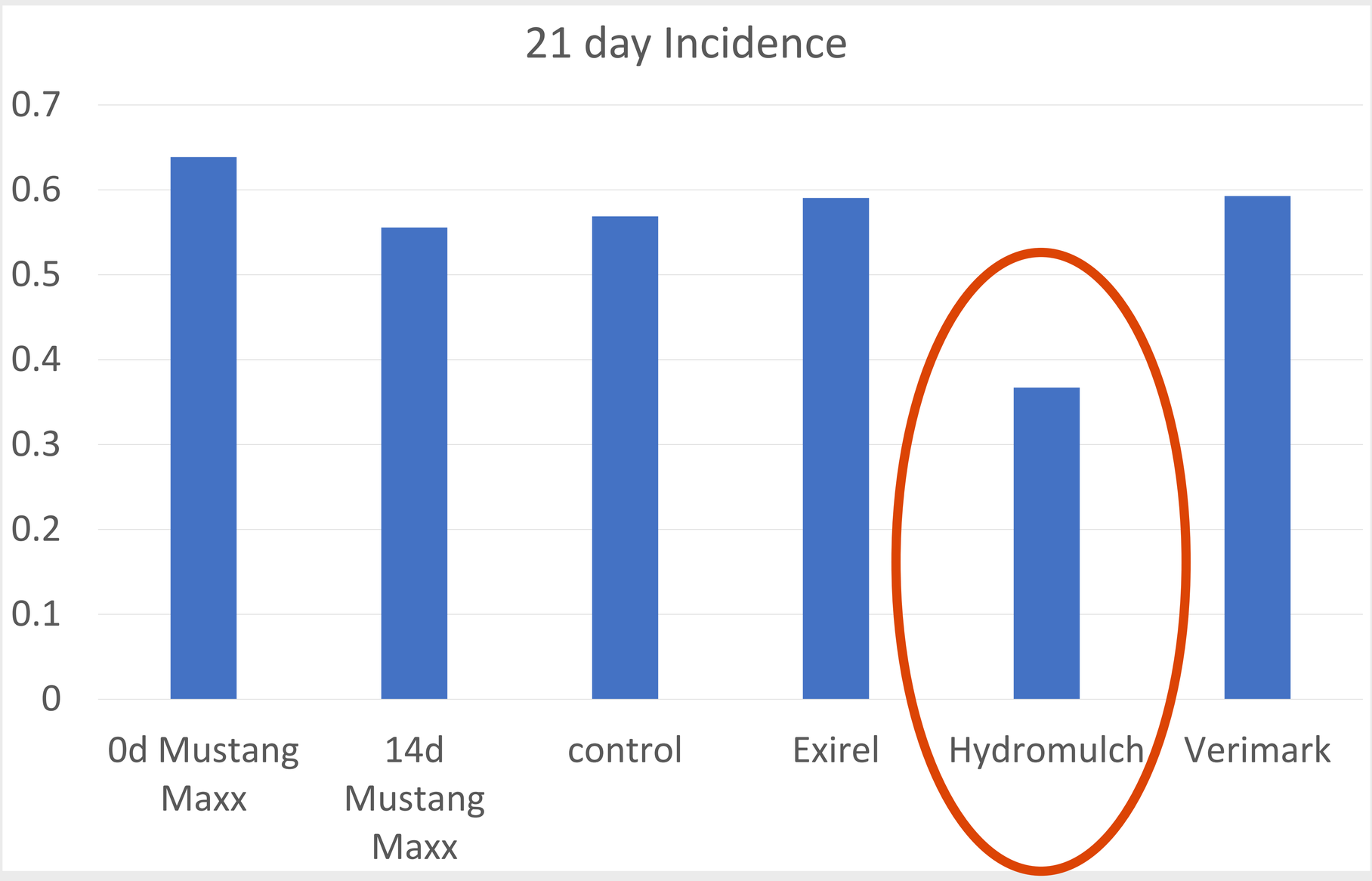
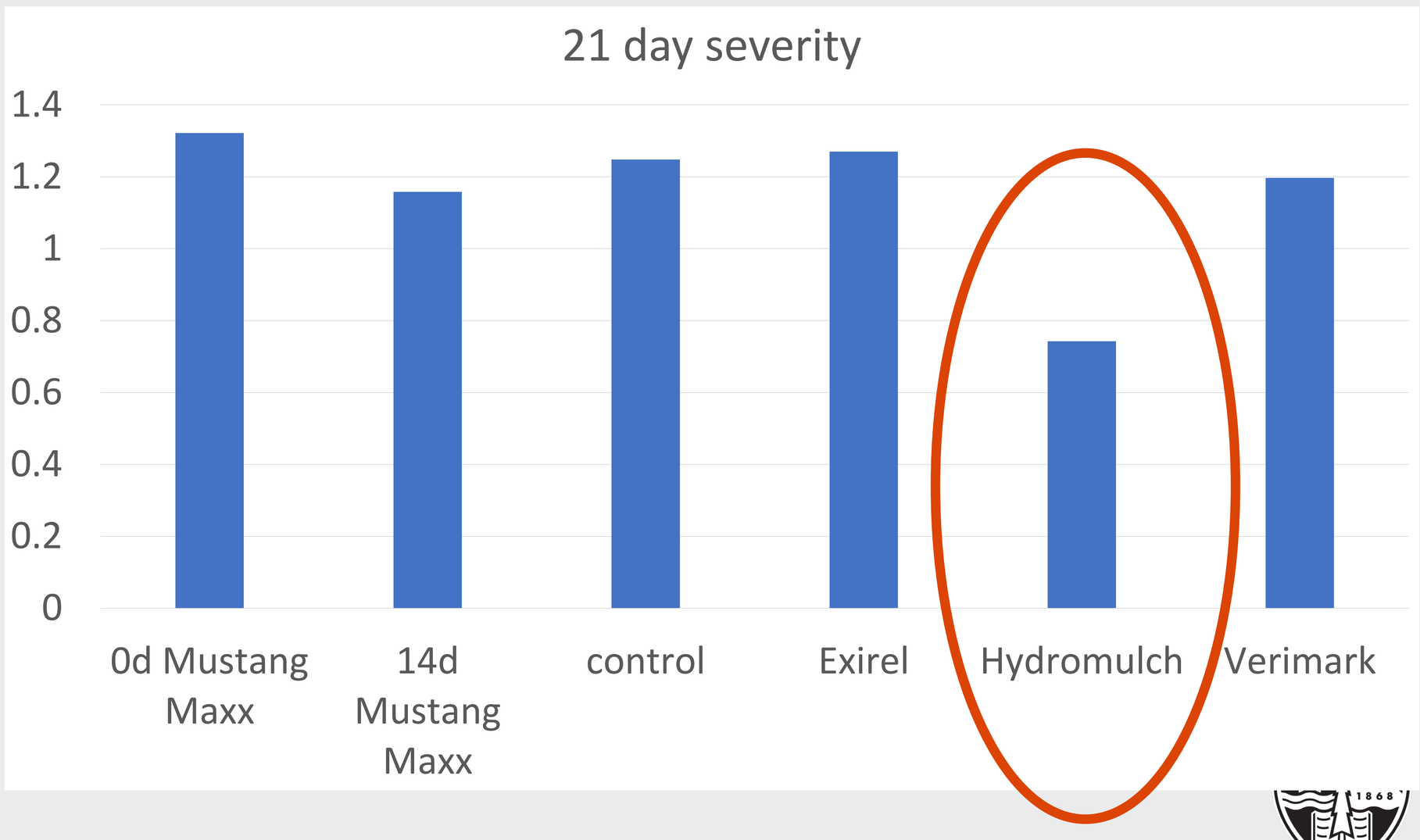
A NEW APPROACH

Physical Barrier Technology

Objective 2. Evaluate the efficacy of hydromulch (pelleted commercial product) at reduction of cabbage maggot damage in the field.





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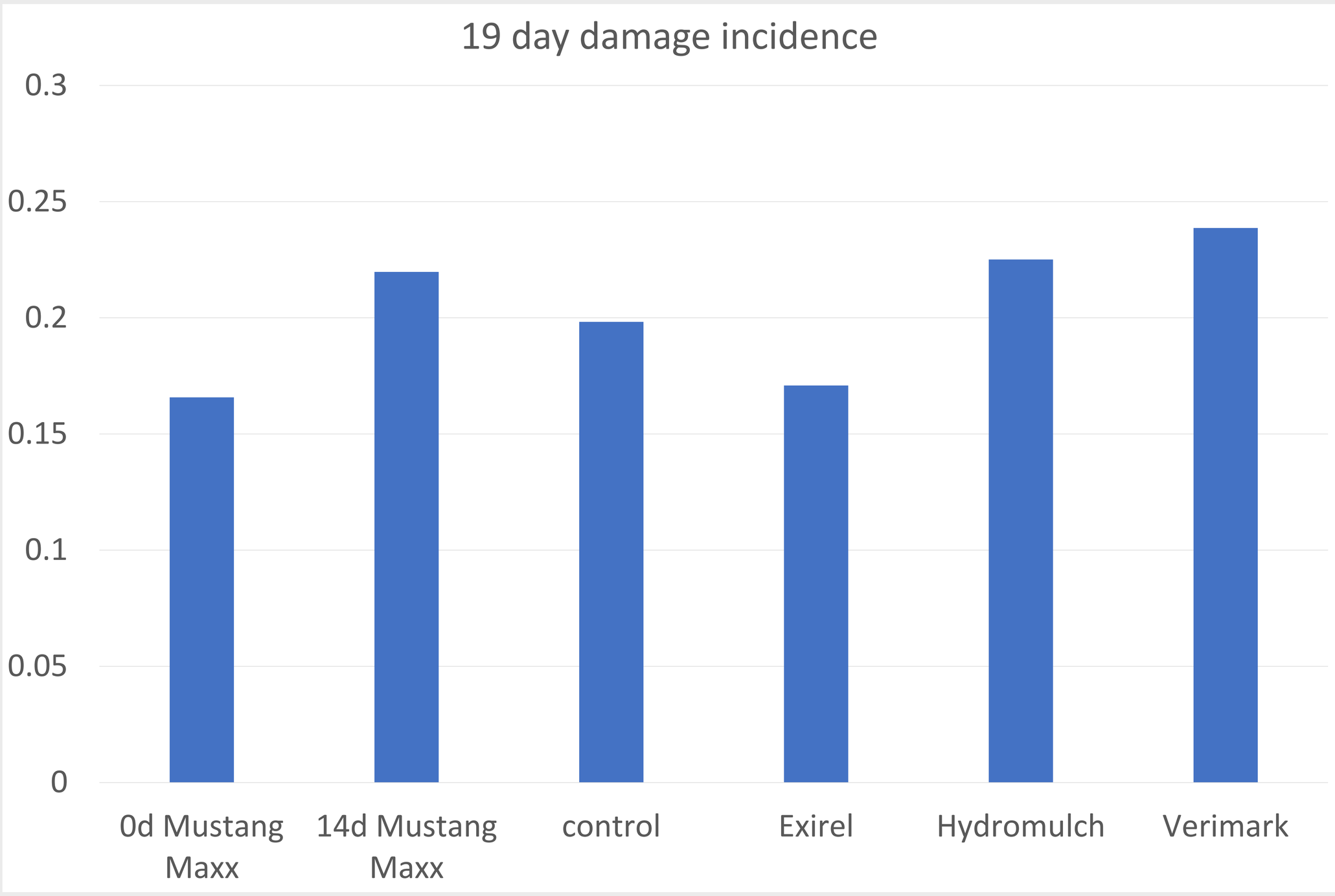
A NEW APPROACH

Physical Barrier Technology

Objective 2. Evaluate the efficacy of hydromulch at reduction of cabbage maggot damage in the field.

But sometimes we see this…..



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A NEW APPROACH

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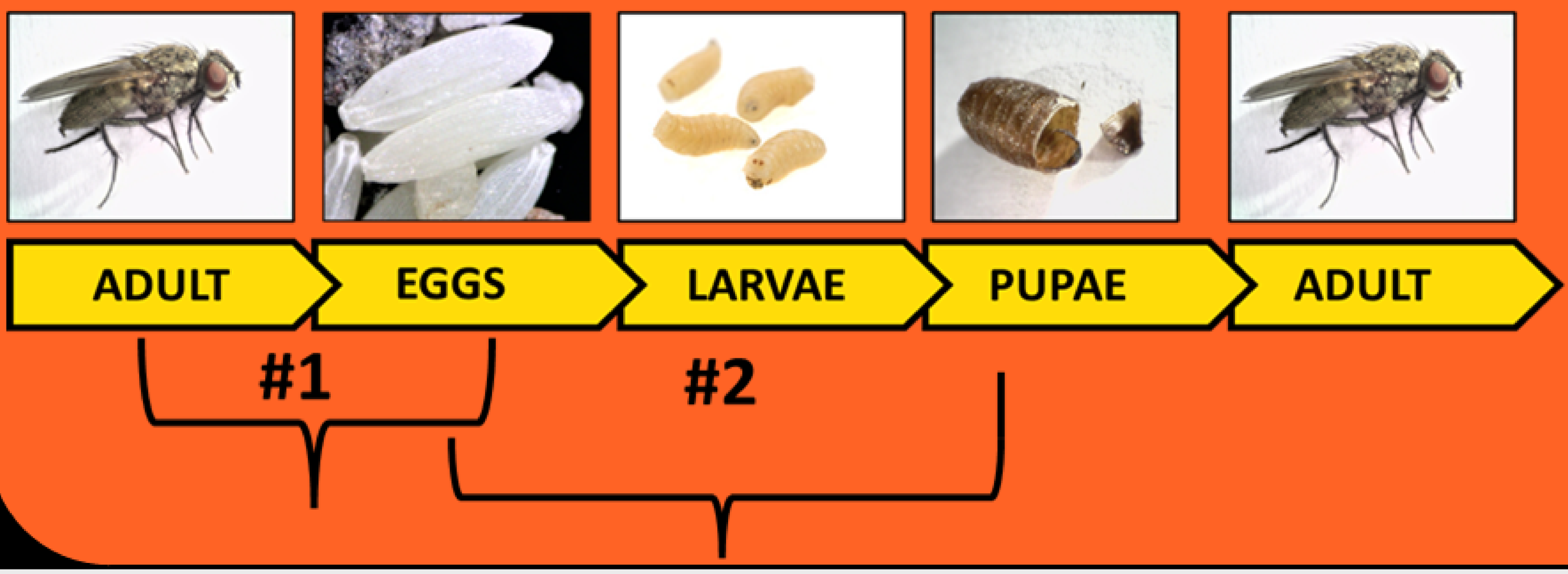
Dani Lightle, OSU NWREC

Greenhouse Trials



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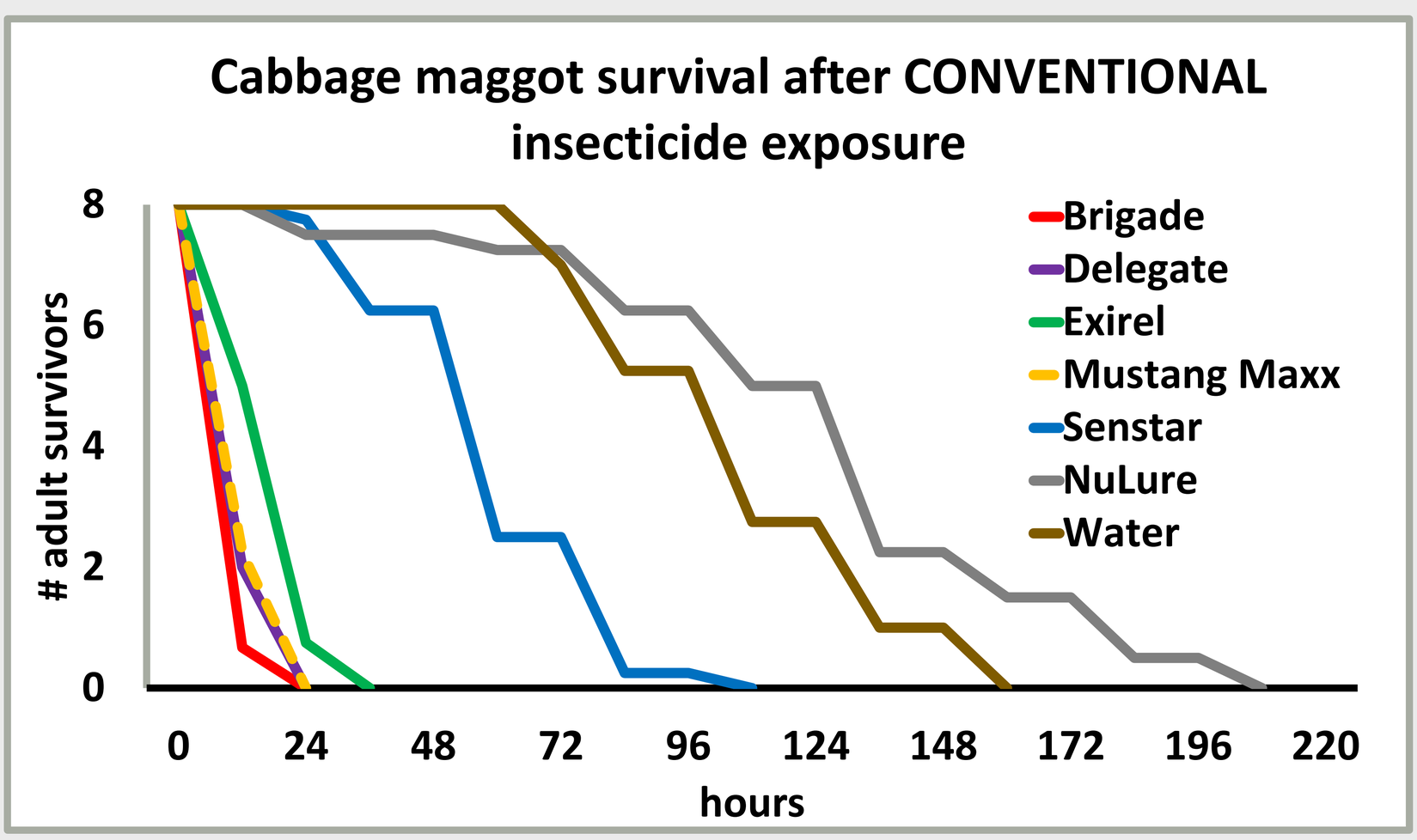
FLY CHEMICAL CONTROL RESEARCH

Lab experiments were conducted at NWREC to determine novel chemical methods to control cabbage maggot flies.

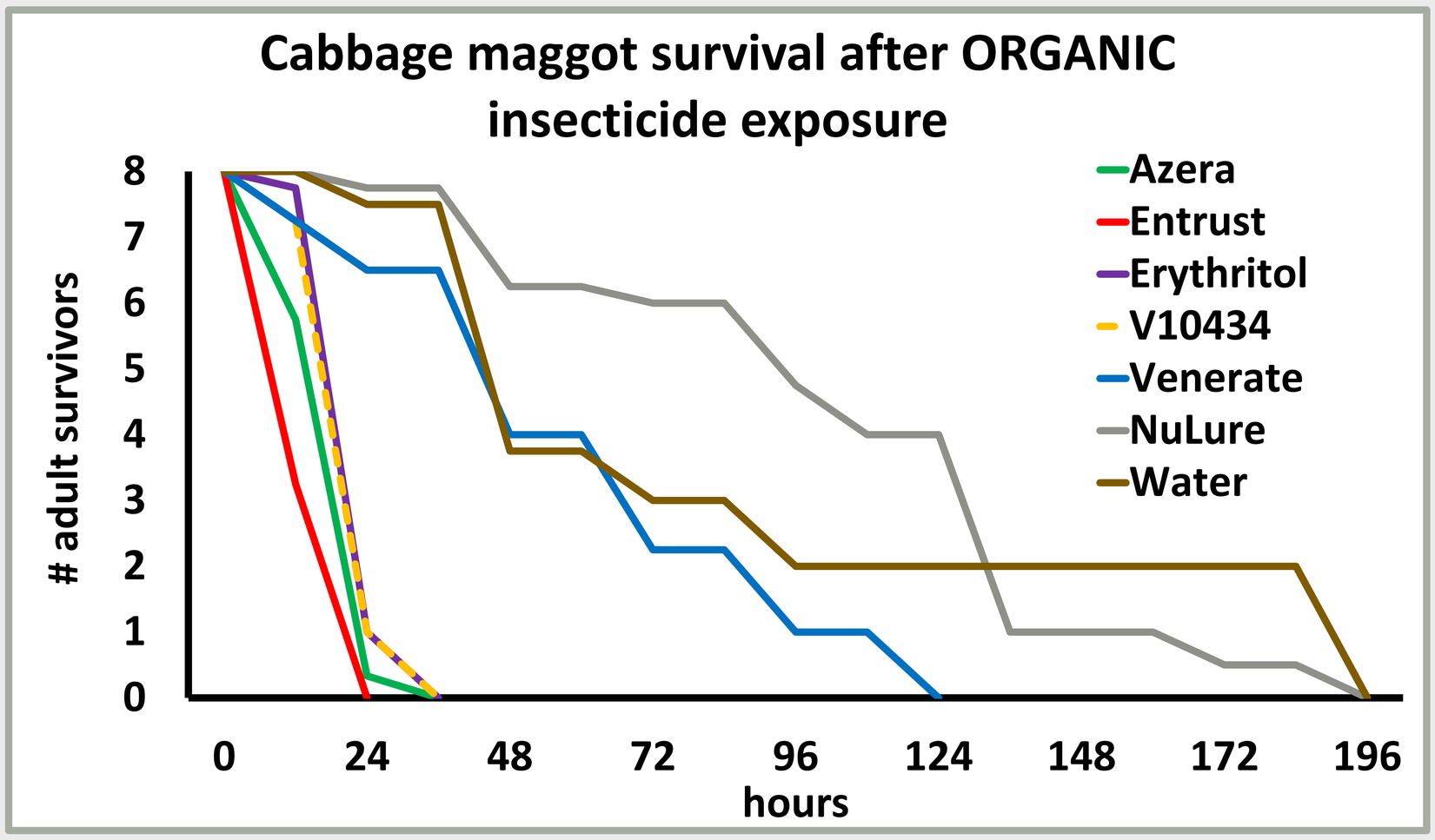
PESTICIDE LAB TRIALS

The efficacy of 5 organic and 5 conventional pesticides were evaluated in lab experiments. Adult female cabbage maggot flies were monitored after ingestion of the insecticides to see how soon they died after exposure.

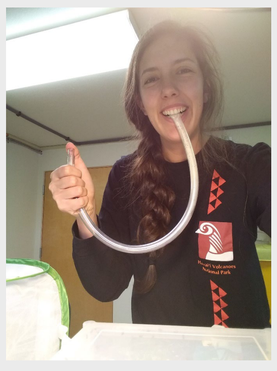


Mustang Maxx, Brigade, and Delegate were highly effective within 24 hours after exposure while Exirel was moderately effective within 24 hours after exposure. Senstar was not effective.

Entrust was highly effective within 24 hours after exposure while Azera, Erythritol, and V-10434 were moderately effective within 24 hours after exposure. Venerate was not effective.



These insecticides that were highly to moderately effective have the potential to be incorporated into baits or lures that could be used to control cabbage maggot in a field setting.



For more information, please contact:
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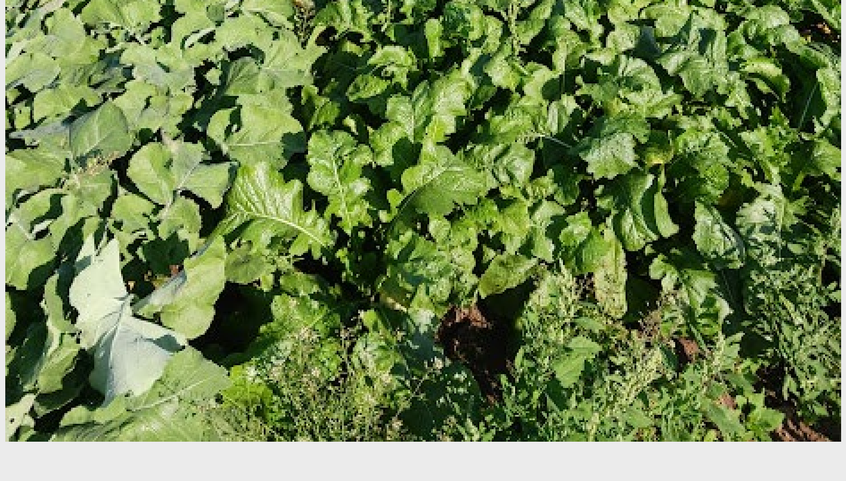
FLY CULTURAL CONTROL RESEARCH

Field experiments were conducted in a grower's field in Canby and at NWREC to determine novel cultural methods to control cabbage maggot.

TRAP CROP FIELD TRIAL

Field trials were conducted in 2021 and 2022 to evaluate the effectiveness of three different turnip varieties as trap crops in relation to a rutabaga cash crop. One bed of the turnip varieties were planted next to beds of rutabaga and then monitored and sampled throughout the growing season to determine the presence and impact of cabbage maggot throughout the field.

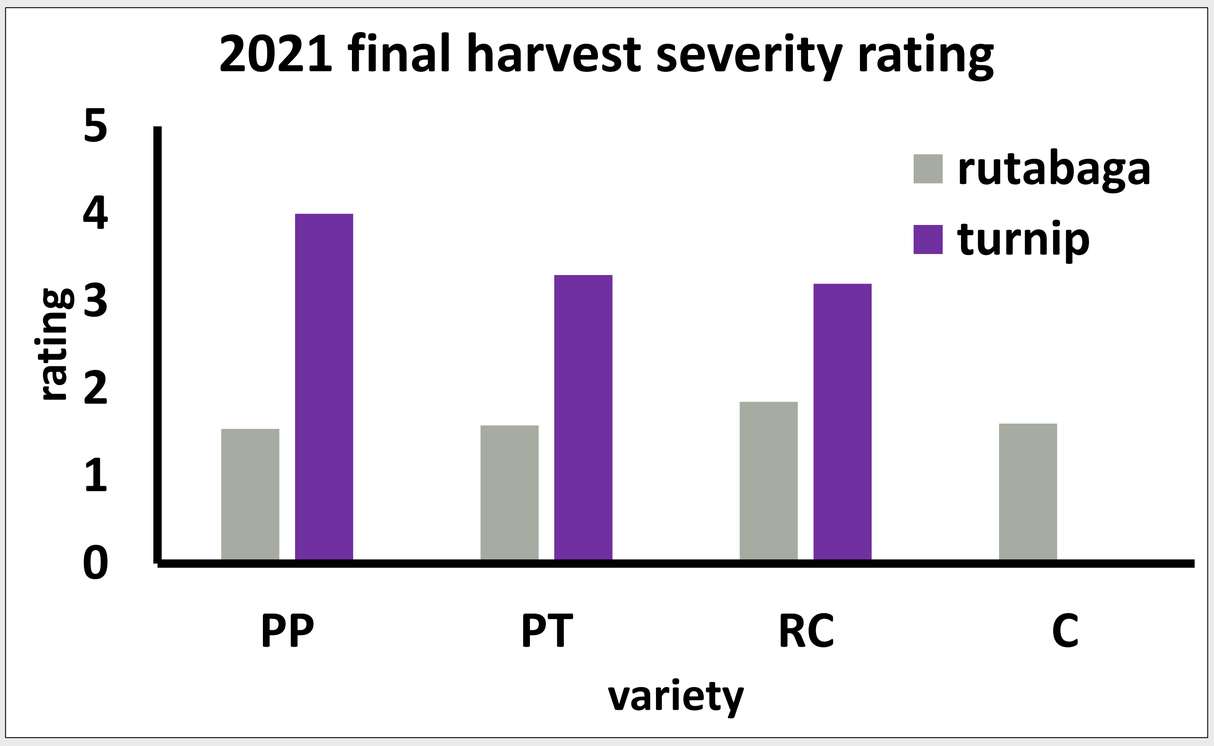


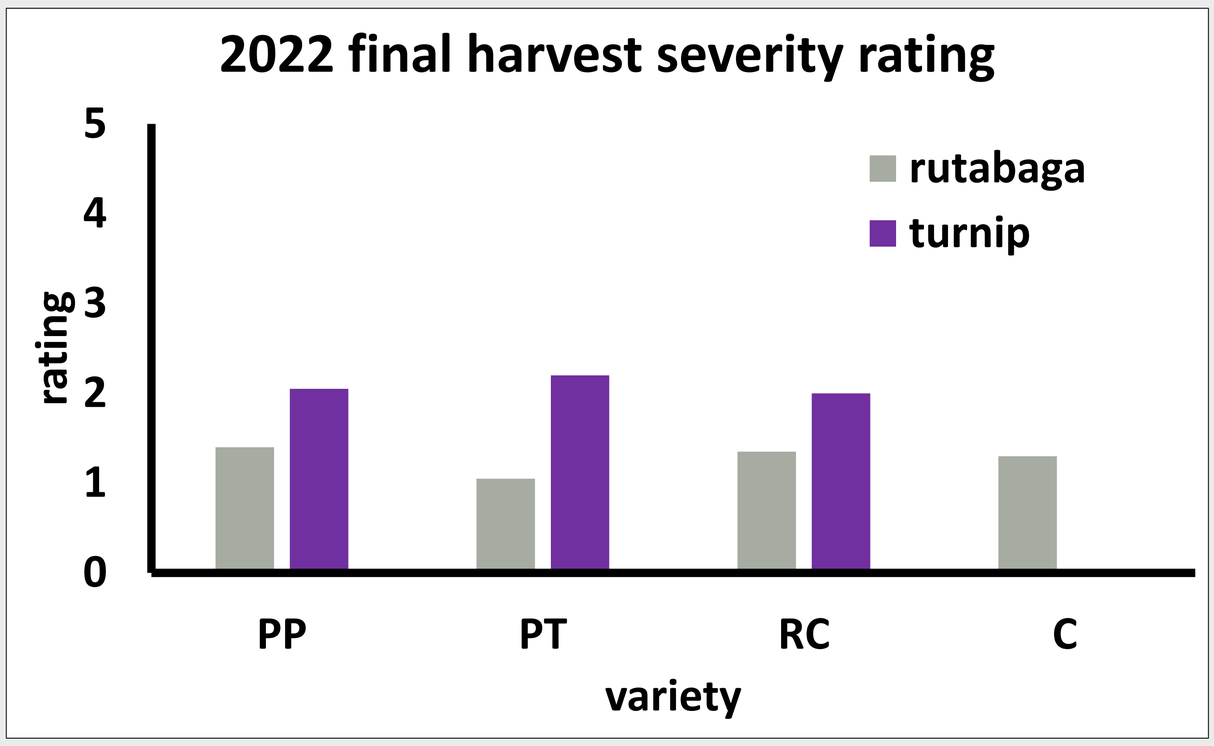
rutabaga

'Purple Prince'

'Purple Top'

'Royal Crown'





PP: 'Purple Prince'; PT: 'Purple Top'; RC: 'Royal Crown'; C: control

In 2021, 'Purple Prince' had the highest average severity rating while in 2022, 'Purple Top' had the highest average rating for the final harvest. For both 2021 and 2022, turnips had higher severity ratings than the rutabagas.

For more information, please contact:
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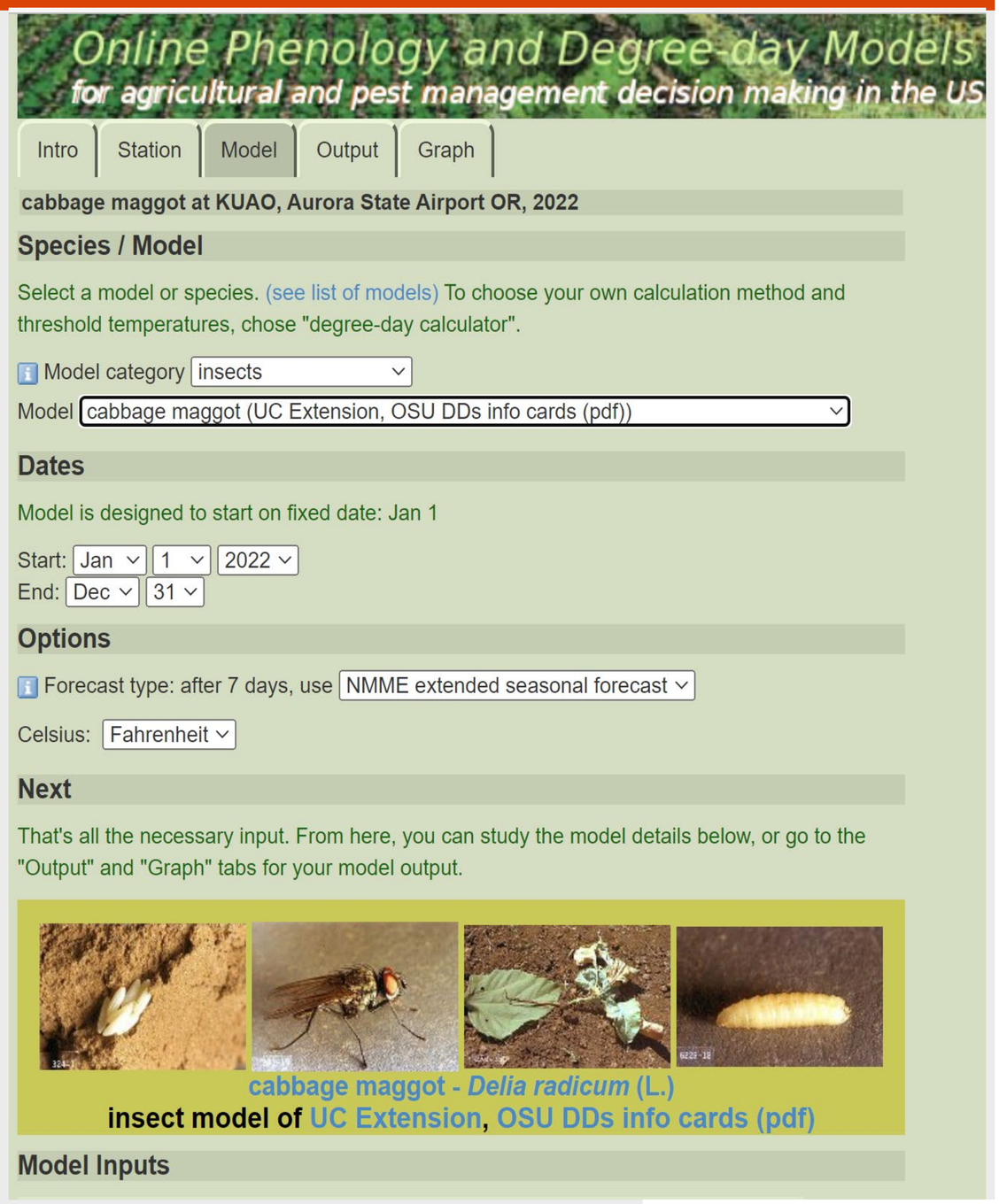
WHAT NOW???

Things to Adopt Now!

- Managing culls
- Think about switching to post-emergence sprays when applicable
- Scout or trap for flies
- Field arrangement & crop rotation
- Early spring and late fall—try out the online model



QR code for the online model at uspest.org

Visit the cabbage maggot portal for all the latest research
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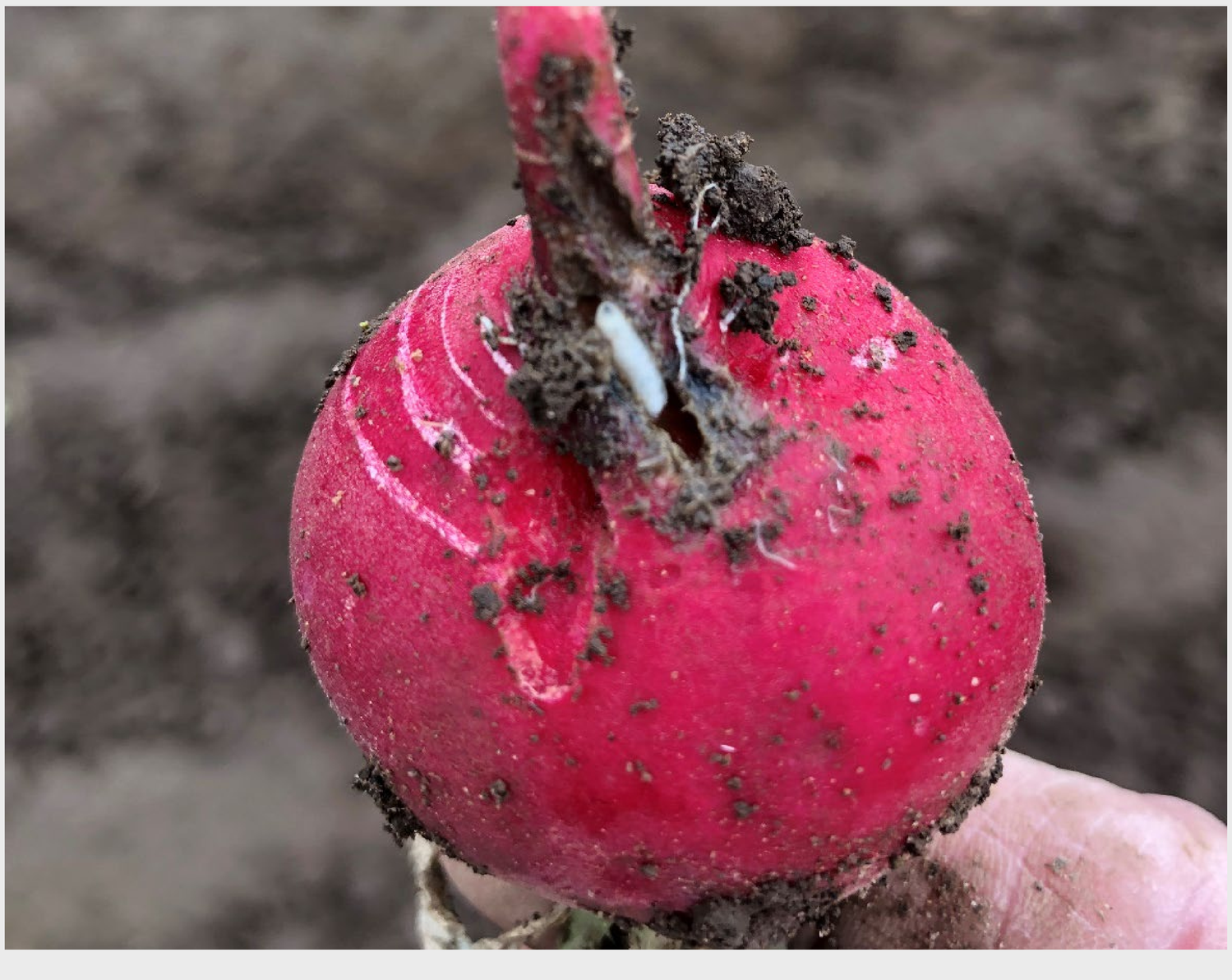

PLEASE TAKE THE SURVEY!

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